UPDATE SECTOR ANALYSIS 2025

STRUCTURAL ADVANCEMENTS IN DUTCH IT & COMPUTER SCIENCES

SHOWING THE GROWTH IN IT & COMPUTER SCIENCES EDUCATION AND LABOUR FORCE IN RELATION TO STRUCTURAL INVESTMENTS IN THIS FIELD (BY MEANS OF THE SECTOR PLANS)
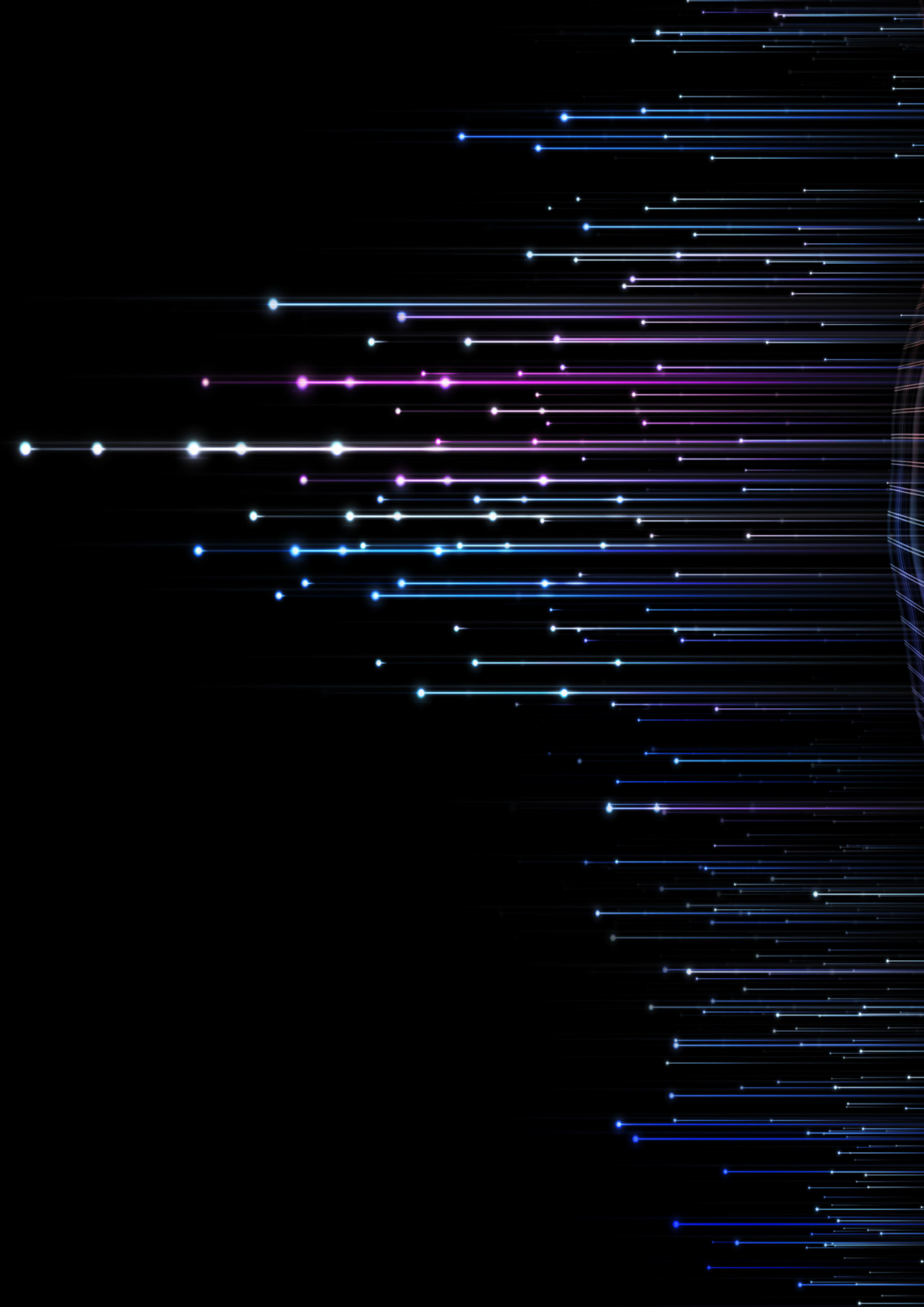
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MANAGEMENT SUMMARY

IPN (ICT Research Platform Netherlands) has commissioned an update of the Sector Analysis for the Dutch Computer Sciences[1] in February 2025. This update provides an interim assessment of the progress made since the implementation of the Sector Plans in 2019 and 2022 and relate these to developments at the European level. This document gives an overview of four aspects of the Sector Analysis: new study programmes[2]; the number of students in IT study programmes and the number of graduates[3]; the student/staff ratio[4] and developments in the labour market and society[5].

The results of this interim assessment demonstrate significant progress since the start of the first Sector Plan[6] in 2019:

1. Students can enrol in more academic IT programmes. Per March 2025 students can enrol in 29 Bachelor's and 48 Master's IT and Computer Science related pro-grammes (in 2023 students could enrol in 27 Bachelor's and 45 Master's IT and Computer Science related programmes).

2. The number of enrolled academic students has grown from almost 15,000 (in 2019) to more than 21,000 (per September 2024). This population has become more diverse. The share of female students has grown from approximately 3,500 (20%) to 5,000 (24%).

3. More students have graduated (Bachelor's & Master's) yearly and entered the IT workforce: from approximately 3,000 graduates in 2019 to 5,200 in 2024. This growth is accompanied by greater diversity. The share of female graduates rose from approximately 580 (19%) to 1,300 (25%).

4. The share of the IT-workforce in Dutch labour has grown: from 5.3% in 2019 to 6.9% in 2023. The efforts of the universities and their students have resulted in that the share of academic graduates in the total group of the IT workforce has grown from 32% in 2019 to 35% in 2023.

5. Universities have been able to invest in permanent staff, from 500 FTE in 2019 to more than 780 FTE in 2024. In this group the share of female staff has grown from approximately 100 FTE (20%) in 2019 to 220 FTE (28%) in 2024. This growth has led to a slightly better student/staff ratio: from 31.3 to 28.1 students per FTE.

6. The European Union shows, in her Eurostat data, a growth in the number of jobs in ICT from an estimate of 7180K FTE in 2017 to an estimated 9789K FTE in 2023. This is a growth of 36% in those six years. This is below the growth in the Dutch ICT sector (56%), which could suggest that the Sector Plans have had a positive effect on the labour market developments.

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1   Sector Portrait Dutch Computer Sciences: Foundation under the digital society
2   Appendix 5 in the Sector Portrait Dutch Computer Sciences
3   Appendix 4a in the Sector Portrait Dutch Computer Sciences
4   Appendix 4b in the Sector Portrait Dutch Computer Sciences
5   Appendix 4b in the Sector Portrait Dutch Computer Sciences
6   Sectorplan Bèta en techniek

Informatics research plays a crucial role in addressing the societal and scientific challenges posed by digitization and digital transformation

Even though a clear causal relationship between these positive developments and the Sector Plans cannot be proven with the current analyses, it is highly likely that without the annual investment of €20 million from the Sector Plans, the universities would not have been able to hire permanent staff and start new programmes, leading to more students enrolling and graduating.

These results stress the importance of the initiative of IPN to aim for a European Sector Plan for IT & Computer Science which is driven by two key factors: the pressing shortage of IT personnel and the increasing urgency of EU digital sovereignty and competitiveness globally.

INTRODUCTION

The EU faces a major shortage of well-trained and qualified IT personnel for current and future work[7]. With a target of 20 million IT professionals by 2030[8], a boost in higher education is needed to ensure that this target can be met. In recent years, structural investments have been made by the Dutch government in academic education and research as part of their efforts to tackle the current and future shortage of IT personnel (next to other efforts to upskill, reskill and re-educate professionals). This was done through the Sector Plans and Sector Analyses. The Sector Analysis Dutch Computer Sciences[9] was developed by IPN (ICT Research Platform Netherlands). The Sector Plans were a joined effort by the Ministry of Education, Culture and Science, IPN and the institutions. With these Sector Plans, the Dutch government has shown commitment to a healthy and strong system of higher education and research, with an increasing outflow of IT professionals as one of the objectives.

Over the past period, IPN, with the support of Top Sector ICT, has been committed to propose a European Sector Plan for IT & Computer Science. This initiative is driven by two key factors: the pressing shortage of IT personnel and the increasing urgency of EU digital sovereignty and competitiveness in global politics. Discussions with various stakeholders have shown sufficient support for a European Sector Plan. As a next step, this document highlights the impact of the Sector Plans by updating the first results and linking these to developments in the Dutch and European labour market and politics.

To this end, the following sections of the Dutch sector analysis have been updated in this document[10]:

1. new IT and Computer Science related Bachelor's and Master's programmes;
2. student numbers September 2024 per institution;
3. staff size and student-staff ratio as of 1 January 2025;
4. developments in the labour market and society.

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7   European Labour Authority, report on labour shortages and surpluses 2023
8   2030 Digital Decade, report on the state of the digital decade 2023 by European Commission
9   Sector Portrait Dutch Computer Sciences: Foundation under the digital society
10 The sector analysis was the first step in the process of a sector plan. The main ingredients of a sector analysis are an overview of the academic education programmes and research institutes involved, including their key indicators (number of students, number of scientific staff, gender aspects, research output, focus areas), as well as their societal impact.

Background: the Dutch Science and Technology Sector Plans 2019 and 2023

In 2019 and 2023, the Dutch parliament decided to structurally invest (> €200 mln) in academic education and research via national Sector Plans which were based on Sector Analyses made by the sector themselves . The Sector Plans aim to increase the quality of higher education and science. The plans were coordinated by the scientific sectors across all research universities.

Within the IT & Computer Science sector, the collective efforts by the institutions involved, have resulted in increased research collaborations, strengthened cooperation between higher education institutes, has ensured sharp choices in the specialization of individual institutes and has given a boost to the quality of higher education and research. Other issues have also been addressed, such as the gender imbalance, outreach to prospective students and the acute shortage of IT & Computer science teachers. In this document, the effects of the two plans are not separately indicated since both plans aim at the same results.

1. NEW COURSES SINCE 2023[11]

Since 2023, a few universities have introduced new courses and programmes in the IT domain. In total, six new programmes have been launched; three Bachelor's and three Master's programmes. One of the existing Bachelor's programmes has been discontinued. Per March 2025, students can choose from 29 Bachelor's and 48 Master's IT and Computer Science related programmes at university level in the Netherlands.

The top 3 programmes with the most students in the academic year 2024-2025 are:
- Bachelor Technische Informatica at Technische Universiteit Delft
- Bachelor Technische Informatica at Technische Universiteit Eindhoven
- Bachelor Computer Science at Vrije Universiteit Amsterdam

The following table showcases all mutations in courses since 2023[12]:

Level	Name programme	University	CROHO	Offered since
Bachelor	Data science and Artificial Intelligence	Leiden University	50300	2022-2023
Bachelor	Computer Science	Maastricht University	50426	2024-2025
Master	Quantum information science and technology	TU Delft	65029	2024-2025
Master	Computer and Embedded-Systems Engineering	TU Delft	60988	2023-2024
Master	Data Science and Artificial Intelligence Technology	TU Delft	60992	2024-2025
Bachelor	Quantum computer science	Universiteit van Amsterdam	60274	2024-2025

Level	Name programme	University	CROHO	Ended in
Bachelor	Information Sciences	Vrije Universiteit	56869	2023

The introduction of these new programmes indicate that universities are able to offer new programmes as their staff has increased. Additionally it demonstrates their commitment to developing programmes in cutting-edge fields, such as quantum computer science, ensuring that the latest technological advancements are incorporated and reflected in Dutch academic education.

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11 Appendix 5 in Sector Analysis Dutch Computer Sciences.
12 Among the newly introduced programmes, four use CROHO codes that were not previously in use. These codes are: 60275, 65029, 60988, 60992. The new codes have been incorporated into the dataset. The discontinued program is the Bachelor's in Information Sciences at Vrije Universiteit (CROHO: 56869). As this was the only program under this CROHO code, it will no longer be included in the dataset.

2. STUDENT NUMBERS AS OF SEPTEMBER 2024

APPROACH TO DETERMINING STUDENT NUMBERS AS OF SEPTEMBER 2024[13]
The open education data of the Education Executive Agency (DUO) was used to compile the tables of student numbers. The following were used:
- the file Students WO 2019-2023[14]
- the file Students WO 2020-2024
- graduates WO

The source files of DUO are living databases. The tables have been updated based on the most recently published source files. The nominal extent of the differences between the Sector Analysis Dutch Computer Sciences and this update is limited.

The updated tables do not include data from Wageningen University and the Open University as both universities offer computer science related courses within various programmes that are not only focused on computer science or can be unambiguously linked to the selected CROHO codes[15].

STUDENT AND GRADUATE NUMBERS AS OF SEPTEMBER 2024
The tables below show the total student population within the selected CROHO codes over the period September 2019 to September 2024[16].

Students	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025
Bachelor	9217	10621	11308	12135	12723	12943
% women	19%	20%	21%	21%	22%	23%
Master	5610	6567	7303	7656	7880	8156
% women	21%	22%	23%	23%	25%	25%
Total	14827	17188	18611	19791	20604	21099
% women	20%	21%	21%	22%	23%	24%

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13 Appendix 4a in the Sector Portrait Dutch Computer Sciences
14 File is available on request as it is no longer accessible through DUO
15 CROHO stands for 'Centraal Register Opleidingen Hoger Onderwijs'. A CROHO code refers to the registration code assigned to higher education programmes within the central register of higher education study programmes.
16 DUO publishes data over the last 5 years. For the 2019-2020 data was used from the most recent database available with these years. This is the document 'students WO 2019-2023'. For all other years the document 'students WO 2020-2024' was used.
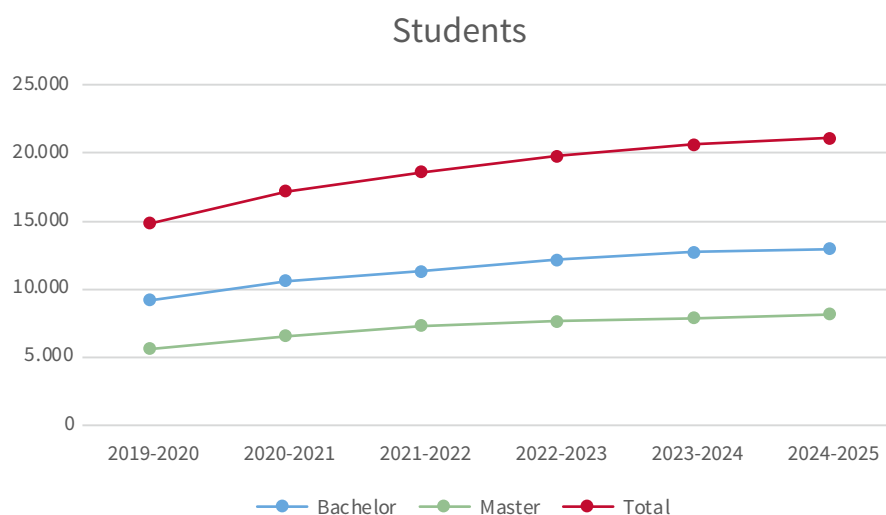
Students

These numbers highlight a substantial growth since the introduction of the Sector Plans. From 2019 to 2024, the total number of students in the field has increased by 42%, demonstrating a steady expansion in IT and Computer Science students. At the same time, the share of female students has also shown consistent growth from approximately 3,500 (19%) to 5,000 (24%).

Students	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025
Number of women (bachelor)	2124	2339	2597	2795	2944
Number of women (master)	1464	1646	1789	1931	2058
Total number of women	3588	3986	4386	4726	5002

An even more notable increase is found in the number of graduates with a bachelor and/or master diploma. Since 2019, the total number of yearly graduated students has grown by 58% in 2024, indicating a significant rise in the number of graduates entering the IT sector.

Graduates	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
Bachelor	1405	1688	1898	2231	2411
% women	18%	20%	22%	22%	23%
Master	1605	2082	2117	2495	2750
% women	21%	26%	24%	26%	26%
Total	3010	3770	4015	4726	5162
% women	19%	23%	23%	24%	25%
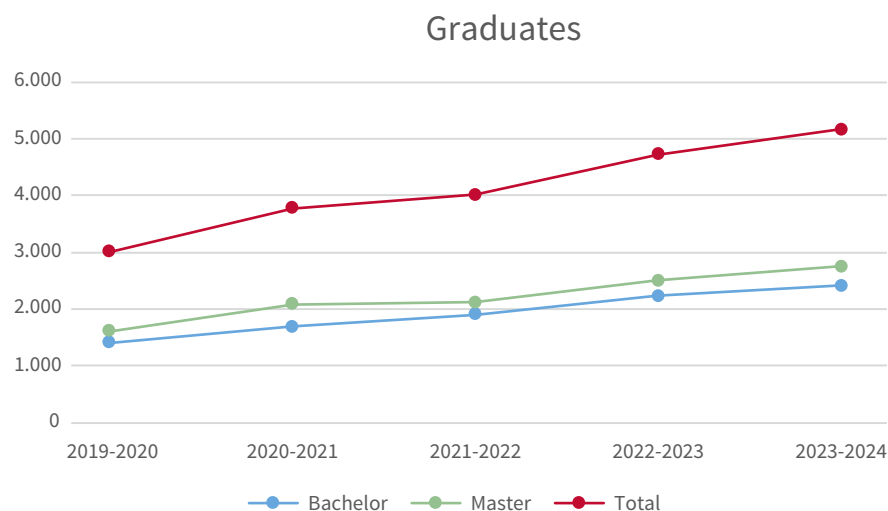
Graduates

The share of female graduates has also risen, the share of female graduates rose from 19% (approximately 580) to 25% (approximately 1,300) in 2024.

Graduates	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
Number of women (bachelor)	249	343	410	487	545
Number of women (master)	330	531	518	643	726
Total number of women	580	875	927	1131	1271

Given that a high percentage of graduates secure employment shortly after completing their studies, the growth in IT-students and graduates translates directly into an increased influx of professionals into the field (see paragraph 4).

3. STAFF SIZE AND STUDENT-STAFF RATIO AS OF 1 JANUARY 2025[17]

Through the funding from the Sector Plans the universities have been able to invest in permanent staff. This has contributed to a 52% increase in staff (from 500 FTE in 2019 to more than 780 FTE in 2024). For an overview of growth per university, see the table below. The research staff of the CWI (Center for Mathematics and Informatics) has not been included in this document as CWI was not part of the Sector Analysis. CWI is however part of the academic computer science community and had 26 FTE research staff in 2024 in Informatics.

The share of female staff has also increased from approx. 100 FTE (20%) in 2019 to 220 FTE (28%) in 2024.

Institution	Staff growth since 2019
Radboud University	83%
University of Groningen	56%
TU Delft	56%
TU Eindhoven	36%
Twente University	67%
Leiden University	44%
Maastricht University	55%
Utrecht University	53%
University of Amsterdam	69%
Free University Amsterdam	16%
Tilburg University	32%
Average	52%

One of the goals of investment in staff was to improve the student-staff ratio. The most recent Dutch national benchmark for the student-staff ratio across all universities and programmes dates from 2023 and is 17.5. This means that, on average, for every 17.5[18] students, 1 FTE of scientific staff should be employed. For all IT-programmes included in this report, the student-staff ratio in 2024 was 28.1 which is lower than the ratio of 31.3 reported in the original sector analysis. Although staff numbers have grown significantly since 2019, the student-staff ratio remains well above the Dutch average. This highlights two key points: the high demand for IT study programmes by students, which slows the reduction of the ratio, and the ongoing need for investment to further improve this ratio.

17 Appendix 4b in Sector Analysis Dutch Computer Sciences.
18 UNL: Studentengroei en student/staf ratio 2014 - 2023

Other topics in Sector Plans: Profiling, outreach and secondary education teaching

In the first Sector Plan of 2019, the Dutch universities identified the following seven themes as focus areas for the strengthening of the academic fundamental research: Data modelling and analysis, Machine learning, Machine reasoning and interaction, Algorithms, Software, Security and privacy & Computer networks and embedded systems

Universities agreed to select four of these themes, and restrict the local implementation of the sector plan to these themes. The choices made in 2019 were kept identical in 2023 with the second sector plan. The new academic positions funded by the Sector Plans have been filled according to the four themes selected by each university. However, this restriction did not apply to other new positions. Consequently, the Sector Plans have resulted in some profiling amongst the universities but the process is still in an early stage.

In the first sector plan of 2019, attention was paid to outreach as well as secondary education teachers (without finances being allotted). In the second sector plan there was no follow-up on these topics. The universities have therefore concentrated their efforts on their primary responsibilities, rather than also reaching out to secondary education.

4. DEVELOPMENTS IN THE LABOUR MARKET AND SOCIETY[19]

The urgency for IT & computer science research, innovation, and a highly skilled workforce in this field has only increased since the start of the Dutch Sector Plans. IT & Computer Science research and education play a vital role in addressing economic, societal and political challenges while also shaping opportunities that emerge for a secure, prosperous and sustainable future.

EU COMPETITIVENESS AND DIGITAL SOVEREIGNTY

A key challenge for the EU is maintaining digital sovereignty and competitiveness. Currently, the EU struggles to keep pace with major digital economies like India, the United States and China. European governments and institutions remain highly dependent on the digital infrastructure of non-European 'big tech' companies. This dependence threatens not just economic stability but also public values, cybersecurity, and strategic autonomy. A unified EU is essential to achieving the necessary scale for global competitiveness and securing long-term welfare and stability.

The Digital Intelligence Index classifies most European economies as 'stall out economies' - economies that enjoy a high state of digital advancement while exhibiting slowing momentum. Only a few European economies are categorised as 'stand out economies' - economies that are both digitally advanced and exhibit high momentum. Similarly, the Global Ranking of Academic Subjects of 2023 places only four EU universities and institutes in the top 100 of the ranking of the Computer Science & Engineering discipline. Compared to other fields such as physics or mathematics (respectively 33 and 27 European institutes in the top 100), the European IT & Computer science field is lagging (far) behind.

The recent report by Mario Draghi[20] also stressed the lagging behind of the EU in innovation and in the digital revolution specifically. These gaps highlight the need for stronger investment in research and education. Higher education and research in the EU could also be strengthened by better organization and collaboration, which is highlighted as well in the 2024 report by Enrico Letta[21].

LABOUR MARKET

Another key challenge for the EU is addressing human capital challenges. All industries and professions are feeling the impact of ongoing digitalization. Over the past decade, rapid advancements in IT have transformed society to a point where

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19 Appendix 2 in Sector Analysis Dutch Computer Sciences.
20 The future of European competitiveness, Mario Draghi, September 2024.
21 Much more than a market, Enrico Letta, April 2024.

large parts of society can no longer function if digital systems fail. As complexity grows, specialized expertise is required to prevent system failures and maintain security.

Technical innovations in areas such as software engineering, AI, and quantum computing are rooted in academic research. These fast-moving social and digital advancements demand computer scientists with deep expertise in AI, the Internet of Things, Big Data analytics, (sustainable) software development, and cybersecurity. Additionally, diversity in IT & Computer Science, particularly the male-female ratio, remains a critical concern. As highlighted in Virkkunen's mission letter[22], strengthening STEM and IT skills, with a specific focus on increasing women's participation, is essential. This is also the case for this sector's future.

Still, IT education and workforce development remain key challenges for the EU. In 2021, only 4% of the graduates in the EU were in the IT field and in 2022, over 9 million people in the EU – 5% of the total employment – worked as IT specialists. Following the EU's digital targets as stated in the Digital Decade, this should increase to at least 20 million IT specialists in 2030. The 2024 State of the Digital Decade report urges all stakeholders to make greater efforts with a focus on realising sufficient progress towards objectives and targets, and solving significant disparities among Member States.

In the meantime, the EU ICT sector continues to grow rapidly. The data from the Dutch Statistics Agency (CBS) shows continued growth in the number of jobs in the ICT sector. As the sector analysis describes, the number of jobs in this sector in the Netherlands was approximately 440K FTE in 2017 and 620K FTE in 2021. In 2023, this increased to 670K FTE (see chart below, source www.pr-edict.nl, in Dutch). This is a growth from 2017 to 2023 of 52%.

Jobs in the ICT sector
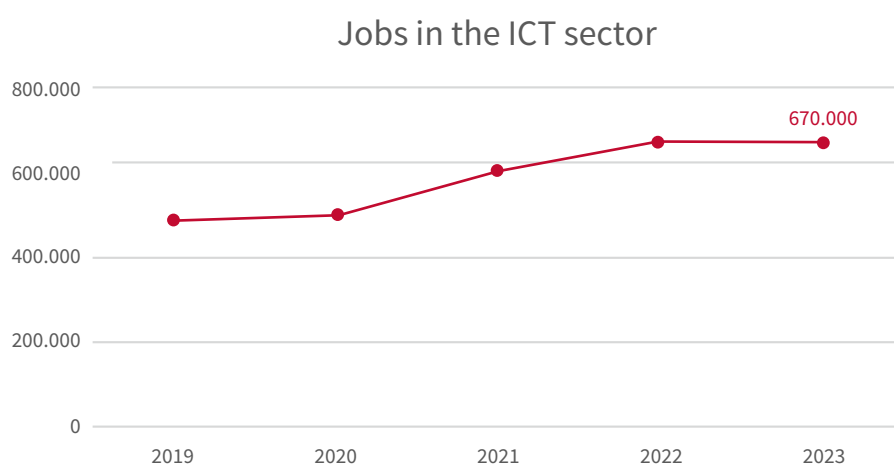
The total Dutch ICT workforce has grown from 5.3% in 2019 to 6.9% in 2023. The efforts of the universities and their students have resulted in an increase of academic graduates working in IT in the total IT workforce from 32% in 2019 to 35% in 2023.

22 Henna Virkkunen – Mission Letter

The European Union in total also shows (taken from Eurostat data) a growth in the number of jobs in the ICT sector: from an estimated 7180K FTE in 2017 to an estimated 9789K FTE in 2023, a growth of 36% in those six years. This is below the growth in the Dutch ICT sector (56%), which suggests that the Sector Plans have had a positive effect on the labour market developments. And, not surprisingly, the European IT labour market is still growing and so is the need for IT specialists at both Master's and Bachelor's degree levels.

RELATED EU DEVELOPMENTS

The EU invests in the improvement of digitalization and digital technology, digital inclusion and digital autonomy. A first example is that, complementary to the cyber-security skills academy, the European commission is setting up three new academies in Quantum Technologies, Artificial Intelligence and Virtual Worlds[23]. A second example is that recently Ursula von der Leyen announced the InvestAI initiative, making €200 billion available for AI infrastructure (AI giga factories, also announced as the CERN for AI). The new AI gigafactories will specialize in training the most complex, large AI models. These developments ask for more trained professionals who are equipped to build, train and use these models.

To meet the labour market demand between now and 2030 (and beyond), to increase European competitiveness and sovereignty in a geopolitically changing world, and to ensure a secure and prosperous digital future, the EU needs highly trained IT specialists. Higher education and research across the EU should be equipped to educate and train these IT professionals.

23   'European Commission, New digital skills academies to support the EU's technological sovereignty, competitiveness and preparedness