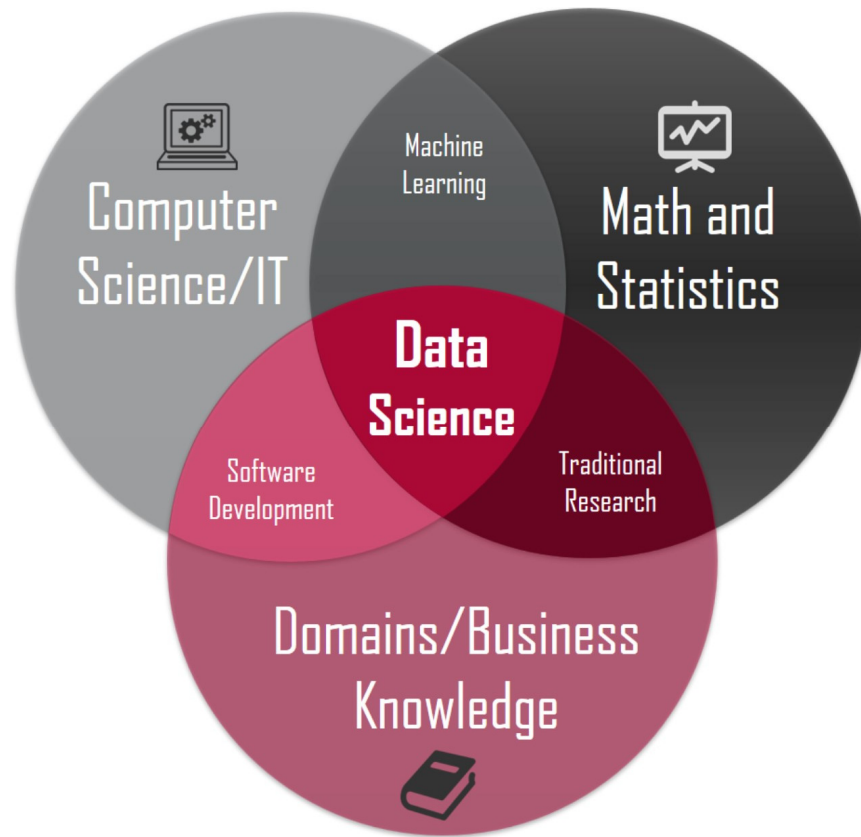


Minor Data Driven Decision Making (M3DM) in Business



International School of Business Study Guide — Academic Year 2023/2024

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1. Introduction

“In God we trust... everyone else must bring data”

William Edwards Deming

Nowadays, data science is a term that's used a lot but often misunderstood. Data Science refers to the multi-disciplinary field that extracts knowledge and insights from data using techniques from mathematics, statistics and computer science.

Data science is, put simply, addressing organizational challenges with smart use of data. The scope of such challenges is enormous.

- Marketing (enhancing customer retention; cross-selling by analysis of customer buying patterns; sentiment analysis)
- Human Resource Management (determinants of individual and team performance; trends in competencies and skills required in job vacancy announcements; employee recruitment)
- Finance & Banking (assessment of loan applications; financial modelling)
- Logistics and Operations Management (demand forecasting; process improvements through process mining; simulation of impact of new distribution centres).

And although organizations increasingly realise that data science has the potential to enhance organisational performance, they often struggle with applying it in practice. In fact, research suggests that still many - especially small and medium sized – organizations barely make use of data-driven techniques to improve their decision-making abilities. One of the main reasons is the growing knowledge and skill gap between managers and data science professionals. Managers lack an understanding of what data science can bring them, and data scientists lack the skills to tailor the information to the needs of the decision makers.

The overall ambition of this minor is to close this knowledge and skill gap, by:

- Developing students of economics and business studies (and related specializations) into “analytics translators”. An analytics translator can best be described as a bridge builder, who is the link between data scientists (or data experts) on the one hand and business domains, such as managers in logistics/supply chain management, marketing, finance, and human resources, on the other.
- Providing students of economics and business studies (and related specializations) with the opportunity to develop the competences and prepare themselves for the role of a data science specialist.

2. Learning Objectives & Learning Outcomes

The key objective of the minor Data Driven Decision Making in Business (3DMiB) is to prepare students of economics and business studies for the rapidly growing use of data science, in organizations in all sectors of the economy and of all sizes.

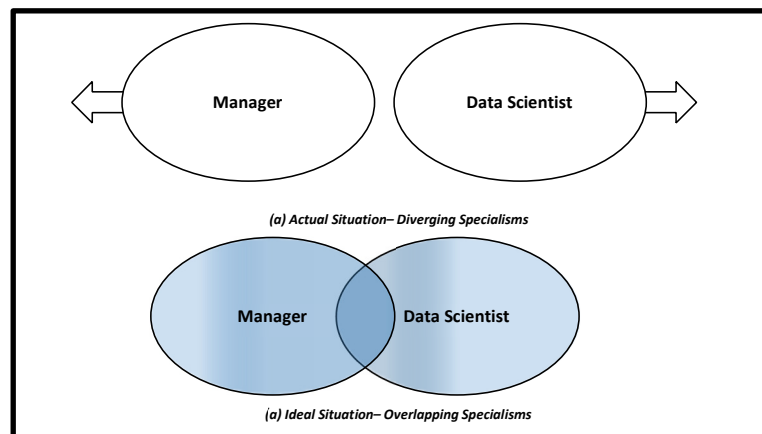
The target groups of the minor are twofold.

The primary target group are students in economics and business administration (and related specializations) who, in most current curricula, are hardly educated and trained in data science techniques. For this target group, the minor will offer a concise, complete, and accessible introduction to this exciting new aspect of business. The structure and contents of the curriculum will be aligned with the needs of modern organizations. The objective of the minor is explicitly not to train the students to become data science experts with high-level programming skills, but to provide them with a sound overview and intuitive understanding of the most prevalent techniques and applications of the tools used in data science analytics. This line of thinking is in line with the CRISP-DM model, the model used in this minor programme. Fawcett & Provost classify in their book, data science techniques as classification; pattern detection; and prediction, among others (Fawcett & Provost, 2013).

Another target group would be students who do have the ambition to become data science specialists. For this target group, the minor – over time – will offer possibilities to some students to deepen their understanding and skills of data science techniques.

For both target groups, the emphasis of the minor is on applications relevant to (business) organizations: students must learn to critically analyse, evaluate, communicate, and implement the findings, for effective use.

The diagram below illustrates the overall ambition of this minor: closing the gap between data scientists and managers (decision-makers). In the optimal situation, both groups know enough about the other domain to effectively collaborate.



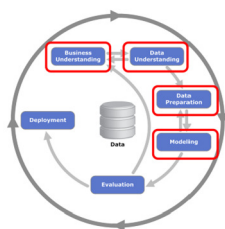
Upon completing the minor, students will have developed 2 of the competencies, as listed below, for learning, teaching, and leading in the digital age, as developed by ISTE Standards, and aligned with UNESCO (<https://www.iste.org/iste-standards>, 2022).

1. Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving;
2. Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models, and algorithmic thinking in exploring and finding solutions.

Below is an illustration of the learning upon successful completion of the minor.

- The **RED** circled parts highlight competences developed in the first 6 weeks of the course.
- The **GREEN** circled parts highlight competences developed during the remainder of the minor.

Learning outcomes - Intermediate level



Student:

1. Defines / describes data science challenges
2. Applies algorithms and statistical methods to data in order to assess quality and prepare for requirements (descriptive and inferential statistics / visualization)
3. Lists main data science models and applies them

Learning outcomes - Minor level



Student:

1. Formulates a data science challenge for a specific case
2. Applies algorithms and statistical methods to data in order to assess quality and prepare for requirements (descriptive and inferential statistics / visualization)
3. Applies relevant data sciences models to specific case
4. Relates model quality to original challenge
5. Communicates model application to stakeholders

Entry requirements

Students of:

- Business related study programmes.
- Technical study programmes with business and/or management profile.
- Other study programmes with a business and/or management profile.
- All other students with a strong motivation to learn data science techniques.

In all cases, students need approval from their study programme or home university.

All students must have a good knowledge of English, at least B2 level, and not afraid of numbers.

Students with no business and/or management profile in their study programme will only be accepted upon an evaluation and assessment by the minor coordinator.

3. Structure of the Minor

The structure of the minor takes into consideration that a good understanding of the concepts and techniques used in data science, requires a good understanding of basic mathematics and statistics. That is why we offer the refresher subject called ‘Mathematics and Statistics.’ For those that would like to use their free time to refresh their mathematics and statistics, they can visit the following website and take an online course, www.khanacademy.org. Follow the following topics Algebra 1, Algebra 2 and Statistics & Probability.

The minor has two parts namely **Foundation** and **Data Science Analytics**.

All modules offered in period 1 or 3 only, are Foundation modules. The rest are Data science Analytics modules.

Throughout the curriculum, students will make use of the most widely used tools for data science, Python and/or R.

Module/Subjects offered and assessment

The minor offers the following and these will be offered as follows (1st period of semester 1 or 3rd period of semester 2, and , 2nd period of semester 1 or 4th period of semester 2):

Osiris exam code	Module name	ECTS	Exam type	Students per assignment	Period
TOETS-01	Project M3DMiB.	10	Report and Presentation	3	1&2/ 3&4.
TOETS-02	Mathematics & Statistics in R or /and Python.	2.5	Report	2	1 / 3
TOETS-03	Data science for business - the CRISP model for data mining.	2.5	Report and Presentation	2	1 / 3
TOETS-04	Storytelling with Data - the art of data visualization.	2.5	Report and Presentation	2	1 / 3
TOETS-05	Business intelligence.	2.5	Report	2	1 / 3
TOETS-06	Introduction to data mining.	2.5	Report	2	1 / 3
TOETS-07	Introduction to modelling.	2.5	Report	1	1 / 3
TOETS-08	Data Science Tools and Techniques. (the individual assignment/product for the 2 bootcamps make up the portfolio).	5	Portfolio	1	1/2/3/4
	Total	30			

4 workshops/classes will be offered, next to the modules stated above. These are supporting classes.

In the first week you will follow 3 classes namely:

1. Python workshop by Witek ten Hove (HAVEW).
2. The Art of Skepticism by Tijmen Weber (WBRT).
3. Minor ‘The kick-off’ by Oliver Ntenje (NTNJO).

In the third or fourth week you will follow the fourth workshop, namely:

4. Ethics in Data Science by Michiel Kamphuis (KSCA).

4. Exam Registration / Enrolment

For you to receive the grade for each of the modules, you must enrol in Osiris for the specific examination.

HAN and Visiting students enrol as follows:

Go to Osiris and choose to enrol for exams.

Choose the Course code and then the exam. The exam codes are the same for everyone. The course code differs, though. Below are the course codes that you must choose:

- HAN students ➔ COURSE CODE IS: DATDRD05. This applies to all exams, except 'TOETS-02'.
- Visiting students ➔ COURSE CODE IS: DATDRD06. This applies to all exams, except 'TOETS-02'.
- For TOETS-02, all students enrol under COURSE CODE: DATDRD02.

In all cases, make sure to choose the correct:

COURSE STARTING BLOCK ➔ P1A or P2A / P3A or P4A. P stands for PERIOD. See screenshot below.

TEST MOMENT: OPPORTUNITY ➔ 1 or 2. Opportunity means either you take the exam for the first time or it is a resit/retake. See screenshot below.

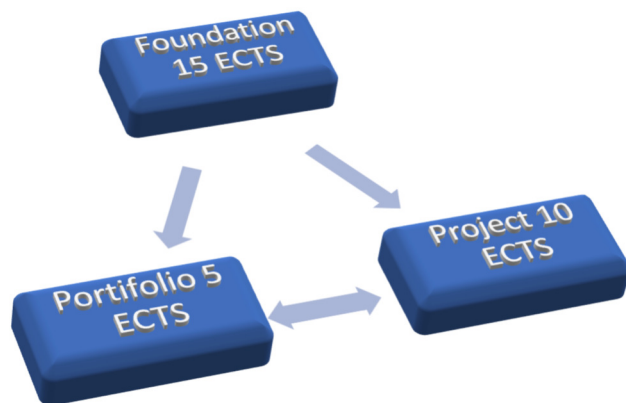
A list of the Examinations can be found in the table on the previous page.

Course	Test moment
DATDRD06 Data Driven Decision Making in Business 2022, Starting block P3A	TOETS-05 Business intelligence Block JAAR, Opportunity 1 01-09-2022 until 31-08-2023

Course	Test moment
DATDRD02 Data Driven Decision Making in Business 2022, Starting block P3A	TOETS-02 Mathematics & Statistics in R or Python Block JAAR, Opportunity 1 01-09-2022 until 31-08-2023

DATDRD05 Data Driven Decision Making in Business 2022, Starting block P3A	TOETS-05 Business intelligence Block JAAR, Opportunity 1 01-09-2022 until 31-08-2023
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Composition of the minor



Foundation:

In the foundation, students will learn the basics of data science, learn the generic tools and techniques used so that the students are at the level to take the next step of developing the necessary skills and competences with regards to the tools and techniques used in data science analytics. Below are 2 examples of modules offered in the foundation.

Foundation – Storytelling with Data (Data Visualization)

A picture is worth a thousand words, as the saying goes. The big challenge to many data scientists is to compile their findings from big data in a way that conveys the essential information to decision makers – who are already overloaded with information. Data visualization is both an art and a skill. It is an essential element of effective communication. This module will teach the student the principles of data visualization based on the principles of Storytelling with Data (Knafllic, 2015).

Foundation – Introduction to Modelling

Without exaggeration, regression analysis is the parent technique in statistical modelling. The flexibility of the regression model makes it a powerful tool for the data scientist to model many types of relationships between outcome variables and predictor variables. This module will give an overview of extensions of the simple regression model and teach students how to estimate regression models and evaluate and interpret the outcomes. Like in all modules, the module will make extensive use of data visualization!

Data Science Analytics:

In the Data Science Analytics part, the focus is on choosing the right tools and techniques that are applicable to a specific data science business problem. The application (Project) will be carried out within a real business problem from companies or institutions. Students will also do the same at an individual level (Portfolio) to showcase their data science competency and skills. To showcase these skills, the minor offers the students tools and techniques that are up-to-date and the talk of town then with a focus on the future use within the business domain. It is to this reason that business and/or management study profiles are a pre-requisite for one to follow the minor.

Tools, Techniques, and Application – Portfolio (Skills and competences showcasing)

You will, at an individual level, showcase the skills and competences in the field of data science analytics. You will pick a Data Science Analytics project of your interest and go through the necessary steps in order

to come up with a portfolio where you communicate several things, among others, quality of analyses, communication skills, business relevancy, and the mastered skills of data science analytics. The different phases of the data science life cycle as discussed in CRISP-DM must be adhered to as you carry out the project. The CRISP-DM model is the basis of the background. The minor will offer you bootcamps and guest lectures where the state-of-the-art tools and techniques will be demonstrated. Guest lecturers will share their experiences and usage of some tools to support your knowledge and skills acquisition. This portfolio can be used by yourself to show others (employers etc) your data science analytics skills. To acquire some of the skills, you will need to be entrepreneurial and look for them yourself. Coaches and supervisors will help and guide you in that process.

Data Driven Decision Making Project

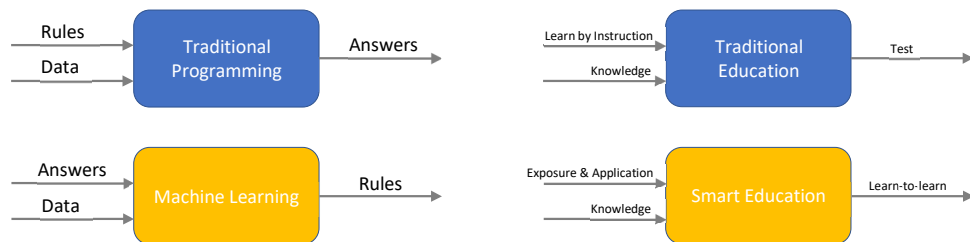
As an icing on the cake, you will work on a project from the first week of the minor until the end. This project is commissioned by a principal that has data science related problems that must be solved/addressed. In this project, you will apply the knowledge, skills, and techniques that you have learned during the minor and skills developed along the learning journey. This is a group work carried by a minimum of 3 students and maximum of 4. Later in this document the project will be explained in detail. During this project you will select the right Tools, Techniques, and Application to solve the company's problem. The different phases of the data science life cycle as discussed in CRISP-DM must be adhered to as you carry out the project. A supervisor will guide you through the process of learning the various data science techniques, the choice of relevant/applicable tools, and the application thereof. Guest lectures, the bootcamp, lessons offered, and self-acquired knowledge and skills play an important role in the learning process and problem solving trajectory.

5. Didactical Approach

The minor uses a didactical approach in which students learn to learn. They will do this as a group supported by experts in the field of study and/or guest lecturers. After the minor, they should be well equipped to find their way, rather than get lost in the growing amount of data science applications.

Interestingly, a smart education approach resonates well with the development from traditional programming and the use of computers to carry out repetitive tasks more efficiently than human beings, to machine learning seeking rules and algorithms to solve problems rather than answers to specific questions.

The diagrams below illustrate the differences between traditional versus smart education.

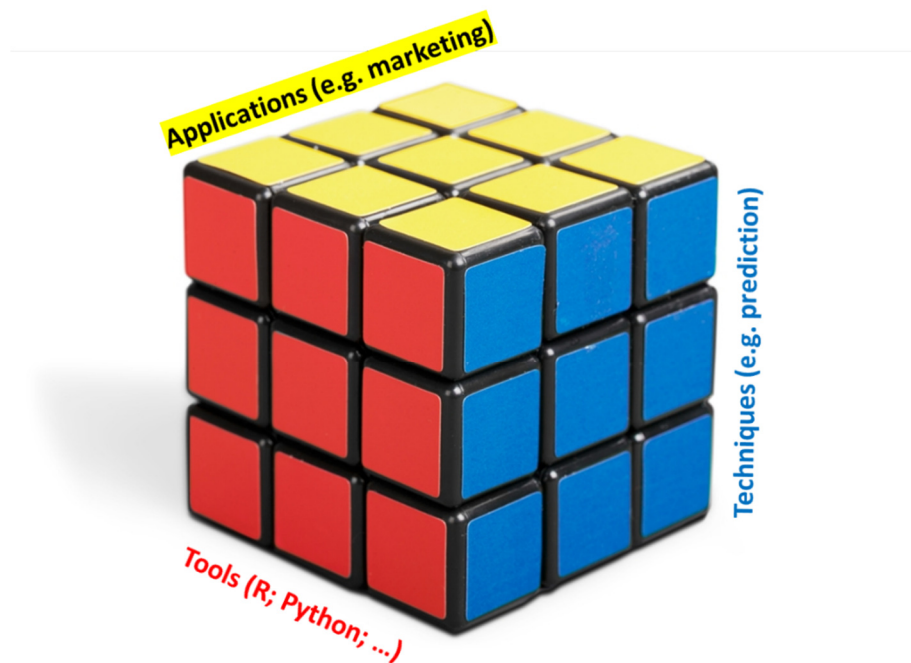


Against this background, the minor will select and structure study materials that enable students to take up data science challenges in order to train them in algorithmic thinking and finding solutions using the principles of data science.

6. Tools, Techniques, and Application within the MDD programme

There are a lot of tools that are in use in data science. Among them are the following: Python, Power BI, Disco or Celonis, Qlik, and web scrapping. At the level of this minor, we have prioritised the tools to be used. We will use R/RStudio, Python, Power BI, Disco, and web scrapping.

Tools	Techniques				
	Math & Stats	Data Visualization	<i>Data Mining</i>	Process Mining	Forecasting
Python	•	•	•		•
Power BI		•			
Disco/Celonis				•	
Web scrapping					



7. Teaching, Supervision and Support

During the whole semester, you will be coached by professionals and experts in the field of study. When executing the project(s), the project principal will also be involved in sharing the necessary knowledge and coaching to support your project activities.

Guest lectures will be organised to enrichen the knowledge required during different phases of your learning process. Students will work together and facilitate each other's learning process. They do this by learning together and sharing their findings.

8. 'M3DMiB' Project Manual

In the next part of the report, an outline of the project, requirements and planning are presented.

Project M3DMiB is the final project of the students for the Minor Data Driven Decision Making in Business. It incorporates a Triple Helix Model, which involves Business partners (companies), HAN University of Applied Science (Education & Research), and Students, in performing project tasks. In this project, students will apply their learnings in the foundation and their chosen track courses. It requires level 2 competences, which means that student must be able to do complex task independently (with intermediate level of supervision) and to argue based on the interdisciplinary competences of the team. The real-life company problem that the students have to deal with involve any of data driven problem in the business and study domain of business (SCM, HRQM, Finance, Marketing, and any other business-related areas). Each project team will be assigned with an academic coach to guide them in the content of their assigned project and in the process. The teams will be composed based on the required interdisciplinary mix for the execution of the project and the preference of the students.

The next section provides the relevant contact details, the objectives of the Project M3DMiB, the Scheduling, the tasks and responsibilities of each party, and the assessments.

Objectives of the Project M3DMiB

The objective of the projects is for you to apply the knowledge, skills, and techniques that you have learned during the course. It is important that you are able to make a realistic plan, realise the plan, explain in writing what you have done and how, and then present your findings to the project principal and the minor programme.

Just like the individual portfolio, in this project, the different phases of the data science life cycle as discussed in CRISP-DM must be adhered to applied.

The objectives of Project M3DMiB will be assessed against the Program Learning Outcomes based on M3DMiB and on ISB assessment matrix.

The project ends in lesson week 2.8 or 4.10 with a group presentation. Prior to that, a Management Report will be delivered. The week numbers are the HAN Year calendar weeks. Week 2.8 means period 2 week 8 and week 4.10 means period 4 week 10.

Professional Tasks

The outputs of the project are management report and an oral presentation.

Program Learning Outcomes (PLOs)

Project M3DMiB is a level 2 course, therefore the students are expected to perform well-defined task and to work independently with intermediate level of coaching. Following are the specific Programme Learning Outcomes for this minor:

PLO from M3DMiB

Student must be able to connect the expertise of a data scientist to a specific business and cross-cultural expertise (and vice versa), which will aid in the decision-making process of the management.

PLO's from IB Programme

Business Research (TWM24): Student must be able to analyse a complex business problem through the use of appropriate research methodology that will result in an appropriate business solution in their assigned project.

Management of Information as Digital Citizen (WW7): Student must be able to produce actionable management information as part of their data driven project.

Communication (WW4): Students must be able to use communicate effectively (visually and orally) the results of their finding and solution to their target stakeholder.

Collaboration (WW6): Student must be able to collaborate effectively with different stakeholders (students, commissioner, academic coach) and achieve a desirable output while considering individual stakeholder goals.

Scheduling

The project will run for a semester, which consists of 2 periods (e.g. Periods 1 and 2, and Periods 3 and 4). The total hours that students need to spend for this course is 280 hours (equivalent to 10 ECTS). Included in these hours are the 80 contact hours with the academic coach. The first six lesson weeks are scheduled for half-days. The first two sessions (half-day each) are for the introduction to the programme and project activities (getting acquainted with teammates, the client, and the company problem), and guest lectures. The rest of the time will be spent on literature review, understanding of the project, and writing proposal. Starting from lesson week 7, the project schedule will be 2 whole days per week. During these moments, the group will be working on the project (meeting the tutors, project principal, and any other activities relevant for the project). 1 day per week will be scheduled for the individual project portfolio activities (tutor meeting, learning, etc). The remaining of the days must be used to review literature, collecting, analysing the data, and writing the report. There will be guest lectures organised where experts in the various fields of data science will share their knowledge with the students. The final presentation will take place once per semester in lesson week 2.8 and 4.10, respectively. The week numbers are the HAN Year calendar weeks. Week 2.8 means period 2 week 8 and week 4.10 means period 4 week 10.

The detailed schedule follows on next page.

Jaarplanning studiejaar 2023-2024				
Calendar Week	Monday Date	Academic week	Project Activity	Stakeholders
33	14/08/2023	Intro 1	Opstart	Students, (academic) project coach.
34	21/08/2023	Intro 2	Introductie	Students, (academic) project coach.
35	28/08/2023	1.1	Kick-off meeting. (Project M3DMiB Course introduction, Project and group introduction, Sample project outcomes, Meeting the client), Guest lecture and workshop op Ethics, Cultural issues and personal development. Workshops: Python, and Data Interpretation and manipulation. Reading and understanding data.	
36	04/09/2023	1.2	Further defining the objective of your project and work on the proposal.	Students, (academic) project coach.
37	11/09/2023	1.3	Submit your proposal for approval in 1.5.	
38	18/09/2023	1.4	Understand your data and ask proper questions to the academic coach and client.	
39	25/09/2023	1.5		
40	02/10/2023	1.6	Project execution. There will be guest lectures organised within the minor but also outside the minor. These are vital for your project and/or personal interest. Choose when to stop coding and start putting up a story together.	Students, (academic) project coach.
41	09/10/2023	1.7	Draft report Hand-in in agreement with academic coach for feedback.	
42	16/10/2023	Fall Break	Take time to implement the feedback given.	
43	23/10/2023	1.8	Exams (Presentations, Work on reports, etc)	
44	30/10/2023	1.9	Bootcamp - Final assignment.	
45	06/11/2023	2.1	Bootcamp - Final assignment.	
46	13/11/2023	2.2	Project execution. You will from now onwards be working on your client project. Guest lectures or company visits will be organised within the HAN but also outside the HAN. These are vital for your project and/or personal growth. Choose when to stop coding and start putting up a story together.	Students.
47	20/11/2023	2.3	Draft report Hand-in in agreement with academic coach for feedback.	
48	27/11/2023	2.4	Take time to implement the feedback given.	
49	04/12/2023	2.5	Week 2.6:	
50	11/12/2023	2.6	Presentation first run: present to a small group familiar with the project to collect initial feedback (0.5–1 week before final presentation).	
51	18/12/2023	2.7	Week 2.7 - 2.8:	
52	25/12/2023	Christmas Break	Final Touches to your project report and presentation.	
1	01/01/2024	Christmas Break	Report hand in deadline: 09/01/2024 by 23.59 hrs (Handin).	
2	08/01/2024	2.8	Final Presentations - 11 January 2024	Students, (academic) project coach.
3	15/01/2024	2.9	Resit report handed in deadline: 20/01/2024 by 23.59 hrs (Handin).	Students.
4	22/01/2024	2.1	Final Grade of the Project Resit	Students, (academic) project coach.
5	29/01/2024	3.1	Kick-off meeting. (Project M3DMiB Course introduction, Project and group introduction, Sample project outcomes, Meeting the client), Guest lecture and workshop op Ethics, Cultural issues and personal development. Workshops: Python and R, and Data Interpretation and manipulation.	Students, (academic) project coach.
6	05/02/2024	3.2	Further defining the objective of your project and work on the proposal.	
7	12/02/2024	Spring Break	Submit your proposal for approval in 1.5.	
8	19/02/2024	3.3	Understand your data and ask proper questions to the academic coach and client.	
9	26/02/2024	3.4		
10	04/03/2024	3.5		Students.
11	11/03/2024	3.6	Project execution. There will be guest lectures organised within the minor but also outside the minor. These are vital for your project and/or personal interest. Choose when to stop coding and start putting up a story together.	Students.
12	18/03/2024	3.7	Draft report Hand-in in agreement with academic coach for feedback.	
13	25/03/2024	3.8	Take time to implement the feedback given.	
14	01/04/2024	3.9	T3 Goede Vrijdag, 29 maart 2024 (Iesvrij, HAN gesloten)	
15	08/04/2024	4.1	Bootcamp	
16	15/04/2024	4.2	Project execution. You will from now onwards be working on your client project.	Students, (academic) project coach.
17	22/04/2024	4.3	Guest lectures or company visits will be organised within the HAN but also outside the HAN. These are vital for your project and/or personal growth.	
18	29/04/2024	May Break	Choose when to stop coding and start putting up a story together.	
19	06/05/2024	4.4	Draft report Hand-in in agreement with academic coach for feedback.	
20	13/05/2024	4.5	Take time to implement the feedback given.	
21	20/05/2024	4.6	Week 2.6:	
22	27/05/2024	4.7	Presentation first run: present to a small group familiar with the project to collect initial feedback (0.5–1 week before final presentation).	
23	03/06/2024	4.8	Week 4.8 - 4.9:	
24	10/06/2024	4.9	Final Touches to your project report and presentation. Report hand in deadline: 13/07/2024 by 23.59 hrs (Handin).	
25	17/06/2024	4.1	Final Presentations - 20 July 2024	Students, (academic) project coach.
26	24/06/2024	4.11	Resit report handed in deadline: 29/01/2024 by 23.59 hrs (Handin).	Students.
27	01/07/2024	extra week	Final Grade of the Project Resit	(Academic) project coach.
28	08/07/2024	Academic year closure		

Table 1. Project M3DMiB Activity outline.

Tasks and Responsibilities

This section highlights the tasks and responsibilities of students, academic coach, and the client.

Students

In this project, the tasks of the students during the project are:

- Write the required reports in accordance with the guidelines provided in this project manual.
- Organize the group meetings by themselves given the schedules provided.
- Coordinate to the academic coach and client the development of the project.
- Hand-in the reports on time.
- Ensure that there are two feedback moments (in the beginning and towards the end) with the academic coach and the project principal (client).
- Report immediately to the academic coach in case that the group process has troubles.
- Ensure that the confidentiality agreement (see Appendix 1) has been agreed with the Client.

Academic coach

The academic coach has the role of controlling the quality of the project and supervising the students. Specifically, he/she must:

- Evaluate the nature and level of the activities offered and carried out during the project.
- Facilitate and evaluate the group process.
- Meet in the beginning, during, and end of the project with the students and the client (company contact person).
- Maintain contact with the client.
- Make clear and monitor the objectives of the project.
- Make sure that the students carry out the relevant activities;
- Make contact with the student.
- Evaluate the performance and results, and if applicable, make suggestions for improvements (in consultation with the company coach and student).

Client

- Provide the necessary support for the students to implement the project (e.g. time, information, etc.)
- Instruct the groups on what to expect in the project
- Evaluate the final reports of the students for accuracy of content;
- Provides assessment with the report

Assessment of the project

The students will be assessed in 2 ways: summative (graded) assessment: final report (Management report) and formative assessment (peer assessment + oral presentation). The assessment code is: TOETS-01.

Management Report

A. The criteria for assessing management report are based on TMW24 (Business research) and WW7 (Management of Information as Digital Citizen). The students must demonstrate the ability to:

- Show connection between the role of a data scientist and manager, which contributes to management decision making process.
- Describe clearly the management problem and project objectives using appropriate business terms in the management report (lean) way.
- Do proper literature research on the current developments related to the given data driven decision making problem and on the relevant models that could potentially solve the given problem (in the report).
- Collect field data and analyse these data using the appropriate methodology, which will lead to meaningful results and conclusions.
- Derive the proper root causes to the problems using proper data analytic tools and a visual model, determining relevant objectives to be realized, and reporting this using the management report.
- Come up with relevant management solutions on how to improve the given data driven problem and reporting these using the CRISP DM model.
- Come up with a time planning to realise the proposed improvements.

Table 2. Assessment matrix for the Report using Bloom's Taxonomy

PLO	Assessment criteria	Level of questions						Weighting
		Lower level thinking skills			Higher level thinking skills			
		Remembering	Under-standing	Applying	Analyzing	Evaluating	Creating	
M3DMi8	The students clearly shows connection between the role of a data scientist and manager, which contributes to relevant management decision making.				X	X		10.5%
TWM 24 and WW7	The students describe clearly the management problem and project objectives using appropriate business terms in the report and A3 format in lean way.				X	X		7.0%
	The students do proper literature research on the current developments related to the given data driven decision making problem and on the relevant models that could potentially solve the given problem in the report and A3 format.				X	X		7.0%
	The students collect field data and to analyze these data using the appropriate methodology, which will lead to meaningful results and conclusions.			X	X			10.5%
	The students derive the proper root causes to the problems using proper analytical tools and a visual model, determining relevant objectives to be realized, and reporting this using the A3 format.				X	X		14.0%
	The students come up with relevant management solutions on how to improve the given data driven problem and reporting these using the A3 format.					X	X	17.5%
	The students come up with a time planning to realise the proposed improvements.					X	X	3.5%
WW4	The students present the project in a creative, concise, and convincing way based on the target group.					X	X	7.5%
	The students communicate effectively (both presentation and orally) the outcome of the project, which is deemed acceptable by the target stakeholder.				X	X		7.5%
	The students defend the results of the project and its consequences in company processes in a logical and convincing way.				X	X		7.5%
	The students are able to defend the relevance of the chosen solutions in a convincing way.				X	X		7.5%
TW 6*	The students collaborate effectively with different stakeholders (students, commissioner, academic coach) and achieve a desirable output while considering individual stakeholder goals*					X		0%
LW10*	Formulate one's own position concerning ethical and social responsibility in a professional environment.				x	x		0%
*A peer assessment form will be used in evaluating TW6 (Collaboration). This is defined in a separate document. *Students will write a paragraph in which they reflect on the ethics of the solution or advice given.								
TOTAL								100%

*Formative assessment.

A peer assessment form will be used in evaluating TW6 (Collaboration). This is defined in a separate document.

Students will write a paragraph in which they reflect on the ethics of the solution or advice given.

Oral presentation

Each group is required to present their project in M3DMiB event, which will be held at the end of the project. This event will be attended by course participants, that include the students, academic coaches, and companies. The pitch presentation also includes question and answers from the participants. The oral presentation is a formative form of assessment and will correspond to the PLO WW4 Communication. Not being able to present the team output at the M3DMiB Event means a failure in the course.

Peer assessment

Since the project involves group work, the individual participation will be assessed twice during the project duration. First in week 7. This assessment is used to provide feedback to the students and further improve the group dynamics. The second assessment will take place in lesson week 16 and the outcome will be used to determine whether the student has met one of the knockout-criteria on the project assessment form. The peer assessment form includes relevant individual factors that are necessary for the group work. Individual students will assess the individual team members based on the Peer assessment form. Students must pass the required factors in order to proceed with the team members. In order to make the assessment more objective, the academic coach can evaluate the outcome of the team assessment based on individual meetings with students. The peer assessment is a formative form of assessment and corresponds to the PLO WW6 Collaboration. Not passing the peer assessment will lead to a failure in the course.

The Peer Assessment scores are interpreted as follows:

1. A Relative Total Score per student higher than or equal to 95% is a pass for the Peer Assessment.
2. A Relative Total Score per student between 94,99% and 90% is insufficient, and requires further investigation from the lecturer (e.g. having a talk with students, personal assessments based on the meeting).
3. A Relative Total Score per student below 90% is considered a failure. This means that the student did not contribute to the project.

Ethics responsibility.

For the report you will write an ethics paragraph in which the following questions must be answered:

1. Who matters?
2. What matters to them?
3. What is the responsibility of the organisation to take care of that?

All this in relation to the client project. Word count is, $\min < x < \max$ ($400 < x < 500$).

A workshop will be given on this topic and attendance is compulsory as the requirements will be discussed.

Grades and Resit

In order for an individual student to pass the Project, three conditions must be met:

1. The final report must have a minimum grade of 5.5.
2. The student must be able to present their work on the presentation day.
3. Individual factors in the peer assessment form must be a pass.

Resit:

1. If the final report is insufficient, the students will get a chance to repair their work.
2. The student that could not give a presentation on the presentation day, will be given the opportunity to present the project or take questions from a panel of examiners to compensate for the failure.
3. A failure in the Peer Assessment score (A Relative Total Score below 90%) cannot be resit. The student must demonstrate that he can collaborate with others by doing the project once again.

9. Relevant contact details:

Contact Persons:

Oliver Ntenje: Oliver.Ntenje@han.nl

Robert Goedegebuure: Robert.Goedegebuure@han.nl

Witek ten Hove: witek.tenhove@han.nl

10. Appendix

Appendix 1. Objection form to make the project results available to others.

Objection form

Mr/Mrs, the Client
(Company

contact person) responsible for this report, has no objection/objects to its contents being placed in the library of Arnhem Business School, in the knowledge that access will be granted for academic purposes only. In the case of an objection, it is understood that the contents will be for the placement tutor's eyes only.

Date:

Signature:

Arnhem Business School attaches great importance to the access of students and staff to reports and graduation papers written during periods of practical training.

At the same time, Arnhem Business School goes to great lengths to preserve confidentiality regarding publications of any sort relating to companies in both the Netherlands and elsewhere.

For this reason, the Client is kindly requested to sign the above statement, so that the proper course of action can be followed.

Appendix 2. Research proposal Standard Format

1. Introduction

The purpose of the introduction is to let reader get acquainted with the topic. You explain here what your topic is, why did you choose this topic, and why it is relevant.

2. Background of the Project/Task

You provide here a brief description of organization that commissioned the project, a description of the project/task and the importance of this task to the organization.

3. Current situation

Describe and visualize the current situation or problem. Here you may use different visualization tools such as tables, charts, graphs, etc.

4. Literature review

Here you review and analysed theories and models (CRIPS' model, Simulation, process mining, blockchain, etc..) that are relevant to the given problem.

5. Goal

Project Goal: A (visual) depiction of what the situation would need to be so that the problem would not occur.

Research Goal: Two perspectives: client (first part A) and research (second part B):

The research objective (A) is to give recommendations A.1 before..... (date) A.2 to (the client)

A.3. for (policy making, a strategic-plan, etc.) A.4 on..... (the problem),

Through(B) B.1. giving insight in (research result) B.2 with regard to (what: key concepts of problem definition).

6. Main and sub-research questions

Questions are formulated based on the key terms of research objective.

Sub-questions can be broken down to questions related to the current and the desired situations to achieve the goal.

7. Methodology

Here you describe the Types of research methods (qualitative or quantitative), the Data (historical, based on literature, report, etc), and the Data analysis (How did you analyse the data? Which techniques did you use?)

8. Bibliography

Provide the lists of all your references

9. Objection or Consent Form

Appendix 3. Project M3DMiB Management Report Standard Format

Half of the report includes what is written in the research proposal.

1. Introduction
2. Background of the Project/Task
3. Current situation
4. Literature review
5. Goal
6. Main and sub-research questions
7. Methodology
8. Results Analysis

Discuss the outcome of the methodology employed. The analysis performed determine the root cause(s) of the problem, a way to make the process efficient, etc.

9. Recommendations

The solutions that will be (or has been implemented) to improve a process, solve a problem, etc.

10. Reflection (1 page)

Reflect on what the group has realized and learned throughout the duration of the project. According to the ethics class (in week 2), what ethical dilemmas did you encounter in the project? How did you approach them?

11. Bibliography
12. Objection / Consent Form