

wo-master  
**Science, Business and  
Innovation**  
VU University Amsterdam

2<sup>nd</sup> of May, 2017

NVAO limited initial accreditation

Panel report

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## 1 Executive summary

The Accreditation Organisation of the Netherlands and Flanders (NVAO) received a request for an initial accreditation procedure, including program documents, regarding a proposed wo-master Science, Business and Innovation at VU University Amsterdam. NVAO convened an expert panel, which studied the information available and discussed the proposed program with representatives of the institution and the program during a site visit.

The following considerations are at the basis of the panel's assessment.

The panel concludes that the focus of the master's program Science, Business and Innovation (SBI) is relevant, innovative and interesting to the academic and professional fields, as well as to students. The program crosses the boundaries of natural and social sciences, within the context of innovation in the natural sciences, in order to contribute to the persistent and growing need for scientific and practical insights into valorization of scientific knowledge and findings in academia, society and business. Students gain experience with these phenomena by research internships in empirical settings, and choose one of two specializations: Energy & Sustainability or Life & Health. These tracks are currently offered in the master's programs of Physics and Chemistry, but the VU wishes to replace the two tracks with an independent master's program in order to enable a more dedicated development and improvement of the integrative, and inter- and transdisciplinary character of the SBI program.

Especially because the program has a transdisciplinary focus and aims to train students to bring a complexity at master's level into practice, the panel finds that the program is a valuable addition to the range of study programs that is offered at the VU specifically, and in the Netherlands as a whole. It is also of the opinion that the choice for the two tracks is well-chosen. The choice reflects a deep understanding of scientific and societal developments that create the need for a program like SBI. In addition, the program builds on well-developed disciplines of VU.

According to the panel, the program has developed a proper curriculum, the program's staff consists of highly motivated and qualified people and the facilities are adequate to support the program. The natural sciences provide a solid basis on which the other disciplines can build, but the panel agrees with the advisory board that courses could pay more attention to project management skills and financial skills. A stronger integration of the social sciences in the SBI program will take more time, but the panel is confident that SBI will continue to develop its 'gamma-side'. Scientific research projects, developed in their specific empirical setting, are an important element of the curriculum. Students can use the laboratories of several institutions for their projects; the master project is an individual and independent research project in the professional field within the chosen specialization.

Teaching staff is provided by the three cooperating VU faculties, as well as the University of Amsterdam. The final responsibility for the SBI program lies with the program director, who is supported by the master coordinator. To ensure an integrative culture within the team, a system of institutionalized contact has been implemented in the form of a so-called 'bridging person' per faculty. The panel noticed that the core team has managed to create an integrated team of professionals. The students pointed out the personal touch that the program supplies, which the panel considers to be a strong aspect of the program. The

panel wishes to stress the importance of safeguarding this personal aspect, especially when more students enroll in the program.

The panel found a functioning assessment system and exam committee. The program is actively creating and implementing rubrics, templates and assessment forms and the panel further encourages this process. The assessment of the science and master projects is well-documented and structured. The panel commends the exam committee for its internal auditing and encourages the program management to implement the suggestions from the committee.

The panel read a selection of fifteen theses coming from the predecessors of the SBI program (the SBI tracks within the master's programs Physics and Chemistry). Overall, the panel found multiple theses that were of high quality and very interesting to read, and it sees the theses as proof of how the program contributes to society. The panel's main point of concern is the methodological underpinning of the theses, but it points out that all theses were written before the program incorporated a course on methodology in its curriculum. The program has already taken steps to address this and the panel expects that the new course and additional attention paid to research skills will lead to a stronger methodological underpinning of theses.

The panel comes to the conclusion that the program meets all assessments standards. Given these considerations, the panel advises NVAO to take a positive decision regarding the quality of the proposed program wo-master Science, Business and Innovation at VU University Amsterdam. The panel agrees with the institution that the intended learning outcomes cannot be achieved within one year and therefore advises to grant the program the right to offer a two-year master's program (120 EC).

The Hague, 2<sup>nd</sup> of May, 2017 (update to the original report of 20<sup>th</sup> of December, 2016)

On behalf of the Initial Accreditation panel convened to wo-master Science, Business and Innovation at VU University Amsterdam,

Prof.dr.ir. O.A.M. Fisscher  
(chair)

A.T.M. Martens & M.L.V. de Waal  
(secretaries)

## 2 Introduction

### 2.1 Procedure

NVAO received a request for an initial accreditation procedure including program documents regarding a proposed wo-master Science, Business and Innovation. The request was received on the 25<sup>th</sup> of August, 2016 from the VU University Amsterdam.

An initial accreditation procedure is required when a recognized institution wants to offer a program and award a recognized bachelor's or master's degree. The procedure for initial accreditation is slightly different as compared to the approach for programs that have already been accredited. Initial accreditation is in fact an ex ante assessment of a program, and a program becomes subject to the normal accreditation procedures once initial accreditation has been granted.

NVAO convened an international panel of experts (see also Annex 1: Composition of the panel). The panel consisted of:

Chair:

- Prof.dr.ir. O.A.M. (Olaf) Fisscher, Professor emeritus of Organization Studies and Business Ethics, University of Twente, and coordinator of the master's program Quality Management at Schouten & Nelissen University.

Panel members:

- Prof.dr. C.P. (Cees) van Beers, Professor of Innovation Management and Head of the section Economics of Technology and Innovations at Delft University of Technology, and co-leader of the Leiden Delft Erasmus (LDE) Centre for Frugal Innovations in Africa
- Prof. T. (Thomas) Hedner, M.D., Ph.D., MBA, EconD, Professor of Clinical Pharmacology at Sahlgrenska University Hospital, Gothenburg University, and founder of several biomedical start-ups.

Student member:

- A.J. (Arie) van Scheepen MSc, B Eng, recent graduate of the master's program Public Administration and Organization, Utrecht University.

On behalf of the NVAO, Jetse Siebenga, external process coordinator, and Anne Martens and Maya de Waal, NVAO policy advisors and secretaries of the panel, were responsible for the process-coordination and the drafting of the experts' report.

The panel has based its assessment on the standards and criteria described in the NVAO Initial Accreditation Framework (Stcrt. 2014, nr 36791). In addition, the panel applied the Protocol for programme extension (October 8<sup>th</sup>, 2003) to assess the two-year duration of the program.

The following procedure was undertaken. The panel members prepared the assessment by studying the documents provided by the institution (Annex 3: Documents reviewed). Their first impressions were sent to the secretary of NVAO, in order to outline these remarks within the accreditation framework and detect the topics to be clarified during the site visit. The panel organized a preparatory meeting on 28<sup>th</sup> of November, 2016, i.e. the day before the site visit. During this meeting, the panel members shared their first impressions and formulated questions for the site visit.

The site visit took place on 29<sup>th</sup> of November, 2016 at VU University Amsterdam. During this visit, the panel was able to discuss the formulated questions and to gather additional information during several sessions (Annex 2: Schedule of the site visit). Afterwards the panel discussed the findings and considerations and pronounced its preliminary assessments per theme and standard. These are based on the findings of the site visit, and built on the assessment of the program documents. At the end of the site visit, the initial findings were presented to the institution. Based on the findings, considerations and conclusions the secretary wrote a draft advisory report that was firstly presented to the panel members. After the panel members had commented on the draft report, the chair endorsed the report. On the 15<sup>th</sup> of December, 2016 the advisory was sent to the institution, which was given the opportunity to respond to any factual inaccuracies in the report. The institution replied on the 20<sup>th</sup> of December, 2016. All suggested corrections were adopted. Subsequently the final report was endorsed by the panel chair. The panel composed its advice fully independently and offered it to NVAO on the 20<sup>th</sup> of December, 2016.

In the original panel report, the panel's assessments of the field of study and two-year duration of the program were accidentally not included. In April, 2017, the panel added these assessments to the final version of the report. An updated version of the panel report was offered to NVAO on the 2<sup>nd</sup> of May, 2017.

## **2.2 Panel report**

The first chapter of this report is the executive summary of the report, while the current chapter is the introduction.

The third chapter gives a description of the program including its position within the VU University Amsterdam and within the higher education system of the Netherlands.

The panel presents its assessments in the fourth chapter. The program is assessed by an examination of the themes and standards in the Initial Accreditation Framework. For each standard the panel presents an outline of its findings, considerations and a conclusion.

The outline of the findings are the objective facts as found by the panel in the program documents, in the additional documents and during the site visit. The panel's considerations consist of the panel's judgments and subjective evaluations regarding these findings and their relative importance. The considerations presented by the panel are at the basis of a concluding overall assessment.

The panel concludes the report with a table containing an overview of its assessments per standard.

## 3 Description of the program

### 3.1 General information

Country	: The Netherlands
Institution	: VU University Amsterdam
Program	: wo-master Science, Business and Innovation
Specialization	: Energy & Sustainability, Life & Health
Mode of study	: full-time
Degree	: Master of Science
Location(s)	: Amsterdam
Study Load (EC)	: 120 EC
Field of Study	: nature

### 3.2 Profile of the institution

The VU University Amsterdam (VU) was founded in 1880 by Reformed Christian minister and statesman Abraham Kuyper. Although originally a private university, it is now organized and funded in the same way as other Dutch universities. The institution's history is still visible today by its distinctive approach to knowledge and the emphasis placed upon social involvement in the university's teaching and research programs. The VU core values are responsible, open and personally engaged.

VU is a broad, research-intensive university attended by diverse groups of students with different backgrounds. In general, VU University Amsterdam aims to offer both fundamental educational programs in core academic disciplines, as well as interdisciplinary programs with a focus on society, institutions and business. Science, Business and Innovation fits within this second type of program. The university presently has eleven faculties and provides education to approximately 23,000 students. The VU employs about 4,500 people.

### 3.3 Profile of the program

The 120 EC master's program Science, Business and Innovation (SBI) crosses the boundaries of natural and social sciences, within the context of innovation in the natural sciences, in order to contribute to the persistent and growing need for scientific and practical insights into valorization of scientific knowledge and findings in academia, society and business. Since 2011, the SBI program has been offered as a track in the master's programs of Physics (specialization in Energy & Sustainability) and Chemistry (specialization in Life & Health). These programs are presently organized as collaborations between the VU and the University of Amsterdam. VU aims to replace the two tracks with an independent master's program SBI, and therefore applied for an initial accreditation assessment. The new master's program will fall under the responsibility of VU only. Developing an independent program will enable a more dedicated development and improvement of the integrative, and inter- and transdisciplinary character of the SBI program. It will also enable a further integration of the two tracks into one coherent program.

The program meshes in with each of the four strategic educational and research themes VU defines in its strategic plan: Governance for Society, Human Health & Life Sciences,



Connected World, and Science for Sustainability. It is offered by the section Science, Business and Innovation of the Faculty of Sciences (FEW), and disciplinary courses in the area of natural sciences of the master's program are offered by the departments Chemistry and Physics from FEW. The Faculties of Economics and Business Administration (FEWEB) and Social Sciences (FSW) offer the business and social scientific disciplinary courses in the program. FEW is responsible for the program, while FEWEB and FSW have a supporting role.

Four other master's programs in the Netherlands (at Utrecht University and Eindhoven University of Technology) focus on the interactions and relations between natural and social sciences. These programs are comparable to VU's SBI program. In addition, several disciplinary programs offer tracks with an interdisciplinary focus and other programs emphasize the specific areas of Life & Health or Energy & Sustainability. VU has used these programs as a benchmark and concluded that unique elements in the SBI program are the focus on science-based innovation, valorization and entrepreneurship in the areas of Energy & Sustainability and Life & Health.

## 4 Assessment per standard

This chapter presents the evaluation of the standards by the assessment panel. The panel has reproduced the criteria for each standard. For each standard the panel presents (1) a brief outline of its findings based on the program documents and on documents provided by the institution and the site visit, (2) the considerations the panel has taken into account and (3) the panel's conclusion. The panel presents a conclusion for each of the standards, as well as a final conclusion.

The assessment is based on the standards and criteria described in the NVAO Initial Accreditation Framework (Stcrt. 2014, nr 36791). In addition, the panel applied the Protocol for programme extension (October 8<sup>th</sup>, 2003) to assess the two-year duration of the program.

Fundamental to the assessment is a discussion with peers regarding the content and quality of the program. It focuses on five questions:

1. What does the program aim for?
2. How does the program intend to achieve its objectives?
3. How does the program intend to assess its performance?
4. Are the objectives achieved?
5. Does the program have sufficient financial resources?

These five questions have been translated into five standards. Regarding each of these standards, the assessment panel gives a substantiated judgement on a three-point scale: meets, does not meet or partially meets the standard. The panel subsequently gives a substantiated final conclusion regarding the quality of the program, also on a three-point scale: positive, conditionally positive or negative.

### 4.1 Standard 1: Intended learning outcomes

*The intended learning outcomes of the program have been concretized with regard to content, level and orientation; they meet international requirements.*

#### *Outline of findings*

The field of Science, Business and Innovation contributes to the persistent and growing need for academic knowledge of, and for academic professionals who practice valorization of natural scientific insights, knowledge and findings. A deep understanding of natural sciences, as well as a thorough insight in the business and social sciences are the basic pillars of the master's program. The master's program Science, Business and Innovation (SBI) intently and substantially crosses the boundaries of natural, business and social sciences, within the context of technology driven, R&D-induced and natural science-based innovation. The program integrates the fields of physics, chemistry, life sciences, social, business and innovation sciences.

The master's level of the program is reflected in the competences and translated into learning outcomes. The competences are derived from the goals and profile of the program. The academic orientation of the program is reflected in the learning outcomes. The master's program of SBI covers five competences, which are accompanied by learning outcomes.

- 1) The master SBI has a scientific, state-of-the-art knowledge base, consisting of the core and relevant theories in the SBI-knowledge domain, and has the competence to increase and develop this through academic research.
- 2) The master SBI is able to identify, unravel, reflect on and value chemistry/physics related questions, systematically following the scientific research cycle, while considering scientific relevance.
- 3) The master SBI has the competence to develop new or modified approaches, plans, solutions, methods and instruments with which (s)he is able to support, renew, improve or speed-up the conversion of scientific findings into business and societal propositions, by means of going through an empirical or design research cycle, and by this contributes to the creation of (future) use, turnover and market and societal value.
- 4) The master SBI is able to describe and present his/her work in accordance with academic standards and is competent to participate in a scientific or public debate.
- 5) The master SBI has the academic learning skills that allows him/her to autonomously prepare, design, conduct, present (written and orally), and reflect on an empirical scientific research project in a business and societal context.

The competences and learning outcomes match the Dublin Descriptors regarding the master's level. In 2015 VU, Utrecht University and Eindhoven University of Technology developed a broader, in-depth and coherent domain specific reference framework for their relevant bachelor's and master's programs. The competences and learning outcomes are in line with this framework, which is based on a vision on science-based and technology-driven innovation, itself based on state-of-the-art insights and knowledge from international academic research in this area.

Students can choose to study the natural science driven innovation process in one of two specializations: Energy & Sustainability, with an emphasis on renewable and clean energy development, or Life & Health, emphasizing drug development, molecular diagnostics and innovative medical instrumentation. Within these specializations, students study the entire chain of technology-driven, R&D induced, science-based innovation, consisting of five typical developmental phases: from research, via development, demonstrations and deployment, to improvement. In the SBI program, students study the specific characteristics, bottlenecks, and feedback and feedforward mechanisms of each step in the R&D induced innovation chain and learn to understand, analyze and solve problems within the chain and its surroundings from an academic and scientific perspective.

Unique elements in the program are the focus on science-based innovation, valorization and entrepreneurship in the specialization areas. Students study and gain experience with these phenomena by research internships in empirical settings (laboratories and R&D-intensive organizations). At the same time, they learn to develop, design, execute, report and present scientific research in these empirical settings in courses of the program. By applying this knowledge in research internships, they learn to conduct and contribute to the academic body of knowledge in this scientific area, and to knowledge that supports practice to valorize.

The program argues for a two-year design, resulting in a curriculum of minimally 120 EC. The learning outcomes have a two-way character, each part needing one year of education. One year is used to enable students to acquire academic knowledge of relevant natural sciences, social sciences and scientific research methods; and one year is used to conduct

academic research in the empirical setting where valorization takes place (a laboratory internship/study, and an internship in an R&D-intensive organization).

In October 2015, the educational director and chair of the section Science, Business and Innovation composed an advisory board for the bachelor's and master's programs SBI. This board consists of members from relevant fields of practice that are related to Science, Business and Innovation.

#### *Considerations*

SBI asks its students to combine elements from different disciplines which brings a complexity with it that is at the master's level. Especially because the program has a transdisciplinary focus and aims to train students to bring the complexity into practice, the panel finds that the program is a valuable addition to the range of study programs that is offered at the VU specifically, and in the Netherlands as a whole. It is also of the opinion that the choice for the two tracks is well-chosen. The choice reflects a deep understanding of scientific and societal developments that create the need for a program like SBI. In addition, the program builds on well-developed disciplines of VU.

The panel studied the intended learning outcomes of the program and concludes that these are in line with both the requirements of the interdisciplinary domain and with the general objectives of the master's program SBI. The intended learning outcomes correspond with the requirements set by national and international professional colleagues. The panel encourages the program to organize a first official meeting of the advisory board soon.

The panel has established that the scientific input in terms of knowledge is at master's level and that students are expected to design their own research and reflect on it. Furthermore, the panel found that the domain specific reference framework of the program is recognized by both students and the professional field. Although fairly unique in the Netherlands, similar programs are available abroad. Therefore the panel recommends that the program looks at possibilities for international benchmarking and cooperation.

The panel concludes that the focus of this program is relevant, innovative and interesting to the academic and professional fields, as well as to students, and deems standard 1 to be of a satisfactory level.

#### *Conclusion*

The program meets standard 1.

## **4.2 Standard 2: Teaching-learning environment**

*The curriculum, staff and program-specific services and facilities enable incoming students to achieve the intended learning outcomes.*

#### *Outline of findings*

The program's learning outcomes have been translated into specific course objectives for the various courses. At the start of the program, students choose a specialization: Energy & Sustainability or Life & Health. The topics related to a specialization are addressed in dedicated courses and projects. The program employs a variety of teaching methods, and

across the master's program, external experts from companies and institutes play a role in a variety of courses.

Students in each specialization partially follow the same courses (24EC Business & Innovation courses), they follow a specific program for all students in each specialization (12 EC science courses, and 6 EC integration course), and they follow a student-specific, specialization-based program (24 EC science project, 36 EC master project and 18 EC electives). Thus the program aims to pay sufficient attention to both the natural sciences and the business and social science of the student's specialization. The balance between disciplinary and interdisciplinary courses depends on the choices students make. Disciplinary courses pay attention to the relation and integration of disciplinary knowledge to and within the larger field of SBI.

Scientific research projects, developed in their specific empirical setting, are an important element of the curriculum. Key features of the program are the science project and the master project, where students train their academic and professional skills. Students are prepared for these projects in the courses SBI Research Methodology, Management of Sustainable Innovation, Networked Organization and Communication, and Transdisciplinarity and Transition. For the science project students can choose between two variants: a research internship (24 EC), or a combination of the Researching Science Research (12EC) course and 12 EC of natural science courses, related to the student's specialization. The master project is an individual and independent research project in the professional field, within the chosen specialization. In preparation for the master project, students develop their research plan as part of the research methodology course.

VU's research based education has to tie in with research conducted by lecturers and students (independently) design and execute a research project. In recent years, three full professors have been appointed in the SBI section, with a specific focus on valorization. Central elements of the SBI field of research are both the connection between science and commercial environments, as well as the creation of value in a broader soci(et)al sense. The master's program SBI is based on a multi- and interdisciplinary didactical concept. It provides students with courses on an advanced level in the natural sciences and in business and innovation sciences, as well as a course in their specific specialization in which natural sciences and business and innovation sciences are integrated. Elective courses may be mono- or multidisciplinary, and students are encouraged to add courses from within but also from outside of VU that are additive to the mandatory 120 EC.

The program is internationally oriented and the results of international research projects are incorporated in the lectures. The teaching and learning of the disciplines within SBI is based on up-to-date and relevant international scientific literature. The international networks of the SBI section members are deployed in the SBI course components. Outlines of the SBI programs have been presented and discussed at international conferences. Each year twenty students from SBI, in close cooperation with the section SBI, organize an international study trip.

Teaching staff is provided by the three cooperating VU faculties, as well as the University of Amsterdam. The staff has to guarantee the interdisciplinary character of the program by developing and teaching integrative courses and projects. All professors at VU have an elementary certificate in teaching in higher education (BKO; 'Basiskwalificatie Onderwijs') or equivalent. PhD students who are participating in teaching activities in the program are

trained, coached and supervised by senior staff. The final responsibility for the SBI program lies with the program director, who is supported by the master coordinator. Next to a yearly kick-off, regular meetings are held with teaching staff as well as with supporting officers. To ensure an integrative culture within the team, a system of institutionalized contact has been implemented in the form of a so-called 'bridging person' per faculty. These bridging people have regular contact and connect the staff of the different faculties with each other.

For the science project, the laboratories from the departments of Physics and Chemistry as well as the facilities of VU Medical Center, O2 Life Sciences, FNWI and IXA (Innovation Exchange Amsterdam) are available to students. In addition, in the science and master project students have access to the laboratories and R&D departments from the companies and institutes involved. The internship coordinator and course coordinator guide students during the master project, while the internship coach is responsible for the daily supervision of the student in the internship-offering organization. Students can use the facilities of the faculty regarding student counseling.

The program aims to attract students with a disciplinary as well as an interdisciplinary background. The requirements to enter the SBI master's program are formulated in terms of knowledge, acquired skills and academic level. Students who do not immediately qualify for admission, but who come from a science-based university bachelor program can enroll after completing a pre-master's program (30 EC). In case a tailor made program needs to be made, for example for international students or for Dutch science bachelors who have a deficiency that is less than 30 EC, this is coordinated by the master coordinator, in close cooperation with the program director of SBI and specialists from the section SBI. The examination committee checks admission based on their Personal Education Plan that is prepared after consulting the master coordinator.

During the two years of study the 24 EC of joint courses stimulate cohesion and cooperation between students of the same cohort. Over the past years the inflowing cohorts were invited to attend six master group meetings annually, which are organized by the program director and master coordinator and co-organized by students. To further stimulate cohesion and cooperation, the master project has several plenary sessions in which students exchange results, experience, insights and knowledge. Additionally, Master Group Meetings are organized to stimulate contact among students of the cohorts and to provide support throughout the program.

#### *Considerations*

The panel supports the fact that the natural sciences are the basis of the SBI program. It is a solid foundation on which the other disciplines can build. The panel agrees with the advisory board that courses could pay more attention to project management skills and financial skills. A stronger integration of the social sciences in the SBI program will take more time, but the panel is confident that SBI will continue to develop its 'gamma-side'. The panel further encourages the program to use its international ties for studying international best practices, benchmarking and cooperation, and was pleased to hear that the program will focus more on internationalization in the following years.

The literature used within the program is satisfactory. However, the panel did notice a struggle to find fitting and interdisciplinary literature that integrates the disciplines, due to the novelty of interdisciplinary programs. As a possible solution, the panel advises the program to create its own literature, if possible with the help of the master's students' research. As is

explained in standard 5, this demands more attention on methodology, research design and reflection within the program – an area of improvement the program is aware of.

The panel encountered highly qualified and enthusiastic teaching staff. Even though the teachers come from very diverse backgrounds, disciplines and faculty positions, the core team has managed to create an integrated team of professionals. The communication lines between the lecturers are short. The fact that the staff is located at the same campus proves to be beneficial. Bridging disciplines and crossing borders between research in the natural sciences on the one hand and innovation, valorization and entrepreneurship on the other requires openness to respective interests, subcultures and vocabularies – it is not just an issue of combining and exchanging knowledge. Students have to learn to deal with these differences and related tensions. The same challenge regards the members of the teaching staff who are involved in integrative courses and supervision. The panel is convinced that this process of bridging and integration is adequately facilitated.

The panel appreciates the teaching environment SBI creates. It is both integrative and flexible. Electives ensure that students can choose their own routes and specializations. The panel met with very committed, ambitious and autonomous students. The panel finds this very positive, but – as mentioned by the representatives of the professional field – more attention can go out to teaching teamwork and social skills. The students pointed out the personal touch that the program supplies, which the panel considers to be a strong aspect of the program. The panel wishes to stress the importance of safeguarding this personal aspect, especially when more students enroll in the program.

The panel concludes that the program has developed a proper curriculum, that the program's staff consists of highly motivated and qualified people and that the facilities are adequate to support the program. It therefore deems standard 2 to be of a satisfactory level.

#### *Conclusion*

The program meets standard 2.

### **4.3 Standard 3: Assessment**

*The program has an adequate assessment system in place.*

#### *Outline of findings*

The program makes use of several assessment forms, such as written or oral exams, assignments, presentations, scientific article reviews, case studies, reports. In the majority of courses, multiple forms of assessment are used. The program management checks whether there is a good balance between summative and formative tests within the program. Students are informed about the assessments in the course descriptions and in the study guide. In each academic year, there will be at least two opportunities per study program component to take a final test.

The four-eye-principle is used in the construction of assessments, and lecturers have to discuss the grading if a certain test yields on average too high or too low marks. In addition, the examination of courses is laid out and controlled through examination templates ('toetsmatrijzen'), rubrics or assessment forms, which are aligned with course objectives and

course content. Test templates and rubrics will be more broadly implemented in the coming time.

The science project (variant 1) and master project are supervised and assessed by two VU lecturers, who use an assessment form to grade the projects. Students are monitored and scored on several aspects: work execution during the internship (40% of the final grade), written thesis (45%) and oral presentation (15%). The internship coach has an advisory role in the assessment of both projects.

The assessment system is described in the program's assessment policy plan and in the Program and Examination Regulations (OER; 'Onderwijs- en Examenregeling'). The SBI program follows VU's assessment policy as described in the Educational Quality Assurance Manual. All VU faculties have an examination board and a program committee (OC; 'opleidingscommissie'), safeguarding the quality standards of the courses. The examination board and program committee meet once every month to assess and improve the quality of SBI's examination and educational program. In addition, the program director and coordinator keep a check on course manuals, rubrics, assessment forms and course evaluations of all courses in conformity with FEW faculty practices.

The examination board judges the results of the master's program and determines on a professional and objective basis if a student meets the requirements of the program. Within the examination board, several sub-committees are responsible for a specific program. The SBI sub-committee is responsible for the bachelor and master's program SBI. An assessment committee ('toetscommissie'), authorized by the examination committee, is responsible for the coordination of the assessment policy for all programs offered by the faculty.

#### *Considerations*

The panel found that the program is actively creating and implementing rubrics, templates and assessment forms. The panel would like to further encourage this process, considering that it found that the motivation for a certain grade is currently not always clear and transparent

The assessment of the science and master projects is well-documented and structured. The panel agrees with the current practice that the advice of the internship coach is taken into account when establishing the final grade.

The panel met with a motivated and active examination board, which established confidence in the program's quality assurance regarding assessments. The committee comes together on a regular basis and has recently examined the quality of thesis assessments. The panel commends the exam committee for its internal auditing and encourages the program management to implement the suggestions from the committee.

The panel found a functioning assessment system and exam committee and therefore deems standard 3 to be of a satisfactory level.

#### *Conclusion*

The program meets standard 3.



#### **4.4 Standard 4: Graduation guarantee and financial provisions:**

*The institution guarantees students that they can complete the entire curriculum and makes sufficient financial provisions available.*

##### *Outline of findings*

The Faculty Board of FEW guarantees that students who have enrolled will be enabled to finish the entire two-year program. In the event of termination of the program, students will be able to take exams until one year after the regular duration of the program. This means that students who at the moment of the termination are in their first year will have at least three years to finish the program. In addition, VU guarantees that additional costs incurred by the students, if any, will be reimbursed.

The provided budget and financial scenarios for the upcoming years show that the program expects to have sufficient funds.

##### *Considerations*

According to the panel, there are sufficient guarantees in place to ensure that students are able to obtain their degree.

##### *Conclusion*

The program meets standard 4.

#### **4.5 Standard 5: Achieved learning outcomes**

*The program demonstrates that the intended learning outcomes are achieved.*

##### *Outline of findings*

Realization of the intended learning outcomes is measured in the final (individual) master project, where students design, execute and report on research, and apply the acquired knowledge and skills in the field of SBI in a project setting. The master project comprises an internship in an (external) organization, the formulation of an SBI-related problem, an analysis of this problem, and written and oral reporting of the problem and analysis. A mandatory part of the master project is the writing of a reflection report, consisting of two parts: a business analysis and self-reflection.

Students are monitored and scored on several aspects (work execution during the internship, final report and presentation), which together cover all intended learning outcomes. In the master project's assessment form all competences (and learning outcomes) are related to the assessment criteria. The panel has looked at a selection of fifteen theses, from both the Energy & Sustainability and Life & Health tracks, and reflecting a variety of final grades.

The research and related activities should be in three areas: science (natural science either in the field of Energy & Sustainability or Life & Health), business, and innovation (both social science). The research question(s) and research design must include both natural sciences and business/innovation sciences elements.

Throughout the master project, students are supported by an internship coordinator, who monitors the process of the master project from start to finish, and a course coordinator,

who assures the general, research methodological and design methodological quality of the master project and supports all students in writing their plans of action during the lecture period.

During the internship, three different contacts are involved. A first coach/assessor is the primary contact for the student for all aspects concerning the content of the research assignment. S/he is a lecturer affiliated with SBI and works at one of four associated faculties. The student has to take the initiative for meetings where the progress is discussed on the basis of the plan of action. A second coach/assessor is knowledgeable in a field complementary to that of the first coach/assessor. Both assessors give input to the plan of action, sign the plan for approval, provide input based on the draft of the student's thesis, and assess the final report. Finally, an internship coach guides the student at the internship organization. Input from the internship coach is taken into account when compiling the final assessment.

The graduates of the current tracks Science, Business and Innovation of the master's programs Physics and Chemistry have found an appropriate work environment smoothly and quickly. Alumni work in jobs at well-known companies such as Shell, EY, PwC, Accenture, Nutricia, Fagron and NS, as well as in small enterprises – mainly (high-)tech start-ups, such as Optics11 and Pontes Medical – and national and international NGOs. Within these organizations, graduates are involved in parts of the chain of R&D induced innovation and the adherent processes of research, product- and market development. The nature of the positions held by the alumni is mainly advisory, sales and marketing, project preparatory or coordinating.

#### *Considerations*

The panel read a selection of fifteen theses coming from the predecessors of the SBI program (the SBI tracks within the master's programs Physics and Chemistry). In almost all of the cases, the grading of the panel matched the grades given by the program. However, it also considered one work graded with a 6 insufficient, and another work was deemed to be awarded with too high a grade (but this thesis was considered to be still more than sufficient). The panel points out that all theses were written before the program incorporated a course on methodology in its curriculum. Overall, the panel found multiple theses that were of high quality and very interesting to read.

The panel found some topics to be more complex than others due to the interests of and differences between students, but most of the theses were based on interesting and relevant topics in innovation sciences. Many of the theses discussed a normative aspect of business and science. The panel sees the theses as proof of how the program contributes to society. This normative orientation fits the VU core values 'responsible', 'open' and 'personally engaged'.

The panel's main point of concern is the methodological underpinning of the theses. The choice for the use of certain methodology was not or not adequately reflected upon, and students did not sufficiently elaborate on why a certain method was used. Some theses reported on several theories without explaining why these theories were chosen. Such theses did not result in a clear conceptual framework as a starting point for the research design. Others showed some problems because the research question was not complex enough or too narrow, or because the theoretical framework was too limited. One thesis showed a forced methodology, combining different approaches that are not very compatible.

The panel is of the opinion that there was often only little integration between the science and the business perspectives in the theses. Reflection on the research design and theoretical choices was either not or only partially addressed in most of the theses.

All in all, the panel would like to stress the importance of methodology and research design in the program. The program has already taken steps to address these issues by implementing a methodology course in the program and by implementing the research cycle in other courses. The panel expects that the new course and additional attention paid to research skills will lead to stronger and more explicit research designs and justification, and that the lines of reasoning in theses will improve.

#### *Conclusion*

The program meets standard 5.

#### **4.6 Recommendations**

Based on the findings, the panel formulated the following recommendations:

- Look at possibilities for international benchmarking and cooperation;
- Organize a first meeting of the advisory board soon;
- Incorporate social studies more explicitly in the program;
- Further develop the module and continuous learning line on methodology, including design methodology;
- Research the possibility to add a course on financial skills to the program;
- Incorporate more training on project management and social skills in the program to better prepare students for the internship;
- Further develop assessment tools;
- Safeguard the program's personal touch when more students enroll in the program.

#### **4.7 Two-year duration of the program**

VU University Amsterdam proposes a two-year duration for the master's program Science, Business and Innovation (SBI). The panel was asked to assess this intention, focusing on the question of whether the program demonstrably requires extension of the curriculum to 120 EC and the relevant criteria as specified in NVAO's Protocol for programme extension (October 8<sup>th</sup>, 2003).

The program argues for the two-year curriculum design by pointing out the two-way character of the learning outcomes, each requiring one year of education. Thus, students obtain a thorough theoretical understanding of the natural and social sciences as well as research methods, and apply this knowledge in an empirical setting where valorization takes place. The depth and complexity of the academic disciplines involved, the required integration of the disciplines and the development and execution of academic research in an empirical setting would not fit into a one-year program.

In order to further support the need for a two-year program, VU prepared a benchmark and compared SBI to related programs. SBI's major focus on the conversion of science into technology makes the program fairly unique within the Netherlands. The majority of related Dutch master's programs (including VU's Physics and Chemistry, the predecessors of the proposed SBI program) offer a two-year curriculum. Related one-year programs are mainly

focused on business management and lack a natural science orientation. Internationally, too, two-year programs are prevalent. A one-year program would set SBI graduates apart from their peers and prove to be a disadvantage in meeting the requirements of the (inter)national professional field.

The panel agrees with VU that the intended learning outcomes, focused on integrating scientific aspects in a business and innovation context, cannot be achieved within one year. The interdisciplinary nature and orientation of the program require that students study a broad scope of knowledge in the natural and social sciences as well as research methods, and are enabled to apply this knowledge in order to meet the requirements of the professional field. Moreover, similar programs, both within the Netherlands and abroad, are offered in a two-year curriculum – as are the two master's programs at the basis of SBI. Therefore, the panel advises to grant the program the right to offer a two-year master's program (120 EC).

#### **4.8 Qualification and field of study (CROHO)**

The panel advises to award the degree 'Master of Science' to the master's program Science, Business and Innovation. The panel supports the program's preference for the CROHO field of study 'nature'.

#### **4.9 Conclusion**

The panel has seen an innovative program that meets the demands of society and the professional field. Its interdisciplinary approach is inventive and well thought-out. With a basis in the sciences, as well as courses on business and innovation, students are prepared for the professional field – now and in the future. More attention paid to methodology and social skills would further improve the program. The panel appreciated the program's preparations and sincerity and noticed that the program is continuously striving for improvement. All in all, the panel assesses the quality of the program as positive. Considering the interdisciplinary nature and orientation of the program, combining theory and research methods with application in laboratory and business settings, the panel advises positively about the program's intention to offer a two-year's master's program.

## 5 Overview of the assessments

Standard	Assessment
<p><i>1. Intended Learning outcomes</i> The intended learning outcomes of the program have been concretised with regard to content, level and orientation; they meet international requirements</p>	Meets the standard
<p><i>2. Teaching-learning environment</i> <i>The curriculum, staff and program-specific services and facilities enable incoming students to achieve the intended learning outcomes.</i></p>	Meets the standard
<p><i>3. Assessment</i> The program has an adequate assessment system in place.</p>	Meets the standard
<p><i>4. Graduation guarantee and financial provisions</i> The institution guarantees students that they can complete the entire curriculum and makes sufficient financial provisions available.</p>	Meets the standard
<p><i>5. Achieved learning outcomes</i> The program demonstrates that the intended learning outcomes are achieved.</p>	Meets the standard
<p><b>Conclusion</b></p>	Positive

The panel advises positively about the program's intention to offer a two-year's master's program.

## **Annex 1: Composition of the panel**

### *Prof.dr.ir. O.A.M. Fisscher (chair)*

Olaf Fisscher is Professor emeritus of Organization Studies and Business Ethics at the University of Twente and coordinator of the master's program Quality Management at Schouten & Nelissen University. He holds a master's degree in Industrial Engineering & Management and obtained his PhD in Social Sciences at the University of Groningen, with a dissertation on the management and organization of R&D laboratories. His research is focused on Organizing for Innovation and Organizing for Corporate Social Responsibility. Until recently he was Director Continuing Education at the School of Management & Governance, University of Twente. Since 2012, Mr Fisscher has been a member of the Accreditation Committee of the Dutch Accreditation Council (RvA). This committee consists of members with expertise in the field of accreditations and advises the RvA's Executive Board and Chief Executive about the award of accreditations.

### *Prof.dr. C.P. van Beers*

Cees van Beers is Professor of Innovation Management and head of the section Economics of Technology and Innovation at Delft University of Technology. He obtained his doctorate in economics from the VU University Amsterdam and subsequently worked for the University of Leiden, the Institute for Research on Public Expenditure in The Hague and as associate professor on innovation economics at Delft University of Technology. His research interests are centered on determinants of responsible innovations and entrepreneurship, inclusive business models for frugal innovations and their role in achieving economic development in developing countries (especially Africa), and the impact of government policy failures' on environmental damage and sustainable technology development. Mr van Beers is also one of the co-leaders of the Leiden Delft Erasmus (LDE) Centre for Frugal Innovations in Africa.

### *Prof. T. Hedner, M.D., Ph.D., MBA, EconD*

Thomas Hedner is Professor and chairman of Clinical Pharmacology at Sahlgrenska University Hospital, Gothenburg University. He holds a doctorate in Medicine and a doctorate in Pharmacology from the Faculty of Medicine, Gothenburg University. His present medical research interests are primarily related to cardiovascular clinical pharmacology. In addition, he recently obtained a PhD from Linköping University, with a dissertation in the field of Innovation and Entrepreneurship: 'Change in the Pharmaceutical Industry'. Mr. Hedner is a member of national as well as international general medical associations, and an active board member and founder of several biomedical start-ups.

### *A.J. van Scheepen MSc, B Eng (student member)*

Arie van Scheepen obtained his bachelor's degree in Engineering from HU University of Applied Sciences and recently graduated from the master's program Public Administration and Organization, Utrecht University. He is currently a teacher of Business Engineering at HU University of Applied Sciences, where he is also a member of the Examination Board.

This composition reflects the expertise deemed necessary by NVAO. All panel members signed a statement of independence and confidentiality.

On behalf of the NVAO, Jetse Siebenga, external process coordinator, and Maya de Waal and Anne Martens, NVAO policy advisors and secretaries of the panel, were responsible for the process coordination and the drafting of the experts' report.

## Annex 2: Schedule of the site visit

The panel visit VU University Amsterdam on November 29<sup>th</sup>, 2016 as part of the external assessment procedure regarding the wo-master Science, Business and Innovation.

**09:00 – 09:30 Reception and preparatory panel meeting** (*confidential*)

**09:30 – 10:30 Representatives of the Executive Board, Institute and program management**

- Prof.dr. Nico van Straalen; Interim dean & Education Portfolio Holder in the Faculty Board of the Faculty of Sciences
- Dr.-ing. Thilo Kielmann; Director of Education, Faculty of Sciences
- Prof.dr.ir. Bart Bossink; Professor of SBI; Program Coordinator Master program SBI; Head of Section SBI, Faculty of sciences
- Drs. Marije de Roos; Administrative Coordinator/Study Advisor SBI, Faculty of Sciences, member section SBI
- Drs. Rob de Crom; Education Portfolio Holder in the Faculty Board of the Faculty of Economics and Business
- Prof.dr. Jacquélien van Stekelenburg; Education Portfolio Holder in the Faculty Board of the Faculty of Social Sciences

**10:00 – 11:30 Teaching staff**

- Prof.dr. Peter van der Sijde; Professor of Organization, Entrepreneurship and Technology; Faculty of Social Sciences & Faculty of Sciences; member department of Organization, member section SBI (also coordinator and examiner SBI Research Methodology)
- Dr. Jan Dekker; Associate Professor of Biophysics; Faculty of Sciences, member department of Physics, member section SBI
- Drs. Peter van Hoorn; Science-Business Expert; Senior Lecturer Science-Business in Life Sciences; Faculty of Sciences, member section SBI (also teacher of methodology course)
- Dr. Marlous Blankesteyn; Assistant Professor SBI; Faculty of Sciences, member section SBI
- Prof.dr. Tjard de Cock Buning; Professor of Applied Ethics in Life Sciences; Faculty of Earth and Life Sciences, member Athena Institute
- Prof.dr. Iwan de Esch; Professor of Biocomputational Chemistry for Drug Innovation; Head of Department Chemistry, Faculty of Sciences

**11:00 – 12:30 Representatives of the Examination Board and Program Evaluation Committee**

- Prof.dr. André Ran; General Chair Exam Committee, Professor of Mathematics, Faculty of Sciences
- Dr. Ivo van Stokkum; Chair Sub Exam Committee SBI, Associate professor of Physics, Faculty of Sciences
- Dr. Jan Dekker; Member Sub Exam Committee SBI, Associate professor of Biophysics, Faculty of Sciences
- Dr. Raoul Frese; Chair Education Committee SBI, Assistant Professor of Biophysics, Faculty of Sciences

- Prof.dr. Hans Berends, Member Education Committee SBI, Professor of Innovation and Organization, Faculty of Economics and Business
- Prof.dr. Peter van der Sijde, Member Education Committee SBI, Professor of Organization, Entrepreneurship and Technology, Faculty of Social Sciences and Faculty of Sciences

**12:30 – 13:15 Panel meeting (confidential)**

**13:15 – 13:45 Tour of the facilities**

Visit VU Science-to-Business Spin-offs and/or Lab facilities

13:15 – 13:30 Lumicks

13:30 – 13:45 Optics11

**13:45 – 14:45 Students and alumni**

- Sytze van Stempvoort, master student SBI, holder of bachelor Bèta-gamma (major Chemistry)
- Bram Orsel, almost graduated as master student SBI (Energy & Sustainability track), holder of bachelor SBI diploma, working as Junior Consultant at Van der Meer & Van Tilburg
- Eva Sormani, 2nd year master student SBI (Life & Health track), holder of bachelor Cognitive Neuroscience diploma
- Hannah Feringa, Alumnus Master SBI (Life & Health track), holder of master biomolecular sciences diploma, holder of bachelor Chemistry diploma, PhD candidate in Food Allergy, University Medical Centre Utrecht and TNO.
- Emy Wijker, Alumnus Master SBI (Energy & Sustainability track), holder of International Land and Water Management diploma, working as Junior Consultant for Accenture
- Pirre Dormans, Alumnus Master SBI (Energy & Sustainability track), holder of Future Planet Studies bachelor diploma, working as strategy consultant at EY.

**14:45 – 15:15 Representatives from the professional field**

- Dr. Corjan Visser, Manager Life Sciences and Health Team at PNO Consultants
- Hugo Vitters, operations coordinator, business operations center at Eneco
- Ir. Alex Hercog, Managing Consultant LUX Research
- Michel Simons, Senior Director Marketing Handheld Diagnostics at Philips (via Skype)
- Dipl.Ing. Jan-Peter Doornik, Senior Business Developer at Enexis B.V and Fudura B.V
- Ir. René Savelsberg, CEO SET Ventures (member of the advisory board)

**15:30 – 16:45 Panel meeting (confidential)**

**16:45 Presentation of initial findings**



## Annex 3: Documents reviewed

### *Program documents presented by the institution*

- Information dossier
- Appendices to the information dossier:
  - o Domain specific reference framework
  - o Overview of the program
  - o Course descriptions
  - o Program and Examination Regulations
  - o Overview of core staff involved
  - o CDHO Ruling
  - o Overview of external contacts
  - o Student-staff ratio
  - o Contact hours per year
  - o Advisory Board
  - o Benchmark programs
  - o Intended learning outcomes
  - o Assessment Policy plan
  - o Assessment form master's thesis
  - o Overview of job positions held by graduates
  - o Arguments for a two-year programme
  - o SBI PhD students and PhD projects
  - o SBI Research program
  - o Assessment of macro effectiveness
  - o Letter from the Faculty Board of FEW
- Theses
  - o 1756214
  - o 1773224
  - o 1896563
  - o 1950967
  - o 1990616
  - o 2504327
  - o 2523568
  - o 2524628
  - o 2525345
  - o 2526943
  - o 2541995
  - o 2542068
  - o 2558807
  - o 2559048
  - o 2559271
- Documents made available during the site visit
  - o Assessments and assessment forms
  - o Report from the examination committee on applied grading throughout the program

## **Annex 4: List of abbreviations**

ba	bachelor's program
BKO	Basic Teaching Qualification ('Basis Kwalificatie Onderwijs')
EC	European Credit
EER	Education and Examination Regulations
FEW	Faculty of Sciences
FEWEB	Faculty of Economics and Business Administration
FSW	Faculty of Social Sciences
ma	master's program
NVAO	Accreditation Organisation of the Netherlands and Flanders
SBI	Science, Business and Innovation
VU	VU University Amsterdam
wo	higher education, scientific orientation ('wetenschappelijk onderwijs')

The panel report has been ordered by NVAO for the initial accreditation of the program wo-master Science, Business and Innovation of VU University Amsterdam.

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