MASTER OF SCIENCE IN ARTIFICIAL INTELLIGENCE IN BUSINESS AND INDUSTRY

KATHOLIEKE UNIVERSITEIT LEUVEN

CONDUCT-TAILORED INITIAL ACCREDITATION • ASSESSMENT REPORT

8 OCTOBER 2021

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1 Executive summary

This report constitutes the advice of the panel assessing the quality of the Master of Science programme in Artificial Intelligence in Business and Industry at KU Leuven. The panel judges the quality of the new programme to be strong, an appreciation that applies to all components of the programme. In view of this holistic judgement, the panel issues a positive advice to NVAO.

The new one-year programme is taught in English and educates students to become technically capable and implementation-oriented professionals, specialised in artificial intelligence. It is offered at an advanced (master after master) level, targets both students and professionals, involves several faculties of KU Leuven and takes place at the Bruges campus of the university.

The informative self-evaluation report (Blueprint) and the lively discussions on site demonstrate that university management and programme developers have reflected extensively on all components of the new programme. The panel supports the choices made because they result in a unique programme that is likely to attract many students and will eventually meet the growing need for AI-competent experts. Furthermore, the panel validates the domain-specific and programme-specific learning outcomes. It also welcomes the commitment of the professional field and their involvement in the preparation and implementation of the curriculum.

The panel notices a strong link between the profile of the programme and the structure of the curriculum. The teaching formats concur with the learning objectives, the contents of the courses and the needs of the different student groups. Moreover, the combination of competent professors, enthusiastic teaching teams and experienced field experts makes the programme attractive.

The new programme can rely on a strong and relevant framework that is set at faculty level and aligns with the overall policy at university level. The panel considers that the assessment plans and processes are both relevant and robust, and ensure that students meet the learning outcomes by the time they graduate. Moreover, the four-year quality assurance cycle of checks and balances allows the contents of individual courses to be adjusted every year to the rapid evolutions in artificial intelligence.

In sum, the panel thinks positively of the quality of MSc in Artificial Intelligence in Business and Industry. It considers that the programme is sufficiently developed to start in September 2022. In addition to all positive appreciations, the panel has a few suggestions which do not affect its overall judgement on the programme quality. The panel advises to:

- raise awareness in the programme on the environmental impact of certain AI techniques;
- ensure that all students acquire the ethical competences mentioned in the learning outcomes;
- monitor that the programme description reflects the set of tools students will learn in the courses;
- uphold the four eyes-principle in preparing and correcting exams as multi-faculty teaching teams may bring their own assessment expectations and approaches to the table.

The Hague, 8 October 2021

On behalf of the expert panel convened to assess the Master of Science in Artificial Intelligence in Business and Industry.

Yingqian Zhang
(chair)

Mark Delmartino
(secretary)

2 Findings and considerations of the panel

The Master of Science in Artificial Intelligence in Business and Industry (MAIBI) is the result of interfaculty collaboration under the coordination of the Faculty of Engineering Technology at KU Leuven. The new one-year programme will be hosted on the Bruges campus, is due to start in September 2022 and will be offered at an advanced level, using English as the language of instruction. In view of this initial accreditation visit, the programme has produced an information file, called Blueprint+, that provides a comprehensive description of the envisaged MAIBI. Reporting on its findings and considerations, the panel follows the order of topics as they are addressed in the Blueprint: profile and vision, realisation, and assessment.

Profile and vision

Profile and objectives

MAIBI aims to educate students to become technically capable and implementation-oriented professionals, specialised in artificial intelligence (AI). The programme is conceived at an advanced level as it expands the application-oriented knowledge of students with a master's degree to an advanced level of knowledge and skills in the multidisciplinary domain of AI. The programme profile is reflected in its name: AI constitutes the field of study and core content of the programme; the focus on applications is confirmed in the addition 'in business and industry'; the term 'business' refers to both the financial sector and to business aspects of the operation of other kinds of companies; 'industry' refers to the application of AI in more technical domains, such as the manufacturing industry.

The panel noticed from the description in the Blueprint that the new programme has been well thought through, an impression that was confirmed during the discussions on site. During the design phase, programme developers have made a number of choices: MAIBI is conceived as an advanced level master programme, featuring a one-year curriculum, targeting both students and professionals, involving several faculties of the KU Leuven and taking place at the Bruges campus of the university. Following the discussions on site, the panel acknowledges and wholeheartedly supports all the choices made.

According to the panel the profile of the new programme is clear and makes MAIBI distinct from other existing master programmes in AI. It welcomes the programme's well-chosen and unique profile which is likely to meet the growing need for AI-competent people in a variety of relevant application domains. MAIBI's focus on the application of AI in business and industry is laudable, and its emphasis on the interplay between foundations and applications of AI promising. Moreover, the panel appreciates that in addition to its technical profile, MAIBI also acknowledges the importance of fundamental reflection on AI and how AI is embedded in society, business, and industry.

The panel also thinks highly of the multidisciplinary and interfaculty approach of the programme. MAIBI is jointly organised by four faculties of KU Leuven: Engineering Science, Economics and Business, Science, and Engineering Technology. Under the coordination of the faculty of Engineering Technology, the programme will have its own dedicated interfaculty Programme Committee.

The advanced master programme will target both recently graduated master students and professionals who operate at master level and want to deepen their knowledge in AI. The

panel welcomes the efforts of the developers to design MAIBI in such a way that it is potentially interesting and feasible for both postgraduate students and professionals.

The language of instruction in the programme will be English. The panel understood that this is an explicit choice of the management in order to allow foreign students (possibly studying already in Belgium) and expats working in Flanders to enrol without language-related difficulties. Following the discussions with both employers and students, the panel understands that there are a good number of foreign students and expats who could be attracted by this programme. Moreover, domestic students and professionals are used to study and operate in an international English-language environment. The panel therefore understands the rationale and supports the choice for an English language programme.

Context

The panel noticed in the Blueprint that the new programme has been created to respond to the identified needs in society – and notably in West Flanders - that require priority attention according to industry, academia and authorities. It is an explicit policy of the Flemish Government to expand opportunities for lifelong learning in West Flanders with regard to technological topics such as AI. To that effect, the Government is supporting the establishment of a Flemish AI Academy. KU Leuven already responded to this initiative by setting up a postgraduate certificate programme in AIBI, which mainly targets professionals and is running at its Kortrijk campus since September 2021.

The new MAIBI programme is another response by KU Leuven and its industry partners in West-Flanders to address the shortage of well-trained AI expert professionals. When designing MAIBI, KU Leuven invited several companies in West Flanders to join – as strategic partners – the development and organisation of the new programme. Seven companies eventually signed up to offer topics for master theses, supervise thesis students in-company, or present in-house AI-related projects and experiences during course modules. The employers' federation of the technology sector, Agoria, also confirmed its support. The panel gathered from the written materials and the discussion with the professional field that companies suffer from a lack of adequately trained personnel in AI. It noticed that the stakes are high and that the strategic partners are very committed to making the new programme a success.

Furthermore, the panel acknowledges the regional context of the initiative and the importance of hosting the new programme on the Bruges campus of KU Leuven. According to the management it is an explicit strategy of KU Leuven to support the economic development in the region by offering high-level good-quality programmes that contribute to lifelong learning. The panel understands from the discussions that the catchment area of the programme – at least during the first years of implementation – will be concentrated in West-Flanders and that there are many domestic and international students on the campuses and in the companies in the region who could be interested in a one-year advanced master programme. Nonetheless, the university management also confirmed that MAIBI will be open right from the start to students and professionals beyond West-Flanders, an intention which the panel fully supports.

The panel considers that the new programme is well-positioned in the context of the region and the university. The interest and commitment from both authorities and professional field

have been a catalyst to design a relevant and good quality programme. The panel welcomes the strong involvement of the professional field in the programme, which it understands will continue - both structurally and informally - once the programme is up and running. The proposed MAIBI, according to the panel, is clearly unique in the region and has great potential to strengthen the educational and professional expertise on AI in West Flanders.

The panel understands the choice of the university to enter into a limited number of strategic partnerships with well established companies in West Flanders when the programme is still in its design phase and needs to be rolled out. Once MAIBI will be up and running, the programme is advised to extend its network of dedicated partners to include also smaller-scale companies who are more locally embedded. The panel was satisfied to hear at the end of the visit that this is indeed the intention of the programme.

Educational vision

The panel gathered from the Blueprint that the new programme is designed according to the guiding principles described in KU Leuven's vision statement on education and in the mission statement of the Engineering Technology faculty. MAIBI offers students who already have a sufficient foundation in informatics and mathematics the opportunity to specialise in the domain of AI and thus to enhance their position on the job market. In keeping with the vision of KU Leuven, students are motived by the image of their disciplinary future self as AI specialists, capable of developing innovative applications with a real added value for the economy and/or society.

Learning outcomes

The educational vision of the university and the profile of MAIBI have been taken on board when translating the programme objectives into learning outcomes. These learning outcomes are listed in annex 2 to this report. Because the proposed programme is new and unique in Flanders, the institution defined independently the domain-specific learning outcomes. A draft version of the learning outcomes was submitted to the Flemish Council of Universities and University Colleges (VLUHR), which in turn organised a review by employer representatives and international experts. The panel has studied the learning outcomes and found that they cover the broad range of competences that graduates need to successfully contribute to the academic and professional field of AI from an engineering perspective. Considering that they are relevant for a master programme in Artificial Intelligence in Business and Society, the panel validates the set of ten domain-specific learning outcomes.

The domain-specific learning outcomes have been concretised in 13 programme-specific learning outcomes, which reflect the domain-specific learning outcomes, the particular profile of the programme and the general framework for learning outcomes implemented throughout the faculty of Engineering Technology. The main features of these learning outcomes have been informatively described in the Blueprint. The panel noticed that the programme-specific learning outcomes are formulated at an advanced master level, reflect the multidisciplinary approach of the programme, and address knowledge and insight, engineering skills, generic skills and practical skills.

According to the panel, there is a clear link between the domain-specific and programme-specific learning outcomes. Both sets of learning outcomes are clear, concise and understandable. Moreover, the learning outcomes are carefully designed across the four

thematic pillars of the programme (cf. realisation). In this regard, the panel thinks it is positive that the MAIBI programme pays attention to the element of creativity in developing a research attitude. The panel considers that the programme-specific learning outcomes are formulated in such a way that they do justice do the discipline (artificial intelligence in business and industry), level (master) and orientation (academic) of the programme. In view of the future developments in the domain of AI – and thus of the curriculum contents – the panel suggests to also raise awareness in the programme and thus in the learning outcomes on the environmental impact of certain AI techniques.

Student profile

It is an explicit goal of MAIBI to target a mixture of recent graduates and people with several years of industry experience. According to estimates of the programme developers, MAIBI will first welcome about 30 students, a number that is likely to grow to 50 students when the programme is up and running. These estimates foresee an equal intake of students and professionals. In order to achieve such numbers and such mixture, the programme is designed in such a way that it can be taken in two variants: a full-time programme (mainly for recent graduates) that can be completed in one year; and a part-time programme for professionals who can spread the same courses and thesis trajectory over two or even three years. The panel thinks highly of this particular student profile as it sees added value for both student groups in the programme and therefore welcomes the availability of a part-time variant for professionals. If anything, the panel thinks that the cohort size is estimated rather conservatively as the programme may well attract many more students and professionals in due course.

Given that MAIBI is an advanced master programme, students should have completed an initial master programme of sufficiently technical nature. The panel noticed that the programme has a clear idea on the entry-level competences of incoming MAIBI students. In addition to the master degrees that grant immediate access to the programme, students with a different degree can apply, as well. These students need to have the basic knowledge that is taught in all engineering programmes, as well as a mathematical background (calculus, analysis, set theory, linear algebra) and the ability to write (object-oriented) programmes in a high-level programming language such as Java or Python. All applications will be evaluated by the Programme Committee.

According to the programme management, there is no intention to add a selection procedure on top of the admission criteria. In case there would be (many) more suitable candidates, all students will be catered for by MAIBI. Both institutional and programme management have assured the panel that the programme and the campus have the capacity to take on board more students than what is currently envisaged in the Blueprint. In that case, the additional capacity can be financed through the programme's increased income through more enrolment fees.

Career perspectives

MAIBI aims to deliver technically capable and implementation-oriented professionals who are specialised in AI. Hence it is expected that MAIBI graduates will pursue different careers: some alumni might opt for a PhD; other graduates will join companies that develop technologies for sectors such as healthcare, logistics or manufacturing. These alumni will translate novel research findings on AI into practical installations and design, develop and test

prototypes, or install and configure instruments; a third group of alumni will join the research department of a university, research institute or specialised company where they develop, verify and validate viable instruments and processes.

The panel gathered from the discussion with students that those who would be interested in MAIBI see an added value in the connection it makes between academia and industry / business. The professional field emphasised with the panel that their current staff have good domain knowledge but struggle to combine this know-how with knowledge on AI. The panel subscribes to the career analysis made by both students and professional field. It is very likely according to the panel that MAIBI will deliver not only professionals who are up to speed with AI but also relatively young graduates who have gained maturity during the course and are passionate about AI.

Realisation

Programme

The study load of the MAIBI amounts to 60 ECTS. The programme is offered in both a full-time and a part-time variant; the curriculum is identical for both variants and consists of compulsory (37 ECTS) and elective (8 EC) courses and a master thesis (15 ECTS). The main difference is that full-time students need one year to complete the programme while part-time students can spread their study pace over several years: five compulsory (and mainly foundational) courses in year one (25 ECTS), followed by 20 ECTS of compulsory and elective courses in year two, and the master thesis in year three.

The panel noticed in the informative description in the Blueprint that the structure of the new master programme aligns neatly with its profile. The programme consists of four thematical pillars - AI and industry, AI and business, AI foundations, and AI and society - which together offer a solid and comprehensive training in the domain of artificial intelligence. The objectives of the four pillars and their respective course contents were covered extensively in the Blueprint and further clarified during the discussions on site. Each of the four pillars has its own focus and relates to the expertise of the participating faculties. Altogether the curriculum constitutes a nice and thoughtful mixture of foundational, application-oriented and society-awareness courses. In this way, the programme contributes to the needs of the industry for well-rounded AI experts. Moreover, the panel thinks that the regular interaction with industry is a particular strength of MAIBI as students will be confronted during their study with real-world problems and real-world data. This is particularly the case in the highly interesting AI in Practice course where several companies have committed to teach a module on their specific industrial perspective. Moreover, the panel welcomes the participation of companies in the master thesis, as this will enhance the relevance of the research assignment for students.

In addition to all positive findings, the panel challenged the programme stakeholders during the site visit on two curriculum aspects. First, the panel noticed in the Blueprint that the course Fundamentals of AI seems to deal with a large variety of AI techniques that are taught on a rather basic level, while the master after master level of MAIBI may warrant a different approach, by offering a limited number of techniques at a more advanced level. In this regard the panel suggested to focus in the course Fundamentals of AI on two techniques (e.g. Search & Optimisation and Planning & Scheduling) and deliver these topics on a more advanced level. The programme management conceded on the one hand that this was a valid suggestion, yet indicated on the other hand that this course also served to create a level

playing field for all incoming students and that in the latter half of the programme some components will be treated more in depth. Secondly, the panel wondered how all students could achieve the learning outcome on ethical behaviour when the Ethics and AI course is only an elective part of the programme. Also in this case, the programme management understood the concern, yet assured the panel that ethical aspects are covered in several courses, including the Fundamentals of AI course and in the case modules taught by the industry representatives. Moreover, ethics is addressed in the master thesis.

Alignment curriculum and learning outcomes
Further to its statement that the programme profile is translated adequately in the curriculum, the panel gathered from the extensive descriptions in the Blueprint and the discussions on site that there is indeed a strong alignment between most programme learning outcomes and the respective courses in the curriculum. The panel noticed from the course descriptions that the curriculum has been designed in such a way that students who graduate indeed reach the stated learning outcomes.

Nonetheless, the panel encourages the programme management to put processes in place – or to change the programme structure – to ensure that the ethical competences are covered in the programme, irrespective of the combination of compulsory and elective courses a student may want to take. In this way all students will (be able to demonstrate that they) have achieved all learning outcomes. In this regard, and further to the above-mentioned discussion on site, the panel advises the programme to revisit the matrix in the Blueprint between programme-specific learning outcomes and courses as the learning outcome on ethical behaviour is currently covered only in the AI and Society pillar.

Teaching formats
The panel gathered from the Blueprint and the discussions that the new programme features different teaching formats. The combination of lectures and lab sessions, of blended learning approaches and flipped classroom settings all contribute to a specific learning environment that befits the purpose of the courses and the application-oriented focus of MAIBI. This appreciation also holds for the master thesis where students investigate and develop innovative AI solutions for problems that are relevant to industry and business.

The panel welcomes the variety of teaching formats and considers that they align well with the programme's learning objectives, the contents of the courses and the needs of the different student groups. It thinks highly of the active role students are expected to play in the learning process. Moreover, the panel considers that the involvement of field experts in various roles and components of the programme constitutes an effective approach to help students understand how state-of-the-art AI systems are built, how they are used in practice, and how they lead to added value from a business perspective.

The panel is convinced that the envisaged mixture of recent graduates and more experienced professionals will provide all students with a challenging intellectual environment in which recent graduates can learn from the experience and professionalism of their older colleagues, while the latter may find it stimulating to informally coach younger students or have some outdated technical opinions discussed. In this regard, the panel welcomes the efforts of the programme designers to develop a curriculum in which both structure and teaching formats allow to combine MAIBI with a job.

Teaching staff

The MAIBI programme brings together teaching staff and expertise from different faculties and campuses. The Blueprint contains a list of 23 professors who are connected to the new programme. The panel gathered from the overview and the CVs that the spectrum of staff specialisations is quite broad and that many staff are excellent academics in their domain. Most professors are member of the Leuven.AI institute. Moreover, all staff combine disciplinary know-how with didactical and assessment skills. Altogether the teaching staff constitute a good mix of research expertise, professional exposure and seniority.

The discussions, moreover, revealed that the multi-campus pool of lectures in combination with the blended teaching format allows for considerable flexibility in designing and delivering the courses. During the session with teaching staff, the panel got very concrete examples of how individual courses will be run by a team of lecturers from different campuses. In this way students will benefit from a wide variety of expertise.

The programme also features a considerable number of guest lecturers and field experts. The panel welcomes this input from field professionals as it will enhance the connection between the academic study, the AI industry and the labour market. In this regard, the panel supports the decision to have one course fully taught by lecturers from industry and to involve field professionals in the supervision of theses. Following a question from the panel, the programme management indicated that it will monitor that lecturers from industry have sufficient teaching skills to deliver the course.

Finally, the panel noticed during the site visit that in addition to their academic, didactic and professional competences, the teaching staff also demonstrated a lot of passion for their domain of expertise and for passing on this know-how and skills to the advanced master students in the new MAIBI programme.

Infrastructure and educational equipment

Almost all educational activities linked to MAIBI take place on the Bruges campus of KU Leuven. The campus is located conveniently next to the railway station and hosts several degree programmes in Engineering Technology. The campus features a new building with sufficient space for lectures, seminars, lab sessions and team project work for an estimated additional student population of 25-50 students per year. The university management assured the panel that in case more students enrol, the material facilities would still suffice and additional enrolment fees would allow for hiring more staff. According to the panel the new programme will run smoothly with the available facilities.

Student support

The panel learned from the Blueprint that the advanced master students on the new programme can make use of all university- and faculty-wide student services, facilities and counselling. The faculty has a structured offer of study and student guidance, supplemented with student support on demand. The newly hired teaching staff will also take on some coordination tasks in relation to the MAIBI cohorts. According to the panel, students on the new programme can rely on a range of adequate support services.

Information on the study

Based on the information in the Blueprint, the panel established that KU Leuven provides general information on all stages of study on its website. This information includes topics like registration, study paths, exams, diplomas and certificates, as well as the educational vision and policy of the university.

Once students are enrolled, they have access to internal information that is available to all members of the university community as well as to personal information on their study programme. This information is provided through Toledo, the KU Leuven online learning environment featuring online course content and communication channels between students and teaching staff. Furthermore, students are given access to the KU Leuven Loket application where they can consult their individual study programme, class schedule and individual examination schedule. It also contains the student's academic progress file. According to the panel, both the online learning environment and the Loket application are very useful instruments for the domestic and international students and professionals enrolling at MAIBI.

The panel welcomes the programme-specific information that is provided online in the detailed descriptions of programme and courses in the programme catalogue. In this way, students and other interested parties – such as the assessment panel – can find comprehensive and readable information on the programme and the different stages of the curriculum. In view of the forthcoming dissemination efforts the university will undertake to publicise MAIBI, the panel advises the programme to monitor that the programme description reflects the set of tools students will learn in the courses. This suggestion is based on the panel's impression that some of the course contents it discussed during the site visit were more comprehensive than the written information the panel had at disposition in the Blueprint.

Assessment

Assessment policy

MAIBI is part of the organizational and administrative responsibility of the Faculty of Engineering Technology. The rules and regulations concerning assessment are outlined in the assessment policy of the faculty, which in turn reflects the faculty's educational policy. The panel noticed in the Blueprint that assessment is based on nine principles, which it considers both clear in formulation and relevant for the purpose of the faculty's degree programmes in general and MAIBI in particular.

The panel gathered from the elaborate description in the Blueprint how these principles will be implemented in the new master programme. It also established that the programme has at its disposal a protocol for dealing with fraud. The panel considers that in terms of assessment, the new programme can rely on a strong and relevant framework that is set at faculty level and aligns with the overall policy at university level.

Assessment and examination

The discussions on site provided the panel with additional clarifications and concrete examples on how the assessment framework will be applied in the new programme. It appreciates MAIBI's intention to use several assessment formats in order to achieve the best possible fit with the learning objectives per course. In this regard, feedback and peer assessment are considered essential parts of the learning process in MAIBI. The panel noticed

furthermore that the teaching team of the respective courses is responsible for course assessment and that individual course descriptions offer a detailed explanation of the assessment method(s).

The assessment matrix in the Blueprint gives an overview of the various assessment methods in MAIBI. Most courses include a written and/or oral exam; other courses contain at least one type of continuous assessment or permanent evaluation featuring assignments where students are assessed on the process or the product. Some courses use formative or summative peer assessment by fellow students. Still other courses combine evaluation methods featuring both continuous assessment and final exam. The panel understood that the choice for a particular assessment format is triggered by the principle to execute assessment in a reliable, valid and transparent way.

The organisation of MAIBI's master thesis follows faculty-wide procedures. This also holds for its evaluation, which is based on a matrix that is used by all master programmes and on all campuses of the Engineering Technology faculty. The assessment focuses on three components: process, product and presentation. Halfway the thesis trajectory, an intermediate assessment with feedback is scheduled. While a thesis can address a specific company issue and involve an industry representative as co-supervisor, thesis supervision will always be monitored by an academic staff, as well. In terms of assessment and grading, the viewpoint of the industrial supervisor is taken into account when academic supervisors set the final grade.

While acknowledging that it can only look at the envisaged assessment plans of the new programme, the panel considers that the assessment process is comprehensive and more than sufficiently elaborated to issue a positive opinion at this stage of initial accreditation. The panel appreciates in particular the use of peer assessment, which it considers particularly relevant for the diverse intake of students and professionals. The description of the assessment methods of courses and thesis is clear. The specific assessment formats are tailored to the contents of the respective courses. Taken altogether, there is a good mixture of, and a nice balance between, assessment methods across courses. In this way, the assessment methods serve the learning goals of the courses and align nicely with the learning outcomes at programme level. In view of MAIBI upholding the four eyes principle in preparing and correcting exams, the panel encourages the teaching teams to work closely together as individual staff from different faculties may bring a variety of expectations and approaches to the table.

Quality assurance

The organization, planning and follow up of the programme will be coordinated by a new interfaculty programme committee, devoted specifically to MAIBI. While lecturers are responsible for a valid and reliable assessment of their respective courses, it is up to this Programme Committee to monitor the process and outcomes of all assessments within a given programme. Meeting once per month, the Programme Committee consists of the programme director and a delegation of lecturers, teaching assistants, students and industry representatives. The panel learned that the Programme Committee is also an important and structural body for students to speak out – and be heard – on the quality of education and assessment in the overall programme and the individual courses. The panel considers that the Programme Committee is an effective instrument to monitor education and assessment

quality in this interfaculty programme. According to the panel, it would be good if the student delegation on this committee is representative for the diverse intake of domestic and international students and professionals.

Public information on programme quality

The panel read in the Blueprint that information on the quality of all programmes at KU Leuven is included in the programme catalogue, which can be consulted by the general public. For MAIBI this information will be available under the tab 'educational quality' in the programme description in the catalogue. The quality assurance method at KU Leuven is called COBRA, which stands for Cooperation, Reflection and Action and pays attention to the Checks & Balances. The internal quality assurance cycle of a programme lasts four years; at the end of such cycle, the programme reflects on the achieved educational quality, based on qualitative and quantitative input by internal and external actors. The panel got confirmation during the discussions that this formal four-year internal quality assurance cycle does not prevent individual staff from adjusting the contents of their courses to new technological evolutions in the domain of AI. Several interlocuters assured the panel that such adjustments follow their own cycle and rationale and can be implemented every academic year. Acknowledging that it cannot yet assess the way the quality assurance tools are operationalised in the new programme, the panel does consider that the university has established a strong engagement for quality assurance that is extensively described on the website. Moreover, the panel is confident that the existing system provides relevant instruments to monitor the quality of the new programme.

3 Assessment

The panel assessing the Master in Artificial Intelligence in Business and Society (MAIBI) at KU Leuven judges the overall quality of the new programme to be good. This appreciation applies equally to all components of the programme as presented in the previous section in terms of profile and vision, realisation, and assessment. In view of this holistic judgement, the panel issues a positive advice to NVAO.

The informative self-evaluation report (Blueprint) and the lively discussions on site demonstrate according to the panel that university management and programme developers have reflected extensively on all components of the new programme.

In terms of profile and vision, the panel acknowledges the link between the profile of the programme and the wider educational vision of the university. MAIBI is conceived as an advanced level master programme, featuring a one-year curriculum, targeting both students and professionals, involving several faculties of KU Leuven and taking place at the Bruges campus of the university. The panel supports the choices made during the development phase because they result in a unique programme that is likely to attract many domestic and international students and professionals and will eventually meet the growing need for AI-competent experts. Furthermore, the panel validates the set of 10 domain-specific learning outcomes and 13 programme-specific learning outcomes as they do justice do the discipline (artificial intelligence in business and industry), level (master) and orientation (academic) of the programme. Another strong feature is the commitment of the professional field to the new programme and their involvement in the preparation and implementation of the curriculum.

In terms of realisation, the panel thinks highly of the rationale for the programme structure and the curriculum. The variety of teaching formats aligns well with the programme's learning objectives, the contents of the courses and the needs of the different student groups. Moreover, the combination of enthusiastic teaching teams and experienced field experts contributes to the attractiveness of the programme. Finally, the panel established that the facilities of the new programme are good and that new students can rely on a broad range of information and support services.

In terms of assessment, the new programme can rely on a strong and relevant framework that is set at faculty level and aligns with the overall policy at university level. According to the panel, the assessment plans and processes envisaged for the new programme are both relevant and robust, and ensure that students meet the learning outcomes by the time they graduate. Moreover, the new programme will be integrated in university-wide quality assurance policies and provisions, which are based on a four-year cycle of checks and balances but also allow for yearly adjustments of the course contents.

In sum, the panel thinks positively of the quality of MAIBI. It considers that at the time of the site visit in September 2021, the programme is sufficiently developed to allow for a roll-out in September 2022. In addition to all positive appreciations, the panel has a few suggestions, which do not affect its positive judgement on the programme quality. The panel advises MAIBI to:

- raise awareness in the programme on the environmental impact of certain AI techniques;

- ensure that all students acquire the ethical competences mentioned in the learning outcomes;
- monitor that the programme description reflects the set of tools students will learn in the courses;
- uphold the four eyes-principle in preparing and correcting exams as multi-faculty teaching teams may bring their own assessment expectations and approaches to the table.

4 Review process

The assessment was carried out in line with the 'Assessment framework programme conduct-tailored accreditation – October 2018'.

The panel prepared itself for the assessment based on the self-assessment report issued by the programme when applying for initial accreditation. The panel followed the learning path Initial Accreditation-Own Conduct on the training platform. Prior to the preparatory meeting each panel member formulated key findings on the programmes, i.e., strengths, points for attention and issues that required further clarification. The secretary compiled these first impressions in a document that served as a basis for discussion during the preparatory panel meeting.

The panel met on 9 September 2021 in Bruges to prepare for the accreditation visit. During this meeting, the panel was informed on the assessment framework and the appreciative approach, in addition to the information provided on the learning path. Moreover, the panel discussed the key findings from the document review and listed the questions per session.

The site visit took place in Bruges on 10 September 2021. The panel spoke to representatives of the university management, as well as to the programme developers, envisaged teaching staff, students from related programmes, and the professional field. Using the appreciative approach, the panel has gathered additional information on the different aspects of the programme. During a closed meeting on 10 September 2021 the panel discussed all information obtained and translated it into a holistic judgement. The panel took this conclusion in full independence.

All information obtained led to a draft assessment report that has been sent to all panel members. The feedback from the panel members has been processed. The assessment report adopted by the chair was submitted to NVAO on 8 October 2021, followed by a 2 weeks term in which KU Leuven could make comments on factual errors.

Annex 1: Administrative data regarding the institution and the programme

Institution	Katholieke Universiteit Leuven
Address, institution website	Oude Markt 13, B-3000 LEUVEN www.kuleuven.be
Status institution	Publicly funded higher education institutions
Programme	Master of Science in Artificial Intelligence in Business and Industry
Level and orientation	Academic Master
(Additional) title	Not applicable
(Parts of) field of study(s)	Industrial Sciences and Technology
Specialisations	Not applicable
Programme routes	Master's in Engineering Technology, Engineering Science, Applied Informatics, Business Engineering, Business and Information Systems Engineering
Locations	Bruges
Teaching language	English
Study load (in credits)	60 ECTS
New training in Flanders	Yes
Connecting options and potential further education	Not applicable

Annex 2: Learning outcomes

Domain-specific learning outcomes

1. Having the required knowledge and understanding of state-of-the-art Artificial Intelligence techniques and tools to be able to engage in professional activities in areas such as Big Data Analysis, Speech and Language Technology, Logistics, Robotics, or other application domains of Artificial Intelligence.
2. Having an advanced understanding of how AI can be applied in an industrial context and how AI can contribute to the business goals of an organisation. Having a sufficient understanding of economy and business administration to be able to appreciate the role of AI in this context.
3. Being able to develop small-scale prototypes or proof-of-concepts of AI systems.
4. Being able to reason about societal aspects of AI, such as ethical, deontological or legal aspects of AI, in the context of concrete applications or use cases, to the extent that is necessary for acting as a responsible professional in this domain.
5. Being able to critically evaluate AI systems and technologies from both a technological and a business perspective.
6. Being able to communicate about AI with both a technical and nontechnical audience.
7. Being able to independently conceive, plan and execute an engineering project at the level of a junior research professional, and to carry out literature research, data collection and -analysis, interpreting results according to scientific standards and from the perspective of possible applications.
8. Acting with a research attitude, which includes creativity, critical reflection and curiosity; recognizing the need for life-long-learning in a field that is under a lot of development, and being able to follow these developments
9. Designing innovation and operation-oriented systems, products, services and processes, integrating and evaluating them in the business context.
10. Acting with an engineering attitude within the discipline specific context of Artificial Intelligence, which includes precision, taking process ownership, and justifying choices by means of application-oriented arguments.

Programme-specific learning outcomes MMK

1. Scientific-disciplinary knowledge and comprehension in the field of Artificial Intelligence - Students have scientific-disciplinary knowledge and comprehension in the field of Artificial Intelligence: they understand how state-of-the-art AI systems are built, how they are used in practice, they lead to added value from a business perspective and what the relevant legal and ethical considerations are.
2. Gaining in-depth knowledge and comprehension, including the ability to develop relevant prototypes or proof-of-concepts, in at least one of the following disciplines in Artificial Intelligence: machine learning, deep learning, knowledge representation, computer vision, audio processing, natural language processing, search and optimisation. Gaining in-depth knowledge and comprehension of at least one of the following application domains of Artificial Intelligence: health, education, logistics, manufacturing, robotics.

Programme-specific learning outcomes MMI

1. Problem analysis and solving - Students adopt a systematic or innovative approach, using their analytical skills, when solving complex practical engineering problems in the domain of Artificial Intelligence.
2. Design and/or development - Students can design, implement and test an Artificial Intelligence product or service, keeping the concrete context in mind.

3. Application-oriented research - Students demonstrate the ability to act with a creative, precise, inquisitive and critical research attitude by formulating an application-oriented research problem in the domain of Artificial Intelligence, and by choosing and applying the appropriate methodologies to carry out the necessary experiments, including the critical interpretation of the results.
4. Ethical behaviour - Students know how to deal with ethical issues in the domain of Artificial Intelligence, and show ethical behaviour when acting as a professional in this domain.
5. Entrepreneurship - Students show an entrepreneurial attitude and are aware of the hurdles that need to be overcome when bringing an innovative idea in the domain of Artificial Intelligence to the market. They can consider different innovative ways of making AI technology operational and are able to draw conclusions from relevant experiments in a business context.

Programme-specific learning outcomes MMP

1. To make operational - Students can perform all acts necessary to make systems, products, devices, equipment, and test installations in the domain of Artificial Intelligence operational.

Programme-specific learning outcomes MMG

1. Information gathering and processing - Students can find, evaluate and process scientific and technological information in the domain of Artificial Intelligence.
2. Communication with engineers and non-engineers - Students correctly employ the scientific and technological vocabulary typical for the domain of Artificial Intelligence.
3. Critical thinking - Students reflect critically on their choices, actions and obtained results, and can justify the choices made. They recognize the need for life-long learning in the quickly developing domain of AI.
4. Working in a team in different roles - Students function as a loyal member within an interdisciplinary team, act independently and in a responsible way, helping the team to achieve its goals.
5. Professionalism - Students work accurately, show curiosity and perseverance, respect deadlines and commitments, are aware of the limitations of own competences. The students act in a result-oriented way, pay attention to planning and to technical, economical and societal constraints like sustainability. The students can estimate risks and feasibility of a proposed approach or solution and obtain effective solutions.

Annex 3: Composition of the panel

The assessment was made by a panel of experts convened and appointed by the NVAO. The panel is composed as follows:

Yingqian Zhang (chair), Associate Professor of AI for Decision Making, Eindhoven University of Technology (Netherlands);

Cees Witteveen (panel member)**,** Emeritus Professor in Algorithmics, Delft University of Technology (Netherlands);

Wouter Van den Broeck (panel member)**,** Chief Technical Officer, Omina Technologies;

Anthony Longo (student panel member), Master student Digital Culture and Society, King's College London and PhD student University of Antwerp.

The panel was assisted by:

- **Mark Frederiks**, coordinator international policy NVAO (Flanders), process coordinator;
- **Mark Delmartino,** secretary.

All panel members and the process coordinator/secretary have signed NVAO's code of ethics.

Annex 4: Schedule of the site visit

Friday 10 September

KU Leuven Campus Bruges, Faculty of Engineering Technology

Time	Meeting
08.30	Arrival and internal panel meeting
09.00	Session 1 – Representation of the university management
09.45	Session 2 – Programme management (curriculum designers)
11.30	Session 3 – Teaching staff
12.30	Lunch and internal panel meeting
13.30	Session 4 – Students
14.10	Session 5 – Professional field
15.00	Dialogue with programme management
15.30	Final panel meeting
17.40	Concluding dialogue

Annex 5: Overview of the material studied

Information file

- Blueprint+ Master of Science in Artificial Intelligence in Business and Industry. Initial accreditation. KU Leuven

Mandatory annexes to the information file

- Domain specific learning outcomes
- Corresponding programmes in Flanders and neighbouring countries
- Schematic overview of the entire curriculum
- Description of the content of the curriculum components
- Description of staff and their CV's
- Overview of the contacts with and support letters from the professional field

Documents made available during or leading up to the dialogue

- Application file Macrodoelmatigheidstoets
- A sample of recent master theses in the field of Artificial Intelligence
- KU Leuven policy documents
- Faculty regulations on assessment
- Information posters on Leuven.AI
- Brochure Postgraduate Certificate Artificial Intelligence in Business and Industry
- Topics covered in AI in Practice: Academic Perspectives and Industrial Perspectives

Colofon

MSc in artificial intelligence in business and industry
KULeuven (VL131118-21)
Conduct-tailored initial accreditation • Assessment report
8 October 2021
Composition: NVAO • Vlaanderen

Nederlands-Vlaamse Accreditatieorganisatie
Accreditation Organisation of the Netherlands and Flanders

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