FORM FOR MAIN PART OF ASSESSMENT OF SIKS

Year of submission
2021

Years in which accreditations were awarded / assessments took place
1998, 2003, 2009, 2015

Name of research school (English)
The Netherlands Research School for Information and Knowledge Systems

Acronym / abbreviation
SIKS

University acting as administrative university ("penvoerder")
Vrije Universiteit Amsterdam

Contact details of research school
Prof. dr. A.P.J.M. Siebes (UU, scientific director SIKS)
Utrecht University, Faculty of Science
Telephone: 06-41364595
E-mail: A.P.J.M.Siebes@uu.nl

Contact details of SIKS Office
Dr. R.J.C.M. Starmans (UU/TiU, managing director SIKS)
Utrecht University, Buys Ballot Laboratory
Princetonplein 5, 3584 CC Utrecht
Telephone: 06-53160481
E-mail: R.J.C.M.Starmans@uu.nl

Institutes participating in the research school
- Vrije Universiteit Amsterdam (VUA, "administrative university")
- Utrecht University (UU)
- University of Twente (UT)
- University of Amsterdam (UVA)
- Technical University Delft (TUD)
- Eindhoven University of Technology (TU/e)
- Radboud University Nijmegen (RU)
- Maastricht University (UM)
- Tilburg University (TiU)
- Open University of the Netherlands (OU)
- University of Leiden (UL)
- University of Groningen (RUG)
- Centre for Mathematics and Computer Science, Amsterdam (CWI)

Research Evaluation SIKS

12 October 2021

1. **Introduction and Mission**

   SIKS is the Netherlands Research School for Information and Knowledge Systems, founded in 1996 by researchers in the field of Artificial Intelligence, Databases & Information Systems and Software Engineering. It is a self-organized and self-financed network organization and was accredited by KNAW in 1998, 2003 and 2009 and received a positive assessment in the National Review of Computer Science, following the SEP-protocol in 2015. Currently, over 600 IKS-researchers, including 200 PhD-students cooperate in SIKS. Representing the vast majority of IKS researchers in the Netherlands, it provides these researchers with a platform for cooperation, information exchange and dissemination of knowledge. In SIKS these researchers shape a nationwide educational program in a way that cannot easily be achieved by local faculties or graduate schools. At present, SIKS brings together 55 research groups from 12 universities in the Netherlands and from CWI (Centre for Mathematics and Computer Science), headed by over 50 full professors. In the period 2015-2020 no less than 236 SIKS PhD-students have successfully defended their theses and published their work in the SIKS dissertation Series, which started in 1998 and counts over 700 titles today.

   SIKS-PhD-students typically have different backgrounds and have been educated in diverse disciplines, varying from mainstream computer science and artificial intelligence to information science, business administration, the social sciences and the humanities (predominantly computational linguistics or natural language processing). This diversity and broad orientation are reflected in the faculties and research groups participating in SIKS and are also mirrored in the research foci that SIKS has established for the next period, as will be explained in Section 2. The key distinguishing characteristic compared to ASCI[1] and IPA[2] (the two other research schools in the area of computer science) is that SIKS research not solely refers to computing machinery and technology, but inherently includes their use by and interaction with humans, social groups and organizations. This orientation on the human condition and social embedding gives SIKS a distinct and well-recognized place in computer science and the aforementioned adjacent disciplines.

   The mission of SIKS is to organize a high-quality educational program for PhD students, using its nationwide network of research fellows, performing high-level fundamental and applied research in the IKS-field. In addition, SIKS stimulates and facilitates cooperation and communication between its members and alumni, as well as stakeholders interested in IKS research, such as other academic bodies or groups, leading companies in business and industry, research funding agencies and governmental organizations. As a KNAW-accredited network organization and as a founding member of IPN[3], SIKS tries to influence the national research policy in the interest of the community of SIKS researchers.

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[1] Advanced School for Computing and Imaging http://www.asci.tudelft.nl/
[2] Institute for Programming research and Algorithmics http://www.win.tue.nl/ipa/
[3] Informatics Platform Netherlands http://www.ictonderzoek.net/

2. **Research context**

SIKS currently concentrates on ten important focus areas in the IKS field, some of which have natural partial overlap. These focus areas have been established by senior research fellows of SIKS in a process of intensive and iterative consultations. The advisory board can help the scientific and managing directors in finding the most suitable researchers for coordinating a course, seminar or conference in that area. A program committee monitors the evolution of the IKS research field through the years and may propose to create new focus areas or discontinue existing ones. The research foci for the upcoming period of six years are as follows:

1. Knowledge Representation and Reasoning
2. Machine Learning
3. Human Centered Artificial Intelligence
4. Multi Agent Systems
5. Natural Language Processing
6. Human Machine Interaction
7. Data Science
8. Data management, Storage and Retrieval
9. Process mining / Business Process Management
10. Information Systems

The list of research foci is periodically reviewed and revised to adequately reflect the current state of the IKS research activities in the Netherlands. During the last review in the summer of 2021 research foci 3 and 7 were added. Human Centered AI includes such research themes as Explainable AI, Responsible AI, Trustworthiness, Social AI. Data science in SIKS focuses on such issues as data acquisition, cleaning, integration, modeling, use and reuse, publishing, and preservation of data in automated manners as well as for large-scale and robust systems. Special attention is paid to the interaction with humans in their roles in processing the data in designing, developing, and using the data processing systems, as well as in their roles to meaningfully and responsibly interpret the insights and decision support provided by the system.

Typically, all elements of the SIKS Activity Program, including courses, master classes, summer schools, seminars or conferences are related to these research foci. Also, all research groups that are member of SIKS fit nicely into one or two of these focus areas. As a result of this clustering the backbone of the educational plan becomes apparent: in the next section it will be outlined how these themes are reflected in the activity program of SIKS.

An important aspect of the SIKS Research Context concerns cooperation. SIKS has strong ties with national and international organizations and programs in the IKS area and in neighboring fields. To exemplify this: SIKS cooperates with the Benelux Association for Artificial Intelligence (BNVKI) since 1998, among other things by co-organizing the yearly Benelux Artificial Intelligence Conference (BNAIC). SIKS has a comparable long running cooperation with / participates in the Belgium Netherlands Conference on Machine Learning

(BENELEARN), the Dutch-Belgian DataBase Day (DBDBD), the Dutch-Belgian Information Retrieval Workshop (DIR), and Computational Linguistics in the Netherlands (CLIN). In addition, SIKS also has a successful cooperation with NIRICT through joint organization of the NIRICT-SIKS spring school on Human Computer Interaction. Furthermore, SIKS is associated with the NWO program on Language in Interaction, it contributes to the "ICT with Industry" workshop(s) at the Lorentz Center and organizes yearly a track in the national ICT.OPEN conference. Due to the cooperation with the aforementioned organizations SIKS members can participate for free in conferences like DBDBD, BENELEARN, DIR and CLIN. Since 2005 SIKS also cooperates with the edition of the top conferences that have been organized in the Netherlands, such as EASSS, SIGIR, CAiSE, and IJCAI, allowing the SIKS PhD-students to participate in tutorial programs, workshops, or doctoral consortia for free. The Scientific Director of SIKS, Prof. dr. A.P.J.M. Siebes represents SIKS in several national organizations and maintains regular and good contacts with other relevant research schools.

Finally, internal communication and cooperation is stimulated by organizing annual SIKS-days (traditionally in Utrecht) or SIKS meetings at ICT Open and, even importantly, by inviting all members at the (educational) activities. On average SIKS (co-) organizes or (co-) finances around 20 activities per year that are primarily aimed at PhD students, but by inviting (senior) research-fellows and frequently alumni, SIKS aims at bringing together the senior staff to foster networking and research collaboration.

3. **Educational Program**

Aim of the program
The main aim of the SIKS Educational Program is to offer PhD students a nation-wide teaching program in the field of Information and Knowledge Systems during the course of their PhD study, that will provide them with broad basic knowledge as well as specialized, advanced training. SIKS-alumni will be high-quality researchers, possessing a thorough knowledge of the School's field of research, and specialized in the subject of their dissertation. They will be able to carry out fundamental research as well as put their knowledge to practical use. As a result, SIKS-alumni can be expected to enter the labor market in a favorable position, whether they continue their career in academic research, industrial research or consultancy.

To obtain these objectives SIKS shapes a four-year program by (co-)organizing and (co-) financing such divergent activities as courses, master classes, seminars, research colloquia, doctoral consortia and lectures/tutorials given by visiting professors from abroad or senior staff members. For the most part SIKS realizes these training activities by utilizing its nation-wide expertise. According to the activity program, that was established in 2016 all courses developed by SIKS itself have a twofold aim:
1. to provide the PhD-student with a basic methodological training and to supplement the Masters courses the PhD-student has followed;
2. to bring the PhD-student into contact with the international forefront of research topics, addressed by the student in his PhD-project.

As of 2016 SIKS organizes its course program along two dimensions:

1. Courses with a broad focus versus courses on a more specialized topic. Courses with a broad scope are typically aimed at the entire population of over 200 SIKS-PhD-students; courses with a narrow focus may be aimed at a small niche.
2. Courses that are offered on a regular basis with a fixed periodicity versus courses which are organized depending on new trends in the field, identified by the SIKS Program Committee, or upon request. In fact they could be organized only once, or evolve into a regular course.

The following list with courses is not complete but gives an impression how these ideas were implemented in SIKS-courses. More details are available on www.siks.nl

Research methods and methodology for IKS (2 ECTS)
This course is required for all students and is organized each year. It fills in the gap left by the lack of attention to research methods for IKS in current Dutch (and foreign) Master curricula. It is not a general research methods course, but tackles methodological issues specifically in the context of computer science and information systems development and more in general the engineering of information and knowledge systems. It is a broad course that covers such divergent topics as research planning, problem analysis, case studies as a research design, empirical validation techniques and qualitative research, but also research methods in machine learning, information retrieval, process mining and multi-agent systems, or foundational topics such as philosophy of data science.
Course directors: Dr. H. Weigand (TiU), Prof.dr. R.J. Wieringa (UT), Prof.dr. J.M. Akkermans (VUA), Dr. R.J.C.M. Starmans (UU, TiU)

Learning and reasoning (1 ECTS)
Mix of symbolic and subsymbolic techniques from an AI perspective by consistent application of the "learning and reasoning" metaphor: Probabilistic reasoning / Introduction Bayesian networks, introduction machine learning, reinforcement learning, learning and reasoning for information access, qualitative reasoning, argumentation systems, model based reasoning.
Course directors: Prof. Dr. A. Ten Teije (VUA), Prof. dr. F. van Harmelen (VUA), Dr. P. Groot (RU)

Trends and topics in multi agent systems (1 ECTS)
For the main part based on symbolic AI. Introduction multi-agent systems: agent logics, agent theories, agent architectures, agent programming, norms/ institutions/deontic logic, planning, coordination, conflict resolution in MAS, negotiation, mechanism design and auctions.
Course directors: Prof. dr. C. Jonker (TUD), Prof. dr. K.V. Hindriks (VUA), Prof. dr. M. M. Dastani (UU).

Advanced data science; Mathematical methods (1 ECTS)
Foundations of deep learning, Information theory, probability, Bayesian learming, statistical techniques for IKS.
Course directors: Prof.dr. E.O. Postma (TiU), Prof. dr. T. Heskes (RU), Prof.dr. A. van den Bosch (Meertens Instituut, UVA)

Advances in Information retrieval (1 ECTS)
Capita Selecta IR (formalisms, models), probabilistic models for IR, multi-media retrieval, empirical methods for IR, multi-media retrieval, XML retrieval, web mining en web retrieval, automatic query improvement.
Course directors: Prof. dr. D. Hiemstra (RU), prof. dr. A. de Vries (RU), Dr. S. Verberne (UL)

Foundations of Data Science: data mining (1 ECTS)
This course covers both fundamental techniques from data mining, knowledge discovery in databases and machine learning and a wide variety of recent application areas; varying from deep learning, text mining and active learning/ stream mining to causal inference and sport analytics.
Course directors: Dr. A. Feelders (UU), Prof.dr. A.P.J.M. Siebes (UU)

Explainable AI (1 ECTS)
In politics, industry and science, much attention is paid today to the ethical and social aspects of AI, the risks of big data and the increasing power of incomprehensible and opaque algorithms, which are seemingly objective, "value-free" and neutral, but which make radical decisions without human intervention, that may deeply influence people and their future. The call for Explainable AI therefore sounds louder all the time. Many researchers who participate in SIKS are directly or indirectly involved in this issue, often in various ways and from different perspectives. All this makes a solid place of Explainable AI in the SIKS Activity Program imperative.
Course directors: Prof. dr. R. Verbrugge (RUG), dr. A. Alishahi (TiU)

Social AI (1 ECTS)
Social AI includes, among others, social robots, virtual humans and conversational agents. From a technical perspective, social AI aims to develop new algorithms to endow social AI systems with more human-like abilities to understand and generate social behavior (e.g., using techniques such as emotion recognition and natural language processing). From a social psychology perspective, social AI studies the psychological effects of interacting with social AI systems on people's perceptions and behavior. From an applied perspective, social AI systems can be used for various practical purposes such as social skills training and behavior change.
Course directors: Prof. dr. K.V. Hindriks (VUA), Prof. dr. T. Bosse (RU)

SIKS demands an active participation from all PhD-students that have entered the school. Especially courses related to the focus area on which a PhD-students works are strongly recommended to the researchers involved. Upon request certificates are provided. For an annual fee of EUR 630,- each SIKS-Phd-student has full access to all elements of the program.

With respect to courses organized by SIKS in a conference center, this includes an in-house stay with single rooms for each student, all meals and course material for free. SIKS deliberately takes these considerable financial and managerial efforts to strengthen the social aspect of doing PhD-research and building up a research community.

The final responsibility for each graduation remains with the university where the defense takes place. SIKS has its own policy with respect to quality control. The scientific director of SIKS is responsible for the overall scientific quality of the teaching program. The managing director is responsible for the organization of the program. Each student entering the school must provide SIKS with a detailed supervision and teaching program. In addition, SIKS demands the promotor or at least the co-promotor and daily supervisor to be senior research fellows of SIKS. Furthermore, SIKS expects a so-called co-supervisor or independent SIKS-member to be added to the reading committee.

Relation between SIKS and local graduate schools
An important issue concerns the current and future relation between SIKS as a federative research school and the local graduate schools. Currently, the relationship between the local graduate schools and federative research schools are clear and the mutual tasks seem well defined. Training on topics of the research field (IKS in the case of SIKS) is organized by the research schools. Training of general skills such as Scientific Writing, Presentation, and Research Integrity, is organized by the participating university itself. The programs of the research schools should be arranged so that the activities fit within the training and supervision plan used by the universities themselves. An important point is that graduate schools in the Netherlands vary considerably. Sometimes there is more than one graduate school per faculty, sometimes there is one graduate school for the entire university. Many SIKS PhD-students are only formally registered at a graduate school. This has not led to any conflict between research schools and graduate schools. Some universities do permit their PhD students to take regular local master courses as part of their training, whereas at other universities this is explicitly prohibited. Especially by organizing activities at a level higher than that of master courses and by making use of the nationwide expertise within a school, a research school like SIKS can demonstrate its value.
As stated before, the final quality control of the individual PhD student lies with the universities (or the graduate schools), as it has always been the case. SIKS ensures that the school is adequately represented in the promotion committees. PhD students from SIKS publish their theses in the SIKS dissertation thesis series, that started in 1998.

Relation with ASCI and IPA
In previous years SIKS, IPA and ASCI have also considered their mutual relation and the question whether reprofiling or harmonizing the mutual programs was necessary.
It was then established that there is no reason for reprofiling or harmonization of the mutual programs. There appears to be little overlap between the schools, though of course there are always issues at the interface. SIKS courses are regularly attended by students from the humanities and social sciences and other schools (including BETA, ERIM, TRAIL) but attendance by PhD students from ASCI and IPA is limited. Currently, we do not have figures

about SIKS PhD students attending courses of other research schools. We do know that SIKS students rarely have co-supervisors who are members of ASCI and IPA.

There are no real organizational or financial barriers for students to participate in courses from other schools. Courses organized by SIKS in a conference center (including all meals and overnight stay in a single room) are more expensive than activities organized on campus (as is done more often by other schools). But there are no financial barriers for attending SIKS courses, as we have a standard financial arrangement for such cases. As indicated above, SIKS primarily aims at PhD-students. They are registered and pay an annual fee. However, external visitors are never excluded, and this obviously applies to master students as well. Until now, master students have only rarely attended SIKS courses. One reason for this is that many courses demand a level of maturity that is beyond the level and capabilities of a typical master student. Another reason concerns the format of the SIKS courses and the requirements for examination or graduation.

4. **Career Prospects for SIKS- alumni**

   Without exaggeration it can be stated that unemployment amongst SIKS-alumni is virtually non-existent; and this situation prevails for many years now. Many of our graduates have already accepted a new position long before the public defense of their thesis. Especially in the fields of data science and AI the demand for researchers with a PhD is high. Where possible SIKS monitors their career moves, for instance via LinkedIn. It appears that about 20% of our students re-enter the School, but now as a research fellow and many become lecturers and even course directors in SIKS educational program themselves. In fact, these former PhD-students often appear to be the best ambassadors of the program. Many of the alumni who continue their career outside academia stay connected with SIKS for example via the SIKS-community on LinkedIn.

5. **Quantitative data**

   This section gives a small update in addition to the data we already mentioned in Section 1. On December 21, 2020 420 research fellows and 2010 PhD-students were registered at SIKS. The 236 PhD-defenses that took place in the period 2015-2020 were divided over the years as follows:
   - 2015: 35 defenses
   - 2016: 50 defenses
   - 2017: 48 defenses
   - 2018: 30 defenses
   - 2019: 38 defenses
   - 2020: 35 defenses

   The past period showed that on average 20-25 percent of the researchers are female. More details on the PhD-theses are provided in Appendix A.

6. **Measures taken in response to criticism made at the previous accreditation**

   At the time of the previous accreditation SIKS was "encouraged to communicate more closely with the corresponding supervision teams at university research institutes and graduate schools, before, during and after attendance at the school, to have a full picture of a student's progress and what impact SIKS is having on the student". SIKS did this among other things by organizing regular meetings with the aforementioned groups. SIKS has also continued to adapt the program to changing demands in the environment, including those of the local graduate schools and research schools within computer science and adjacent areas. In Section 3 we have outlined the current relations with both the graduate schools and federative research schools and shown that the demarcations are clear.

7. **Organization and Management**

   The main organizational change in SIKS during the current accreditation period concerns the appointment of a new Scientific Director. On 1 September 2017 Prof. dr. A.P.J.M. Siebes was appointed by the SIKS Board of Governors as Scientific Director of SIKS. He took over this position from Prof. dr. P. De Bra (TU/e), who was Scientific Director from 1 September 2011 until 1 September 2017. In May 2021 Prof. dr. K.V. Hindriks from the Vrije Universiteit Amsterdam became chairman of the Board. He took over the position from Prof.dr. G. Schreiber (VUA), who was chairman of the Board from 1 February 2015 until 1 May 2021.

8. **Financial Resources**

   SIKS is entirely self-financed. The annual budget depends on the number of research fellows and PhD-students entering the school and varies between EUR 175.000 and 200.000 yearly. Throughout the years SIKS has obtained a sound financial position and has built up a financial reserve of about EUR 200.000. The SIKS expenses consist for the main part of the costs for running the SIKS office and organizing the activity program. To cater for eventual financial fluctuations that characterize the current Dutch academic situation, the board of governors has decided to keep a financial reserve of about EUR 200.000, about the size of the average yearly budget.

9. **Future Plans**

   In the upcoming period SIKS will endeavor to further strengthen its distinct and well-recognized place in the area of computer science and the aforementioned adjacent disciplines, such as social science, humanities and business administration. This diversity and broad orientation are already reflected in the research foci that SIKS has established for the next period of six years, but will lead to adjustments in the educational program of 2022 as well. SIKS already gave shape to the newly established focus "Human-centered AI" by organizing a two-day course on "Explainable AI" in September 2021. A new course on "Social AI" is scheduled for 2022. The new program is now under development.

   SIKS educational program has gained an international character, particularly because SIKS-research fellows increasingly come from foreign countries. This has also been achieved by inviting top speakers from abroad at courses and by arranging a free admission of SIKS PhD-students to accredited international summer schools, or to tutorial programs and doctoral consortia of international conferences. In addition to this SIKS has recently successfully

organized online courses and tutorials, which makes it easier to engage speakers from abroad in an efficient manner.