70,000 PEOPLE NEEDED
in the tech sector by 2024

TECH COMPETENCE SHORTAGE
threatens Swedish innovation capacity and growth

NECESSARY MEASURES
in the short and long term

The IT Competence Shortage

A REPORT FROM SWEDISH IT&TELECOM INDUSTRIES

Swedish IT&TelecomIndustries

Swedish IT&TelecomIndustries

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Tech competence shortage threatens Swedish innovation capacity

While digitalisation as a societal phenomenon means great opportunities, it also entails challenges. The services and products provided by the tech sector have become an increasingly important, and often business critical, part of the national economy. The already strong digitalisation trend was further accelerated with the outbreak of the corona pandemic in the spring of 2020, when video conferencing and other remote solutions went from being the exception to being the rule. However, the digitalisation of society and the development of the tech sector are limited by the competence shortage of tens of thousands of people with IT or digital-related skills that prevails in the industry today.

To be able to meet the substantially increasing demand for digital solutions with video conferencing, cloud services, artificial intelligence, the Internet of Things (IoT), and e-commerce, etc., skilled companies and knowledgeable employees are needed to create and maintain digital services and digital infrastructure. In this report, as in the past reports from 2012, 2015, and 2017, we identify a continued major competence shortage, with a current need for an additional 70,000 people until the year 2024. The grim truth is that tech sector companies are forced to turn down business and contracts because they lack a sufficient number of employees with the right competence. It is also our assessment that the shortage in society and the business community as a whole is much greater than the 70,000 needed in the tech sector.

Since the last report from 2017, we can see that some of our recommendations at the time were indeed heard; among other things, significant measures have been taken in higher vocational education. Unfortunately, however, many things have not happened, and there is still a lot that needs to be done to tear down the obstacles to the development previously identified. Not least, we need to act together to create opportunities for more people to acquire the digital cutting-edge expertise and skills that are in demand in the labour market today. This is not just an industry issue but a societal issue that needs to be taken much more seriously. Powerful efforts are needed – in the short and long term – to get more people interested in and wanting to train for jobs in the tech sector.

The purpose of this report is to provide decision-makers, the media, young people, and adults close to young people, such as teachers and study and guidance counsellors, with a clear picture of the need for cutting-edge expertise linked to digitalisation, but also a glimpse into a dynamic sector with great future potential.

More specifically, we are targeting our recommendations and proposals for action at the parties who are responsible for ensuring competence provision in Sweden and who thereby play a crucial role in our future prospects and our continued competitiveness and welfare, namely:

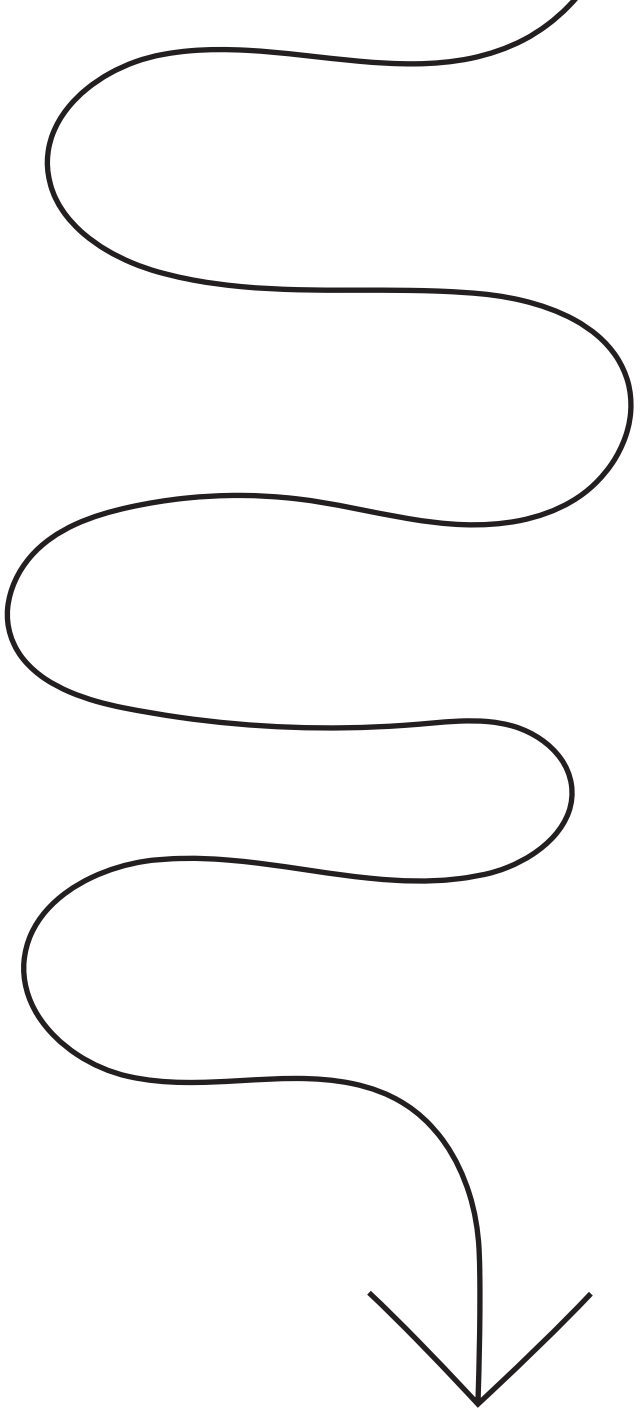
- **The education system,** mainly centres of learning and vocational college providers that offer IT education, and their principal, the Ministry of Education and Research. In addition, the Swedish Higher Education Authority (UKÄ), the Swedish Association of Local Authorities and Regions (SKR), and school principals.
- **Authorities responsible for matching** in the labour market, such as the Swedish Public Employment Service, the Migration Agency, county administrative boards, regions, and municipalities as well as their principals, mainly the Ministries of Employment, Enterprise, and Finance.
- **Authorities responsible for growth,** digitalisation, and business development, such as the Swedish Agency for Economic and Regional Growth, the Agency for Growth Policy Analysis, Vinnova (Sweden's Agency for Innovation), and the Agency for Digital Governance as well as their principals, mainly the Ministries of Enterprise and Infrastructure.
- **The industry**, its management, HR, and its own training activities, i.e. training companies and internal training.

By realising a competency package in line with the recommendations we give in this report, Sweden is well positioned to continue to be a digital leader and live up to the government's goal of Sweden being the best in the world at making use of the possibilities of digitalisation. Great access to and a high level of digital cutting-edge expertise are absolutely crucial for the competitiveness and growth of the entire business community as well as the sustainable development of welfare and society. We are an industry that enables, so let's act together to remedy the competence shortage and turn possibilities into reality.

December 2020

Åsa Zetterberg
Managing Director
Swedish IT&TelecomIndustries

Pär Fors
Chairman of the Board
Swedish IT&TelecomIndustries



SUMMARY

70,000 people needed in the tech sector by 2024

The comprehensive digitalisation taking place both in Sweden and globally has made the tech sector one of the main engines for employment and economic growth – 6 of 10 new jobs created in Sweden between 2010 and 2016 were jobs in this sector.

The biggest obstacle to the continuing growth of the sector is the lack of cutting-edge expertise in IT, telecom, and other forms of digitalisation. A deficit in the range of 70,000 people by 2024 is feared if no special measures are taken.

The shortfall is found in most areas of competence but, in terms of the number of people working in them, various forms of programming, like back-end, front-end, and DevOps dominate. Groups that are fewer in number today, but where need is strongly growing, are data science and game development.

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MEASURES

To remedy the competence shortage, Swedish IT and Telecom Industries propose a number of measures in the short and long term:

1. Establish a high-level forum on digital cutting-edge expertise
2. Ensure that digitalisation permeates knowledge content in the entire school system
3. Advance the skills of teachers so that they can show both girls and boys the way into the digital future
4. Ensure that more tech students – girls as well as boys – complete their education
5. Make sure that the already successful higher vocational education system becomes even better
6. Truly open up universities to people of working age
7. Introduce tech checks to give working people the conditions to develop their digital skills
8. Introduce competency deduction to make it easier for companies to invest in their employees
9. Attract international talent to Sweden and stop talent deportation
10. Make a joint effort to increase gender equality and diversity in the tech sector

THIS IS THE TECH SECTOR

The tech sector: much bigger than IT and telecom, and an important engine for Sweden's growth and prosperity

The comprehensive digitalisation taking place both in Sweden and globally has made the IT and telecom industry one of the main engines for employment and economic growth. The IT intensive sectors accounted for 6 out of 10 new jobs created in Sweden between 2010 and 2016[1]. In addition, the sector is becoming increasingly important for Swedish export; in 2019, the export of IT and telecom services totalled SEK 139 billion, a fifth of Sweden's total service exports. The export of data services alone amounted to over SEK 119 billion in 2019. In the last decade, the export of data services has more than doubled.[2]

But the really defining feature of the development of digital products and services is that it is taking place both in what is traditionally considered the IT and telecom industry and in a wide range of other industries and sectors. To only give an account of the need for competence in IT and telecom would therefore be misleading, which is why we attempt to map the needs of the entire tech sector.[3]

The tech sector includes all businesses that in some form create, develop, deliver, and operate systems, services, and products with digital content in the form of hardware or software, including both suppliers providing only hardware, software, and related services (known as the IT and telecom industry) and other activities where the final products are not IT products in themselves (such as vehicles, financial services, or travel), but where hardware and software are essential components.

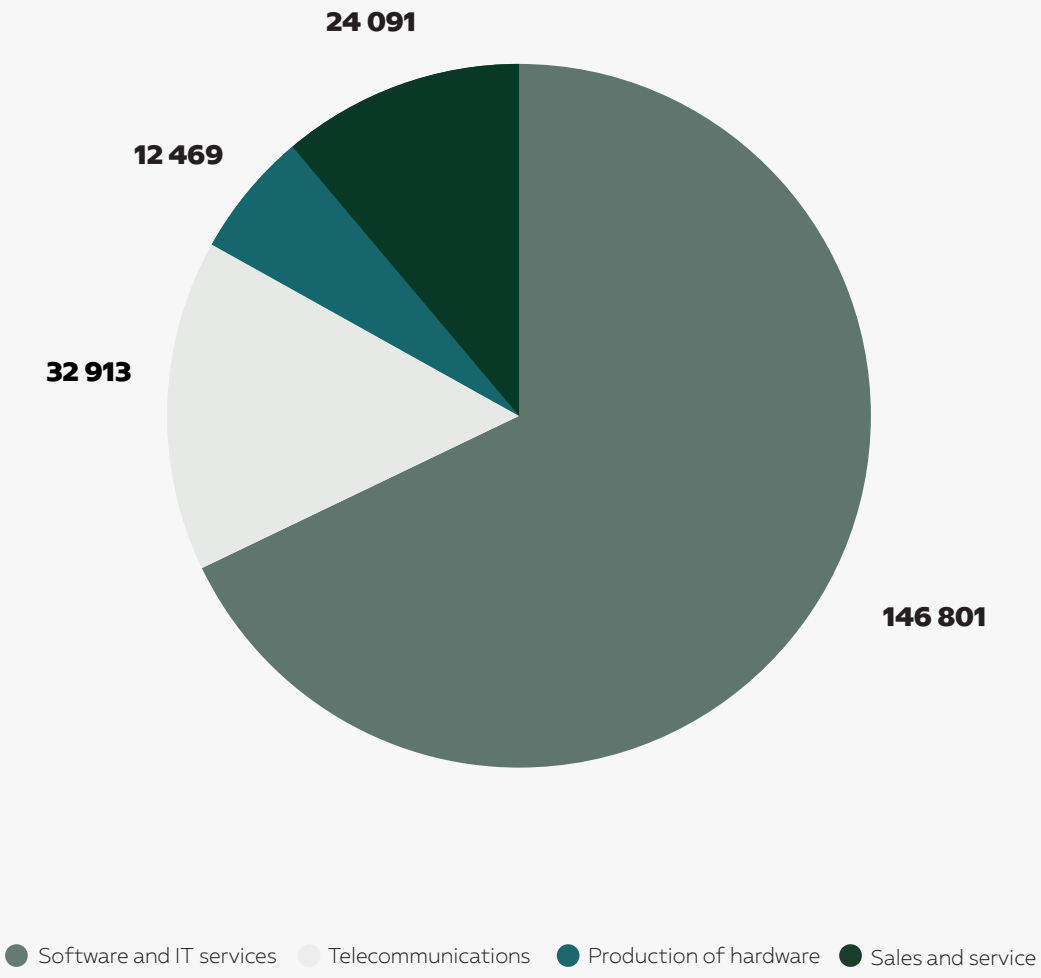
In 2018, the IT and telecom industry had a turnover of SEK 647 billion and employed 216,000 people, distributed over four subsectors[4], see chart 1.

[1] OECD, Measuring the Digital Transformation, a Roadmap for the Future, mars 2019
[2] Statistics Sweden, Trade in services. Exports and imports by item. Year 1982–2019
[3] In the 2017 report referred to as the digital sector.
[4] Swedish IT and Telecom Industries' industry statistics, https://www.itotelekomforetagen.se/fakta-och-debatt/statistik

CHART 1

Number of employees in IT and telecom 2018

Jobs in the IT and telecom industry 2018, distributed over subsectors (source: Statistics Sweden).



From fibre routing to game development – a highly diversified sector

In addition to the difficulty of accurately defining and limiting what the tech sector is, the activities within the group of companies that class themselves as suppliers of IT/telecom/digitalisation solutions differ greatly. Developing digital education services, constructing fibre networks, and building industrial robots are all examples of activities that are connected to digitalisation, but which require very different types of competence.

Categorisation[5] **5 below aims,** despite this complexity, to pinpoint the competence shortage, i.e. to both identify it and estimate how much is needed in various areas, on the basis of the different types of products and services that are supplied. (Provided that the boundaries between the categories are flexible and that many enterprises are active in several of them.)

• **Digital services**
Development of services in education, health care, finance, commerce, transport, etc., where the service itself is physical or personal in nature, but where the essential components are delivered digitally.

• **Management of business support IT**
Development, operation, and maintenance of administrative systems, such as accounting systems, CRM systems, etc.

• **IT infrastructure**
Installation, operation, and maintenance of organisation-internal, as opposed to public, infrastructure, such as servers, networks, and databases.

• **Automation**
Linked to industrial manufacturing (Industry 4.0) but also other complex production and distribution.

• **Development and production of IT and telecom hardware**
Manufacture of computers, network equipment, mobile telecommunications equipment, and other components.

• **Public telecom infrastructure and related services**
Development, operation, and maintenance of telecommunications networks, both broadband/fibre and mobile networks, as well as the traffic transmitted.

• **Design and visualisation**
Use of e.g. BIM (Building Information Modelling) and CAD (Computer-Aided Design) for urban design

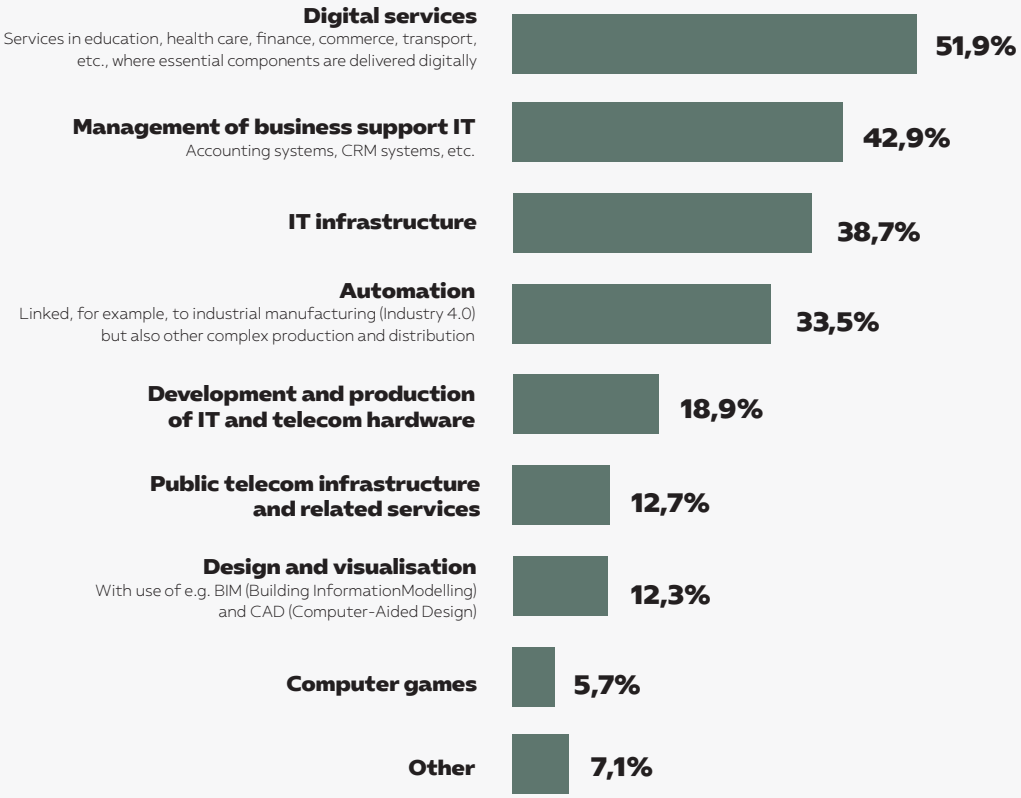
• **Computer games**
Development of mobile games, console and computer games, and related services, such as game engines and tools, as well as systems for design, graphics, animation, networks, user data, etc.

[5] The categorisation is a development of that presented in previous reports: The IT Competence Shortage 2017, "Akut och strukturell kompetensbrist i IT- och Telekomsektorn" ["Acute and structural competency shortage in the IT and telecom Sector"] 2015 and "IT- och telekomsektorns kompetensbrist" ["The IT and telecom sector's competency shortage"] 2012

CHART 2

Forms of IT/telecom/digitalisation that tech companies develop

"Forms of IT/telecom/digitalisation that my company/organisation develops or otherwise use, where competence is needed." (Multiple selections possible)



Source of all charts unless otherwise stated:
Answers to survey in February–March 2020 from 212 tech operators, see Appendix 1

DEVELOPMENT TRENDS AND DRIVERS

Pressure for change and continued digitalisation drive the need for competence

Businesses that develop digital products and services are strongly marked by development trends and a great pressure for change, not only in terms of technology but also in terms of business where new ways of developing and distributing products and services are enabled, partly as a result of technological development. The corona pandemic that began in the spring of 2020 has helped accelerate the pressure for change and the demands placed on those who deliver the services that enable things like teleworking.

The entire digital area is surrounded by buzzwords that give expression to these development trends, but they are often abstract and, to some extent, confusing even for those working in the sector. What do they mean and what trends are the most dominant drivers of consequence for competence needs in the next few years?

We have identified twelve drivers, presented on the next page in ranking order based on their importance for the competence needs (according to our survey respondents).

Twelve drivers

1. Demands for fast and flexible delivery of IT services and systems by continuous supply, cloud services, agile working, etc.
Working methods are developed to support the changing needs of businesses for digital solutions more quickly and more effectively. IT services and systems are updated and kept relevant without the customer/user being hindered in their activities.

2. Demands for usability and accessibility / user experience
Increasing digitalisation and technological development lead to greater focus on the user interface and making digital products and services even more accessible to wider audiences.

3. Management of data/IT/information security
The fact that IT systems and functions are becoming increasingly business-critical places high demands on operational security and protection against various forms of attacks. An important aspect is the management of identities of both physical users and the various machine elements that communicate with each other.

4. Automation of production and processes, through for example robotisation, cloud services, and the Internet of Things
Production chains are becoming increasingly self-regulating through collected and analysed data. Information from different online products helps to develop and optimise both production and processes.

5. Applications in AI: Data Science, including Big Data, machine learning, self-learning systems, etc.
Extensive access to data creates conditions for new, potentially revolutionary analysis tools. Both public data and user data from web-based and mobile services contribute to development.

6. Regulatory requirements: The General Data Protection Regulation (GDPR) and other privacy regulations, copyright, etc.
Greater political awareness of the challenges in a digitised world, for example on integrity and security, leads to new and modified regulatory frameworks that require adaptability in both the private and the public sector.

7. Mobile communications through sensors, mobile networks, and interconnections via the Internet of Things
More and more machine components can be connected in networks. More effective sensors and mobile communication enable more smart objects that interact with each other.

8. Demands for sustainability: Climate change adaptation, circular economy, working conditions with subcontractors, etc.
Today, both the government and the market have greater demands for sustainability. The IT and telecom industry customers demand increased contribution to climate change adaptation, an increased circular economy, and lifecycle mindset, as well as the working conditions with subcontractors.

9. The emergence of new technology opportunities, such as AR/VR (augmented/virtual reality), 3D modelling and production, image analysis, and face/pattern recognition
Inventions and innovations that radically change how products and services are both produced and consumed. The effects can initially be small and hyped and then gradually completely transform businesses and sectors.

10. Global trends in relationships between suppliers, customers, and employees: value networks, partnerships, consolidation, and flexible forms for employing or engaging labour
Great pressure for change affects the business. In order to cope with the competitive pressure and raise productivity, strong specialisation takes place, with production separated along global value chains.

11. Demands for performance of telecom infrastructure
As the amount of communicated data increases, greater demands are placed on the performance and capacity of the telecom infrastructure.

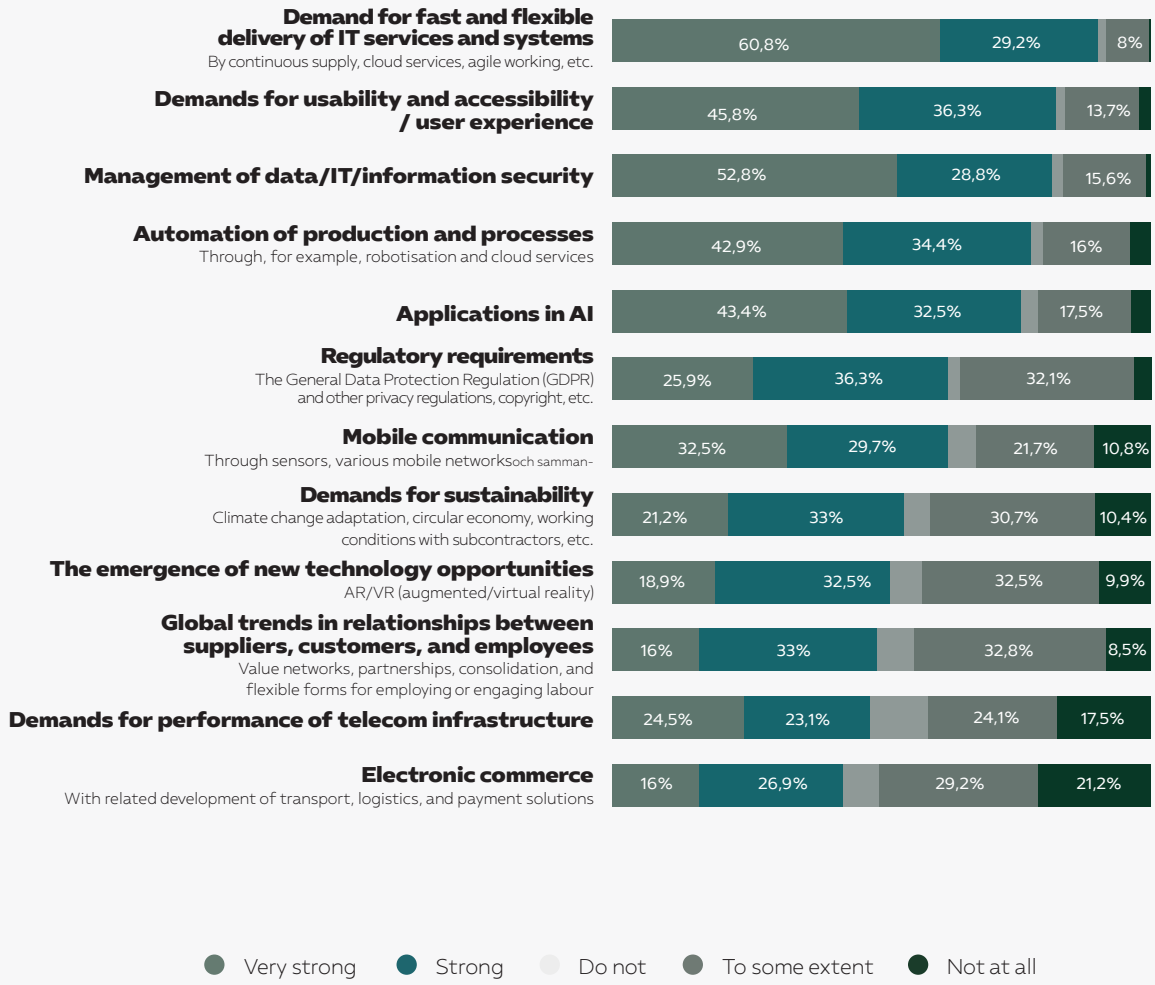
12. Electronic commerce and the related development of transport, logistics, and payment solutions
New payment methods facilitate financial transactions and make them more secure. A growing proportion of trade is electronic, and physical currency – banknotes and coins – is used to a lesser extent than in the past.

Several of the top drivers are the same as in 2017, including management of IT/information security, demands for advanced user interfaces and mobility. Rearticulated drivers include user interfaces, AI, regulatory requirements, automation, sustainability, and advanced data analysis.

CHART 3

Drivers that affect the need for competence

"How strongly do you think that the following drivers will affect the need for competence in your organisation, or the party you represent, in three to five years' time?" Answers are sorted by largest proportion of "Very strongly" + "Fairly strongly"



COMPETENCIES IN DEMAND

Programming, data science, and project management top the list

Our survey is based on 24 competencies[6] of great relevance for the tech sector and provides answers as to how many employees with these competencies the companies currently have and what the need for competence looks like in the next 3 to 5 years.

Together, charts 4–6 outline which competencies are in highest demand, both in terms of the rate of increase and total number. The starting point is how many people with different competencies work today, as illustrated in chart 4. It should be noted that the supplementary survey that was sent out in October of 2020 essentially confirmed the needs outline. This survey went out to the same 212 respondents who completed the main survey in February, with the aim of obtaining an assessment of how the corona pandemic has affected the need for competence. As shown in Appendix 1, the differences turned out to be marginal.

The need for competence in Data Science and Game Development, as shown in chart 5, is greatly on the rise, topping the competencies for which demand will increase the most in the next 3–5 years. However, as shown in chart 6, which combines charts 4 and 5, these are increasing from relatively lower levels.

The overall picture of the total number working in different areas of competence and the rate of increase of need in those areas, shows that the competencies in greatest demand in terms of numbers are various forms of programming (mainly back-end, front-end, and DevOps) and project management. The competencies for which demand has increased the most since the last report in 2017 are DevOps and Data Science.

[6] Three more than in the IT Competence Shortage report from 2017. Some of the competencies have also be renamed, such as "Data Science" instead of "Advanced Data Analysis".

CHART 4

Number of employed with different types of IT competencies, average per company

Based on the answers as to how many, approximately, of the employees in the respondent's organisation who have each competence as one of their main competencies. The respondents answered in intervals; the bars are an estimated mean.

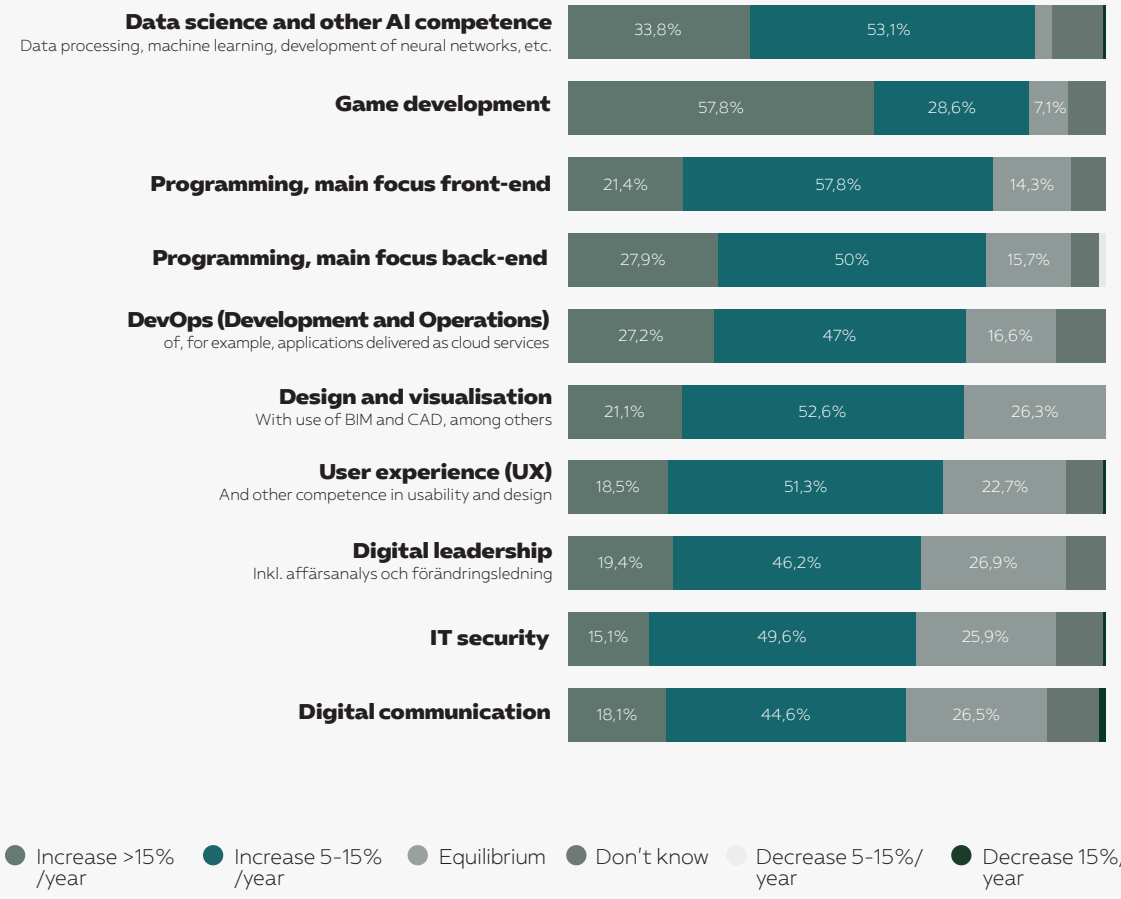
The term 'competence' refers to an individual's ability to perform a task by applying knowledge and skills.

The difference to occupational role is that competence is the possession of skills in a certain area (such as programming), while an occupational role is about working as a result of title or position (such as programmer). Competence and occupational role may not coincide; a person may have a particular competence in IT security, and at the same time have the occupational role of programmer.

CHART 5

The ten competencies with the strongest increase in demand *

"What does the need for new recruitment, or competency development, of people with each competence look like in the next three to five years?"

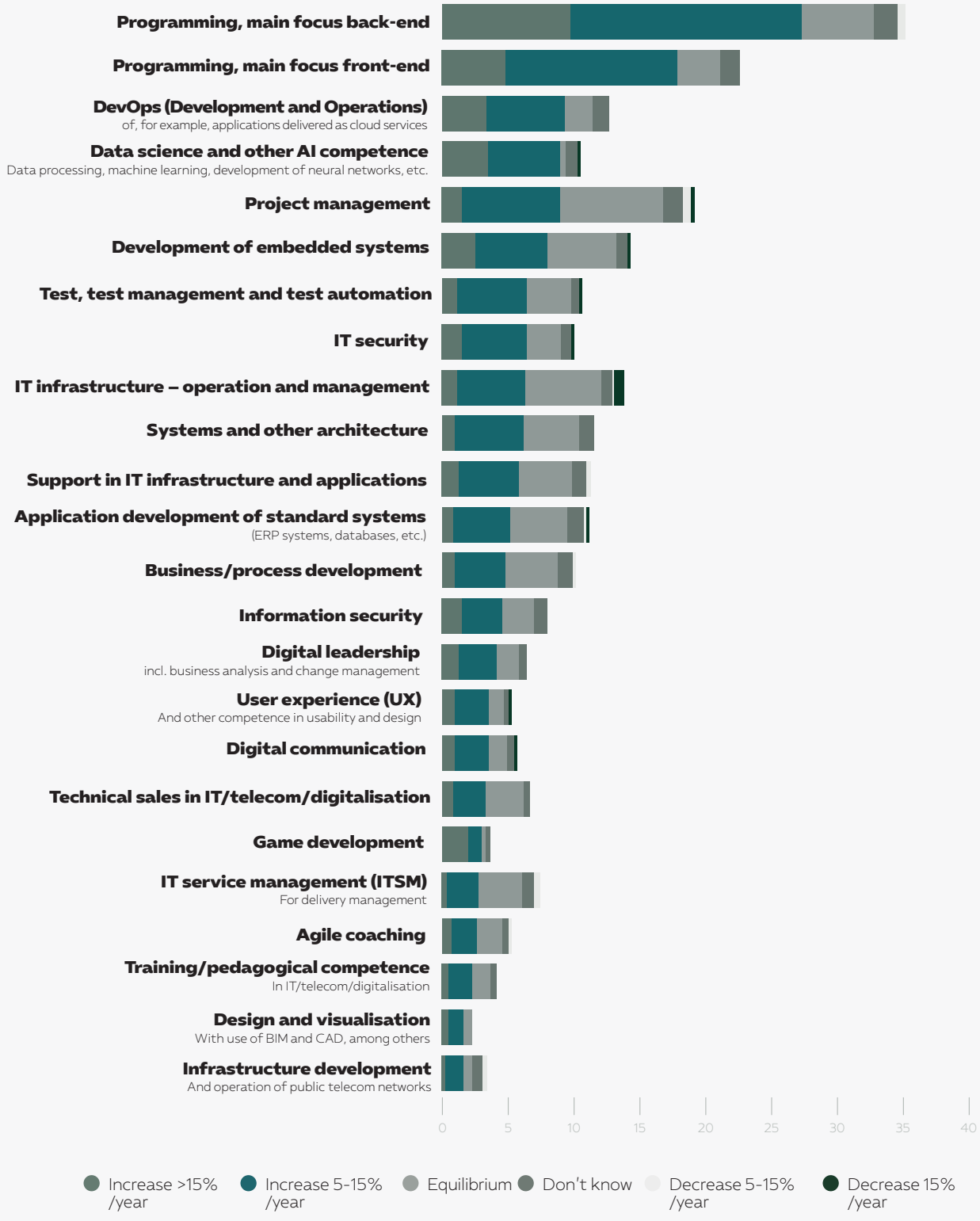


*Charts with all competencies can be found in Appendix 1

CHART 6

The need for different competencies in the next 3–5 years, in relation to the number working today

The total length of the bars corresponds to the average number currently working in Sweden per organisation, see chart 4.



"A job as software developer paves the way for a number of other roles, such as IT Architect, Data Scientist, and Project Manager"

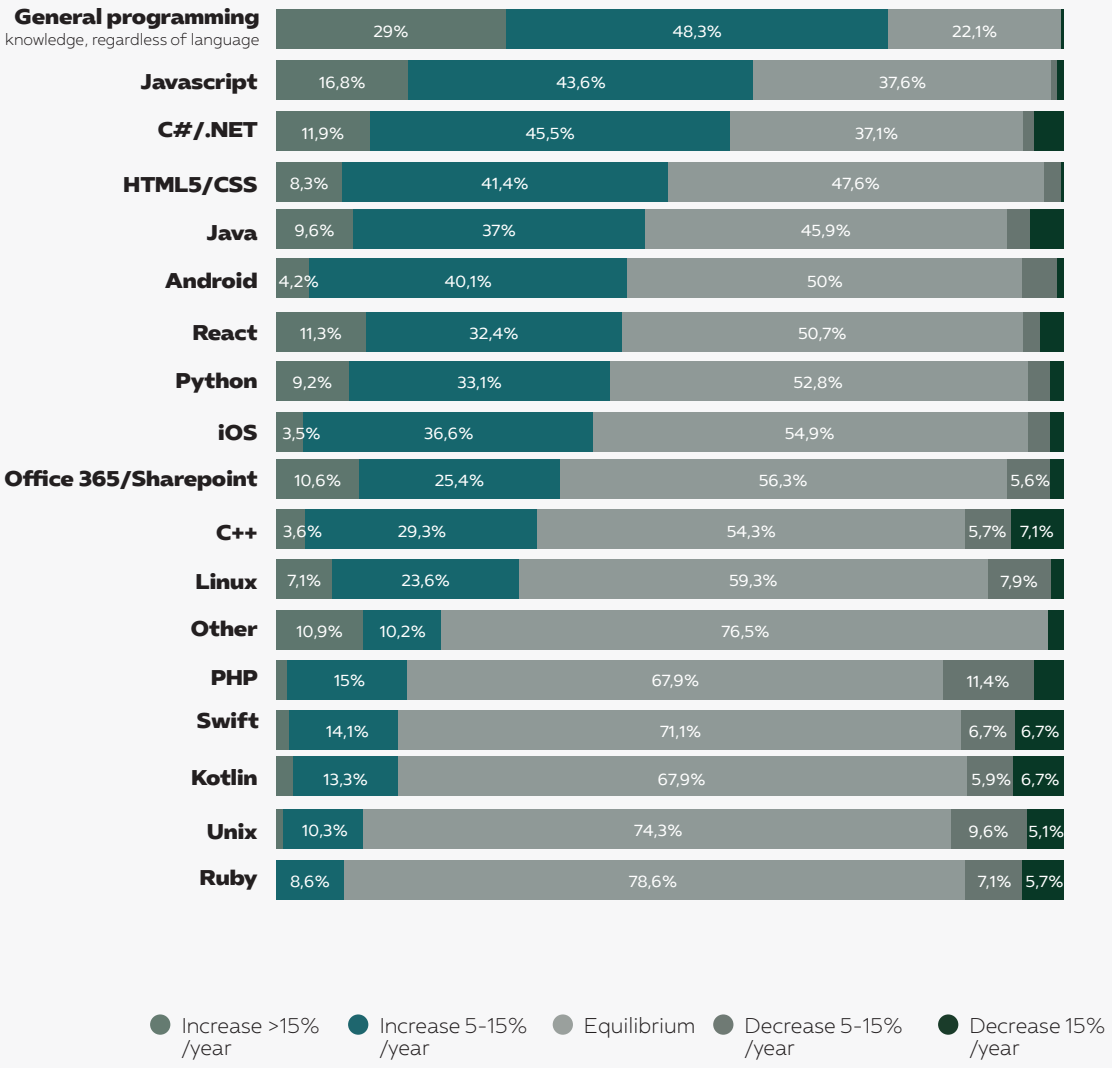
General programming competence regardless of language tops the list

The survey also highlights the need for competencies in specific programming languages and other digital tools, as well as in various database technologies. As in 2017, the answer "General programming competence regardless of language" comes out on top, which confirms what many stakeholders want to highlight: it is programming competence in itself, rather than specific languages, that is in demand.

CHART 7

Need for competence in different programming languages

"What does the need for people with competence in the following programming languages, operating systems, and other technologies look like in the next three to five years?"



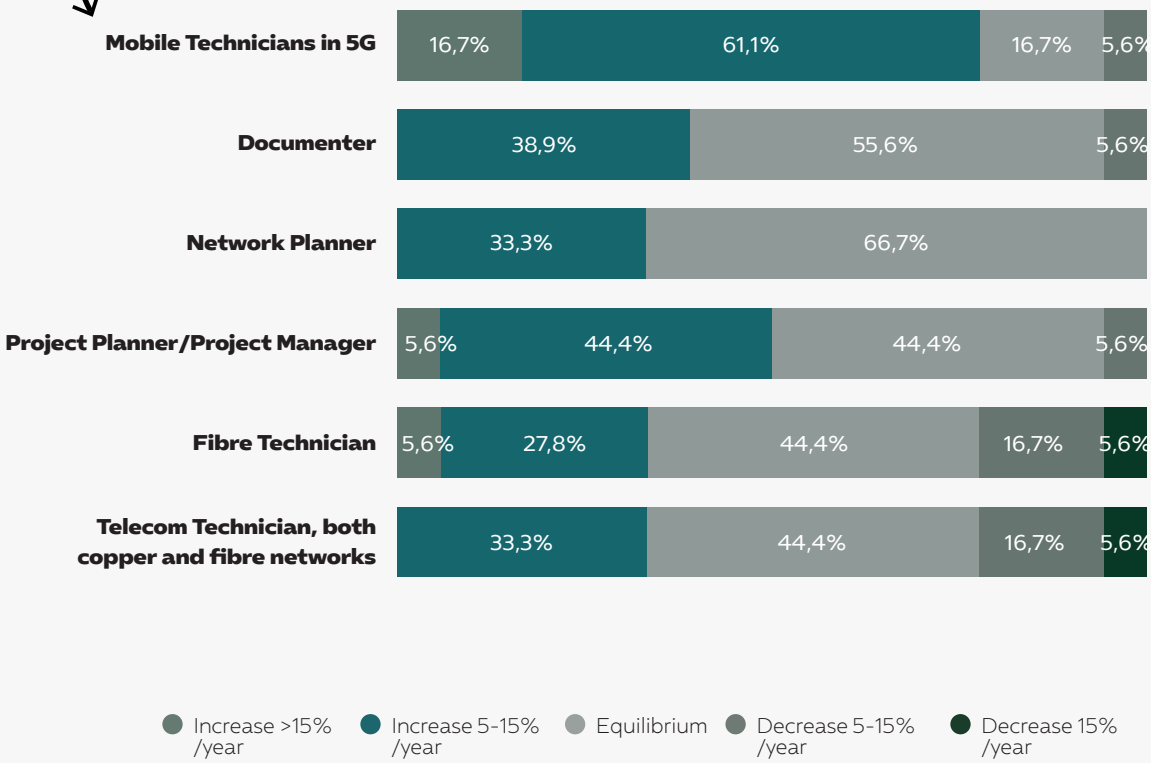
5G competence at the top among telecom technicians

The expansion of broadband and mobile networks has led to a great shortage of field technicians in telecom. As shown in chart 8, the greatest shortage is expected to be in 5G competence.

CHART 8

The need for telecom competence

"What does the need for people with the below competencies look like in the next three to five years?"*



**Follow-up question for those who selected any of the "increase" options for the "Infrastructure development and operation of public telecom networks" competence, see bottom of chart 6. The survey also included questions about the need for various databases and game development competencies, see chart presentation in Appendix 1.*

OCCUPATIONAL ROLES IN DEMAND

Who are the 70,000 that are needed?

The tech sector is relatively young and is strongly developing, which means that many occupational roles lack uniform definitions and change over time.

Our survey, and the companies' estimates of the current number of employees and future needs, are based on 16 identified categories of occupational roles. These are essentially the same as in the 2017 report, with the exception of the "Advanced Data Analyst" role, which has been renamed "Data Scientist", as this is far more used in the industry.

Our assessment of the competence shortage in the tech sector is that we can expect an increased need of at least 70,000 people in the next four years. This means that the 2017 assessment of the future deficit still stands.

TABLE

Occupational roles: categorisation and total

Occupational role*	Currently working, estimated total	Estimated increased need in the next four years, total
Software/Systems Developer	64500	25500
Project Manager	19300	5000
IT Architects	7900	2100
Data Scientists and Database Developers	19900	6300
Business Developers/Business Consultants	5700	1800
Testers	4900	1300
System Managers	10600	2400
Infrastructure Experts, both IT and telecom	12900	3300
Support Technicians, IT	21500	4800
Infrastructure Technicians, Telecom	10000	2600
Sellers with business responsibility	10500	2000
Information/IT Security Experts	2300	900
Usability Experts in IT	3200	1000
Digital Leaders/IT Managers	9600	3500
Trainers in IT/telecom	230	80
Digital Communicators	1800	600
TOTAL	**204 700**	**63 200**

** The occupational roles have, in most cases, their equivalents in Statistics Sweden's official occupational register SSYK (Swedish Standard Classification of Occupations, which is in turn based on the international standard).[7] These equivalents, as well as the competencies covered by the different occupational roles, are presented in a more detailed table in Appendix 2.*

[7] SCB, Yrkesregistret med yrkesstatistik

How we arrived at 70,000

The table here shows an estimate of how many more people will be needed per occupational role within a four-year period (which is halfway in the "3–5 years' time" period specified in the survey), which results in an estimated increased need of approximately 63,000 people halfway through the time period. The estimate is based on the survey answers found in the above charts 4, 5, and 6.

In order to arrive at a credible total figure, the following has been considered:

• **The statistical sustainability of the survey.** The reliability of the survey cannot be guaranteed, mainly because the selection was not random (this is explained further in Appendix 1). The respondents were made up of groups that had registered competence needs, which means that companies that may not have had needs did not participate. This has been offset by a deduction from the increased need, in line with the needs shown in both the Confederation of Swedish Enterprise recruitment survey 2018[8] and the Economic Tendency Survey.[9] The recruitment survey, which was conducted prior to the corona crisis, showed that nearly 80 percent of IT and telecom companies need to recruit, while the Economic Tendency Survey shows that recruitment needs in IT and telecom have decreased after the corona pandemic. However, the supplementary survey sent out in October 2020 showed an unchanged need for competence. Overall, we estimate that about 70 percent of IT companies will need to recruit – the same as in the 2017 report – and we have therefore incorporated a 30 percent reduction in the estimate for the next four years.

• **The official SSYK classification** of occupations, which formed the basis for the calculations, does not capture many of the competencies and roles covered by this survey, which leads to an underestimation of needs. A clear example: according to the occupational register, there are about 2,300 IT security experts currently working, while the more than 200 companies that responded to the survey (i.e. not even the entire industry) say they currently have close to 4,000 employees with either IT or information security as their main competence. The same discrepancy between the answers in the survey and the information in the occupational register is visible in the number of usability experts, trainers, and communicators.

• **A number of the occupations** in the table are not IT specific (including salespeople, trainers, and communicators). In order not to include all communicators, etc. in the entire world of work, the number has been reduced by a factor corresponding to the IT industry's share of the entire world of work. However, this leads to an underestimation, as digital communicators are present among all those currently working, not just the IT industry.

Overall, this points to an underestimation of increased need. We therefore estimate that, in a five-year perspective, we should expect an increased need of at least 70,000 people by 2024.

[8] The Confederation of Swedish Enterprise, "Rekryteringsenkäten 2018, Jobbskaparna larmar! Kompetensbristen ökar" ["Recruitment Survey 2018, Job creators raise the alarm! The competence shortage is growing"] (p. 8), March 2018 and the Economic Tendency Survey's quarterly series
[9] National Institute of Economic Research, Economic Tendency Survey, the service sector, quarterly series.

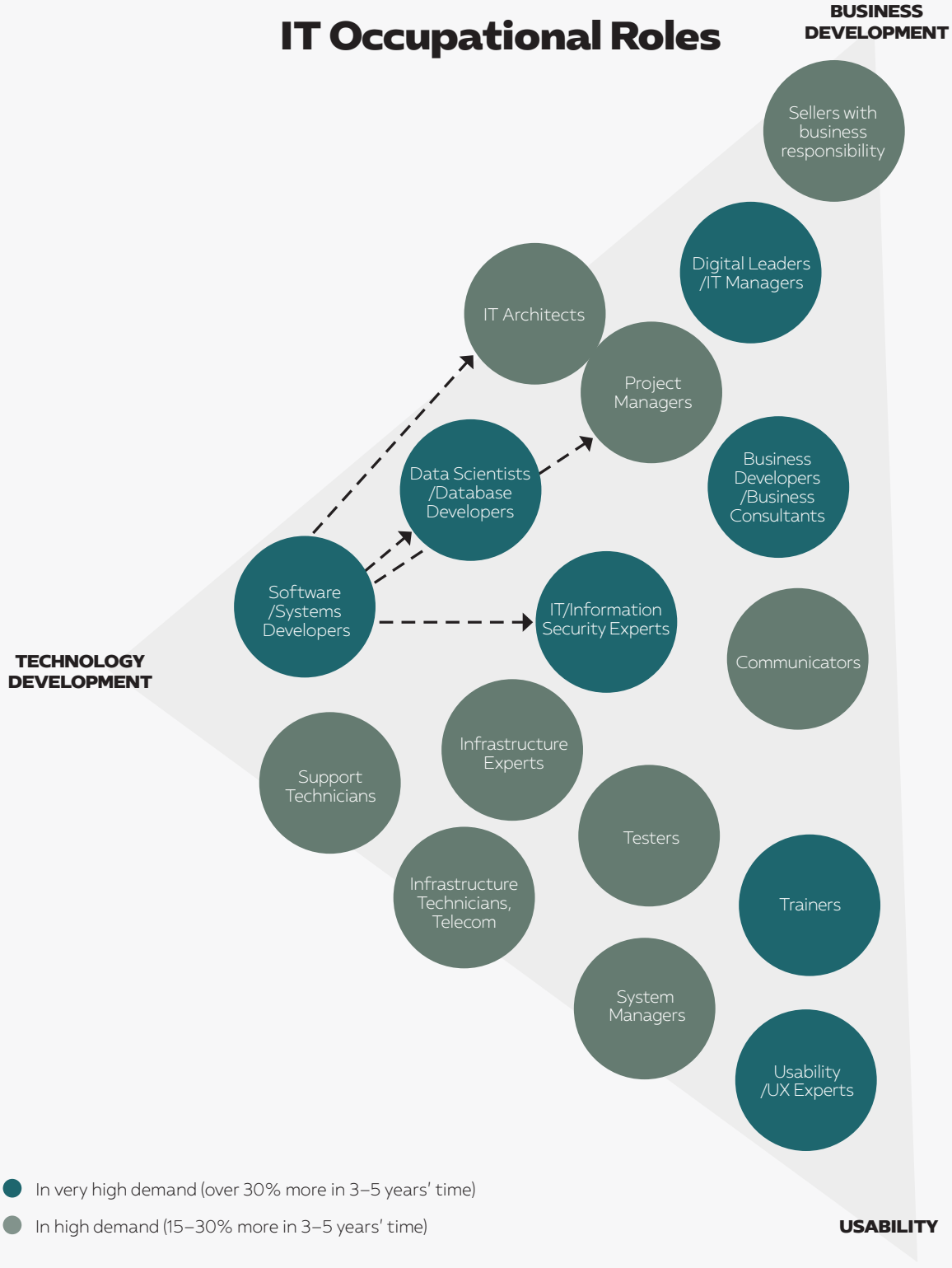
A sector with many job and development opportunities

The tech sector needs:
· A wide range of different occupational roles
· Far more than technical competence – user and business focus are also of great importance.

There are many development paths; for those who do not wish to remain programmers, there are lots of opportunities for a career with a wider focus.

FIGURE

IT Occupational Roles



Main focus on post-secondary education

For the vast majority of competencies, an academic background primarily in systems science and technology is very relevant (response rates of over 50%), while a background in vocational college or other vocational continuing education is slightly less so, with response rates between 20 and 30 percent.

Chart 9 shows the average for all 24 competencies. It is difficult to give a clear picture of the responses for individual competencies given the large number of parameters: 24 competencies, each with seven answer options. The reader is referred to Appendix 1 and the chart presentation published in April 2020, figures 31–32.[10]

There is a certain degree of correlation in that the roles with the lowest response rate for academic education are among the highest in terms of vocational education and training, including support, infrastructure development, and technical sales. Game development stands out by being in the top in both forms of education. Front-end development is also relatively high up in both.

What should be noted are the high response rates for the answers "University, other focus" and "Educational level of lesser significance". However, it does seem that some form of post-secondary education is requested due to the low response rates for "Upper secondary only".
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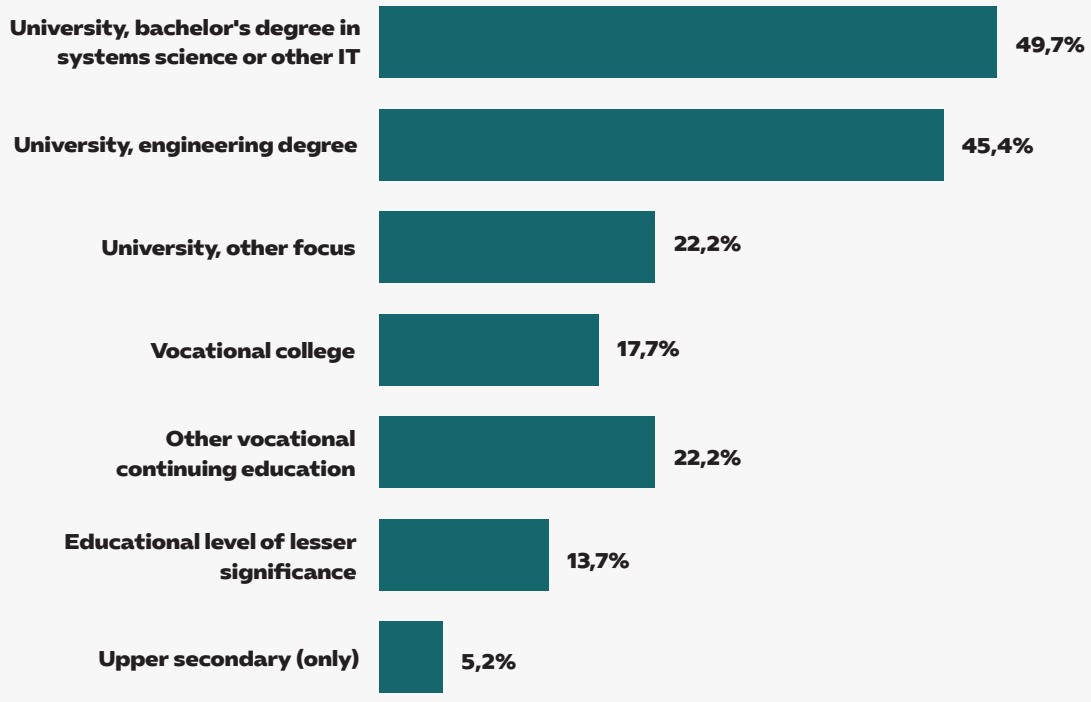
CHART 9

Requested educational background

"As a general rule, what educational background should the people needed in the above competencies have? Multiple selections possible". The chart shows the average for all 24 competencies.



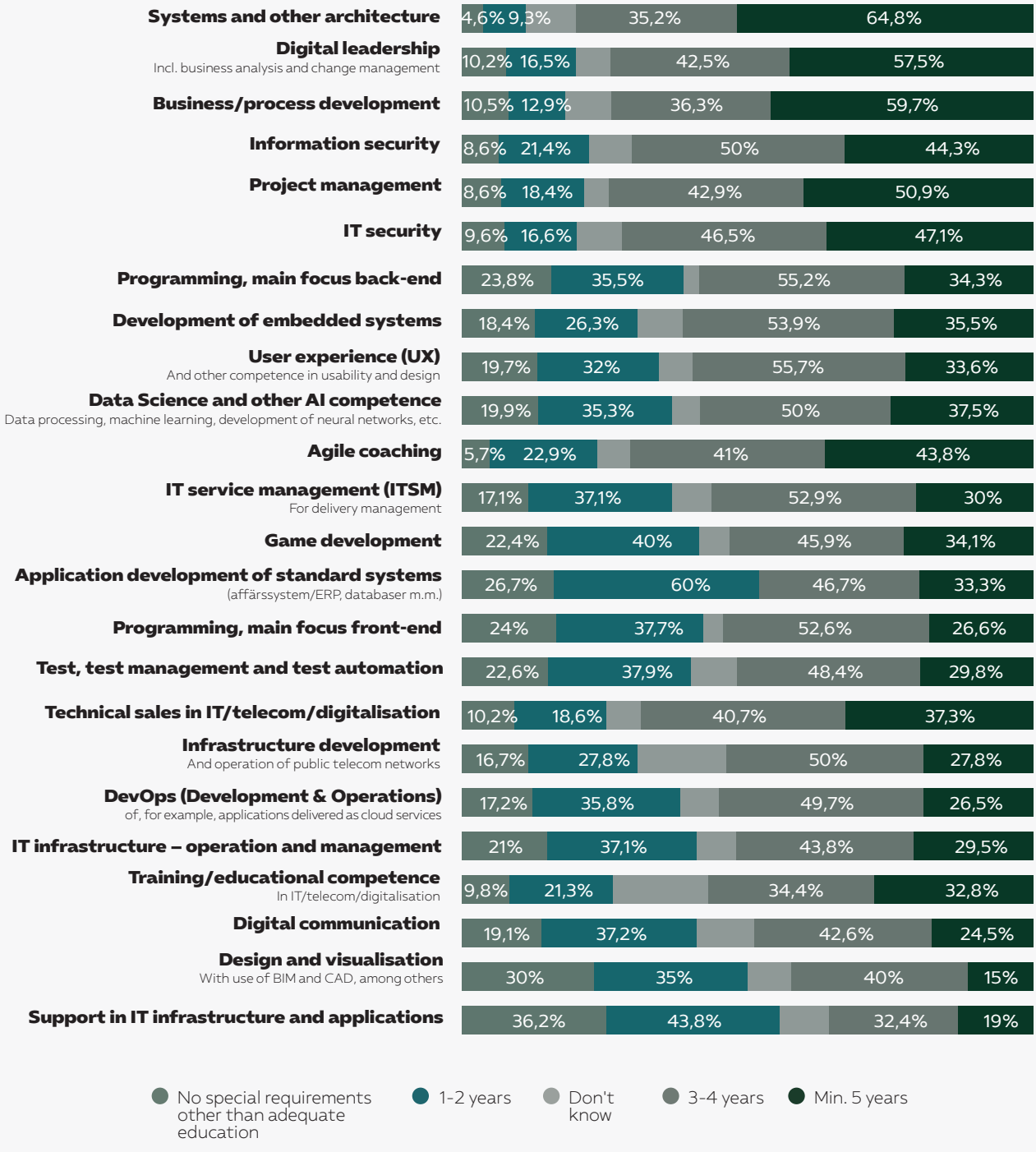
[10] Chart presentation of competency survey, Swedish IT and Telecom Industries, April 2020. Available for download at https://www.itot.se/2020/04/resultat-fran-kompetensenkat-underlag-for-uppskjuten-rapport/

Requirements for occupational experience are generally high, although not to the same extent everywhere: in the case of several of the competencies most in demand, such as programming and DevOps, half or more answer "no special requirements" for experience or "1-2 years".

CHART 10

Requested occupational experience

"As a general rule, how many years of relevant experience should the people needed in the below competencies have?" Multiple selections possible.



Reskilling or upskilling an attractive alternative for business-oriented roles

New to this year's survey is that questions were asked about how attractive reskilling or upskilling existing staff is as an alternative to recruiting a "finished" competence. ("Reskilling/upskilling is a broader term than "continuing education", as "skilling" also includes competency development not in course or other formal educational form).

The question asked for each of the 24 competencies was how attractive it is to invest in someone who has been reskilled/upskilled for 3–6 months, in relation to the other alternatives to a "finished competence", mainly recent graduates or recruitment abroad. A condition that was given was the 3–6 month "skilling initiative" can- be easily financed and implemented (possibly with public funding) without significantly affecting the ongoing activities. Chart 11 shows the average responses.

As shown, the option of recruiting recent graduates is generally more attractive than the reskilling/upskilling options. However, there are significant differences between the competencies, and, as can be seen in charts 12 and 13 (on the next page), reskilling/upskilling for more business-oriented competencies, like business/process development and agile coaching, can be attractive options.

CHART 11

The interest in reskilled/upskilled competence compared to other routes to recruitment

"As an alternative to recruiting a "finished" competence from other companies or hiring consultants in Sweden, how relevant are the following sources, or routes, to increased competence?"
Average for all 24 competencies.

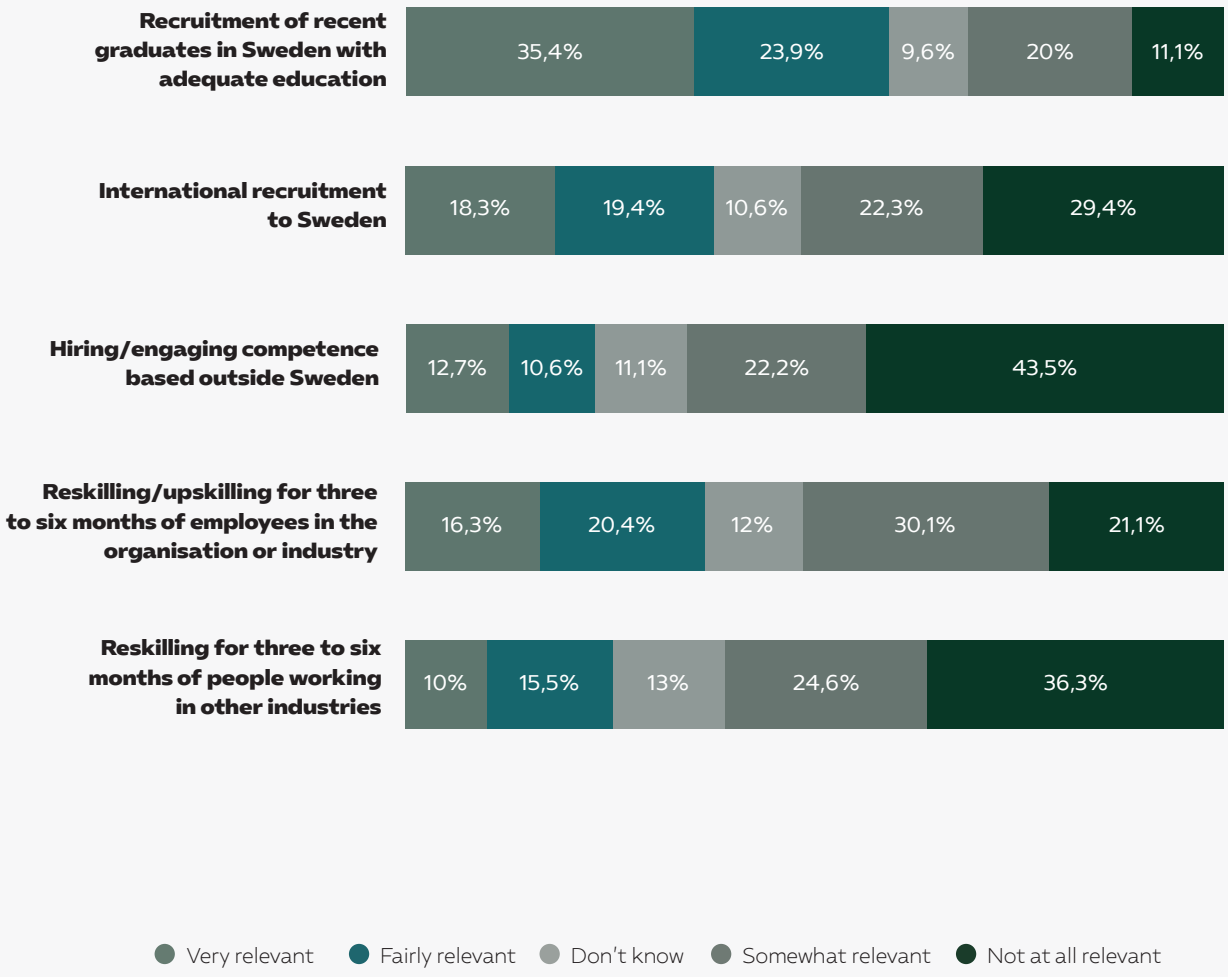
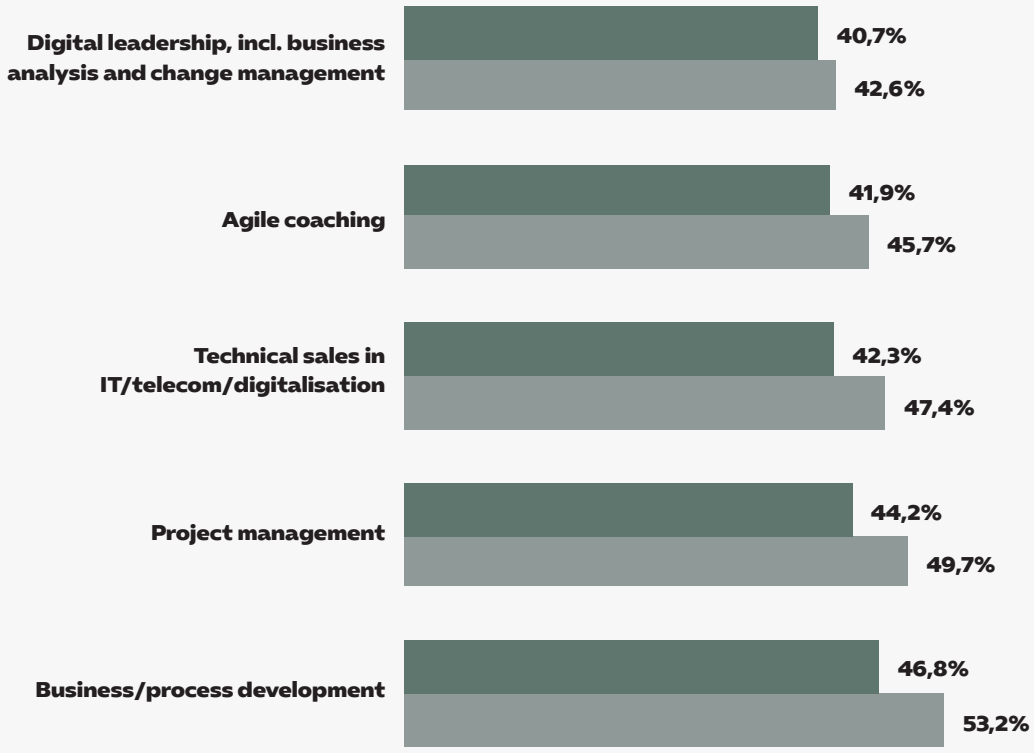


CHART 12

Comparison between reskilling/upskilling within the industry and recent graduates

"As an alternative to recruiting a "finished" competence from other companies or hiring consultants in Sweden, how relevant are the following sources, or routes, to increased competence?"

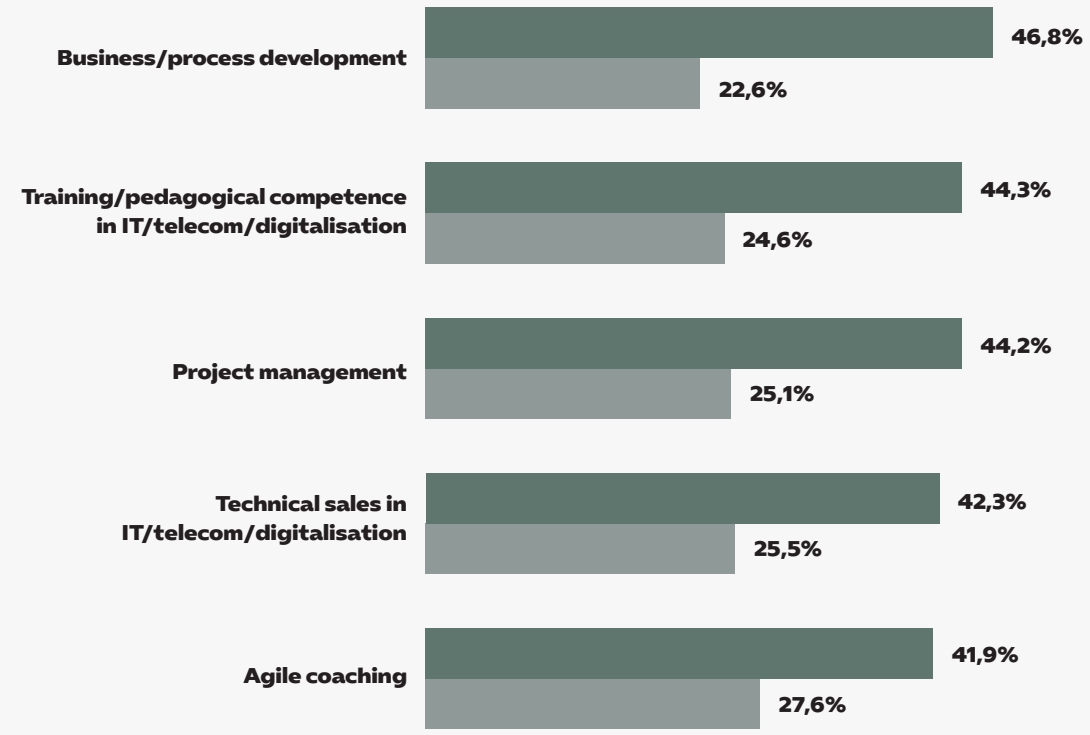


- Reskilling/upskilling for three to six months of employees in the organisation or industry, total very + fairly relevant
- Recruitment of recent graduates in Sweden with adequate education, total very + fairly relevant

CHART 13

Comparison between reskilling/upskilling within the industry and international recruitment

"As an alternative to recruiting a "finished" competence from other companies or hiring consultants in Sweden, how relevant are the following sources, or routes, to increased competence?"



Necessary measures in the short and long

Accounting for a substantial proportion of the new jobs created in our country, the tech sector is an industry of the future that highly contributes to Sweden's growth. The competence shortage in the industry is thus very serious and risks affecting much more than just our own industry. It affects the opportunities of the entire business community and public sector for digital structural transformation, with all that it entails. In the long run, the competence shortage is a threat to Swedish competitiveness, jobs, and sustainable development. Swedish IT and Telecom Industries proposes ten necessary initiatives to meet the need for competence in the tech sector.

Ten proposals to solve the shortage of digital cutting-edge expertise in the short and long term

1. The government should establish a high-level forum on digital cutting-edge expertise.
The overall commitment to the development of high-tech knowledge and solving the issue of competence shortage has been far too low and the responsibility too fragmented between different policy areas, authorities, academia, businesses, and trade union organisations. Establish a strategic high-level forum that monitors, coordinates, and acts to remedy the shortage of digital cutting-edge expertise and promote development. The industry stands ready as a constructive interlocutor and partner.

2. Digitalisation must permeate knowledge content in the entire school system.
Despite curriculum changes in certain subjects, digitalisation still has a far too subordinate role in the curricula and in school activities in general, where the stereotype of IT as something nerdy and just for boys is being reproduced. Digitalisation and its creative applications must be integrated in all subjects, and special initiatives, similar to the municipal music schools, must be implemented – a kind of "digital leisure centre" and makerspaces. With proper planning, companies in the industry will be available as creative learning environments.

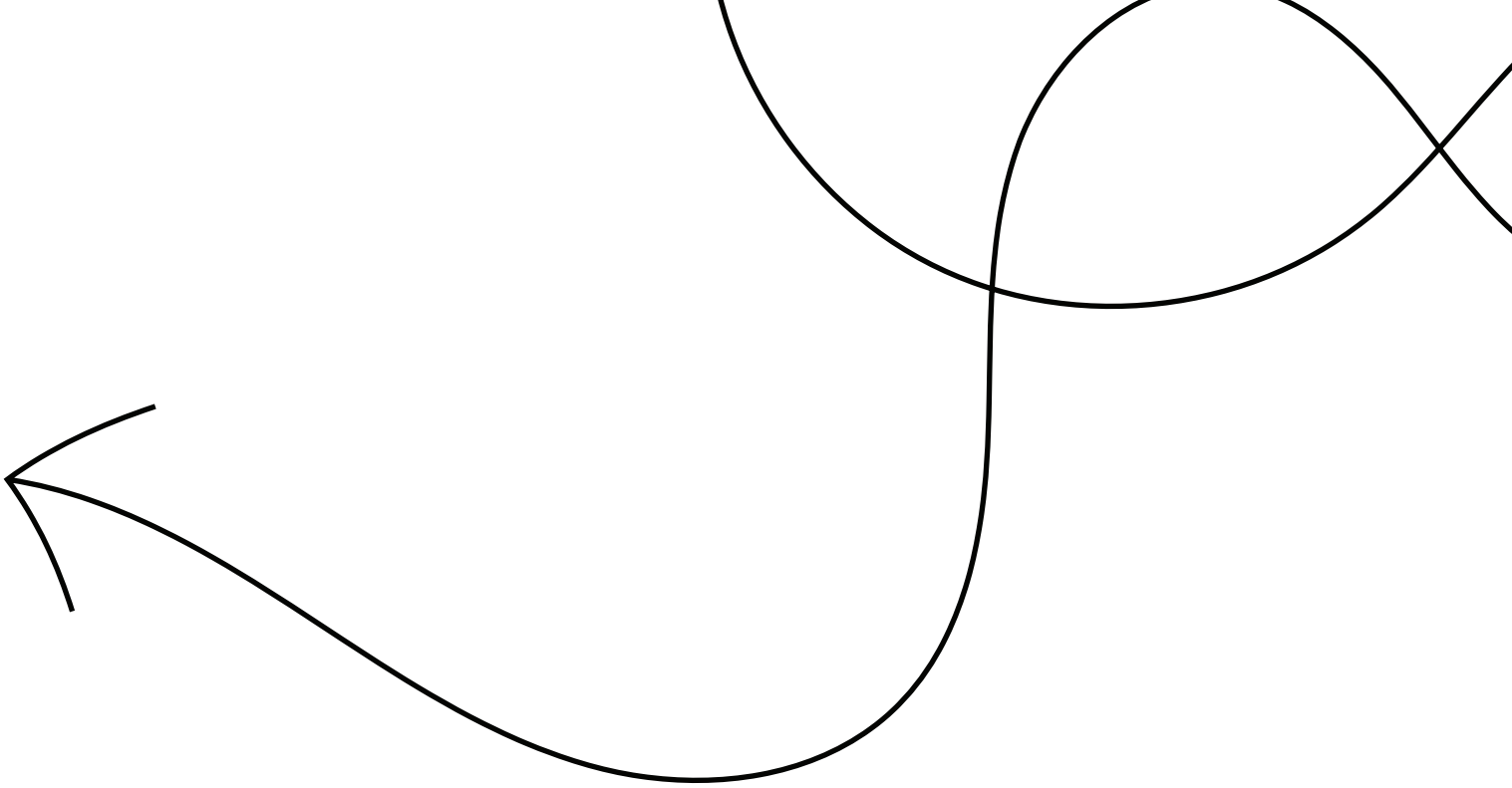
3. Digitally competent teachers and headmasters, who have completed reformed teaching education and headmaster training, should show both girls and boys the way into the digital future.
A key element of the yet to be implemented action plan for the digitalisation of schools is to advance the digital competence of teachers, not least through reformed teacher and headmaster training. Without this, a digitalisation initiative in the school will be ineffective. The government must allocate substantial funds and focus on this! The industry will gladly show the way by making demos of its activities for teachers and teaching students.

4. More tech students – girls as well as boys – must complete their education.
The flow of students through technical programmes at universities is too low; for some engineering degrees, below 50 percent. And this when only 10–20 percent of the students are women to begin with. Universities must ensure, through close collaboration with the working world, that all students receive "skills training" that stimulate them to complete their education. The companies in the industry will be available for internships and by having their employees visit the universities as role models.

5. Higher vocational education is a success that can become even better.
The higher vocational education system has been developed in an exemplary manner; however, some areas are still perceived as being insufficiently adapted to the conditions of the companies. Greater flexibility is needed, with both longer and shorter courses and course content that is more business-adapted. In addition, courses in areas with long-term needs need to be made permanent. An already committed industry will be available for all these adjustments.

6. Universities must truly open up to people of working age.
The mission given to the universities by the government to invest in lifelong learning will have no effect as long as the universities are not given the conditions for it. Implement the proposals that Swedish IT and Telecom Industries, together, among others, the Swedish Association of Graduate Engineers and the technology universities, presented through Study Friday[11]: A special admission track for those who already have a degree and special funds allocated for this purpose. With adequate conditions for companies to let employees participate in university activities, they will be more than happy to collaborate!

[11] Study Friday – "ny modell för utveckling av ingenjörskompetens" ["A new model for the development of engineering skills"]. The Swedish Association of Graduate Engineers, November 2019, https://www.sverigesingenjorer.se/anstallning/allt-om-anstallning/study-friday/



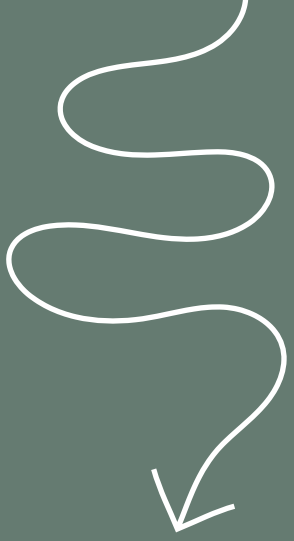
7. Working people, both women and men, who want and need to develop their digital skills must be given the conditions to do so. Introduce tech checks!
In today's fast-moving labour market, and with the rapid development of technology, lifelong learning is as desirable as it is a given; according to a study conducted by Sigma IT, one million Swedes, a large proportion of whom are women, want to further their education to work in IT. At present, however, they have no conditions for doing so.[12] Through a system of tech checks in the amount of SEK 10,000 each, as proposed by Swedish IT and Telecom Industries, working people can receive mentoring, competency development, and compensation for loss of income in order to take this important step to further their education. [13] The companies in the industry will be available as mentors and coaches.

8. Companies must be able to invest in their staff through competency deduction.
The investments of companies in competency development have decreased over the years, and for many companies it is a matter of not being able to afford them. Meanwhile, the companies have a great need to develop their existing staff, but they are limited by the fact that investments in staff development are not deductible in the same way as investments in machines. A right to competency deduction, as proposed by Almega in 2019[14], should be implemented immediately.

9. Attract international talent to Sweden and stop talent deportation.
Global competition over digital cutting-edge expertise is fierce, and attracting talent is difficult. Sweden needs to make a greater overall effort to develop a strategy to attract both talent and investments to our tech sector. Although labour immigration is demonstrably contributing to growth in the billions[15], it is being hampered by slow public authority handling and by threats of deportation due to trivial mistakes made by employers. In addition to a one-stop-shop system for efficient public authority handling, the Aliens Act needs to be amended to allow for a forward-looking overall assessment based on reasonableness.

10. Joint efforts to achieve greater gender equality and diversity in the tech sector.
The proportion of women in the IT and telecom industry is too low. Only 29 percent who work in the industry are women, and the proportion of women in CEO positions is even lower, only 16 percent. Greater gender equality and diversity are important, not least for business benefits and quality. It is also a way to cope with the shortage of competence. The industry must do its part to be attractive and attract and retain women and people with different backgrounds. In addition, efforts are needed from more stakeholders, some of which are mentioned in the recommendations above.

[12] Sigma IT, Tomorrow Report, 2019, https://www.sigmait.se/tomorrow_report
[13] Swedish IT and Telecom Industries, "Det här är tech-check" ["This is tech check"], October 2020, https://www.itot.se/2020/10/det-har-ar-tech-check/
[14] Almega, "Turbodigitaliseringen tar jobben – hög tid för ett kompetensavdrag" ["Rapid digitalisation are taking over jobs – high time for a competency deduction"], April 2018, https://www.almega.se/2018/04/turbodigitaliseringen-tar-jobben-hog-tid-ett-kompetensavdrag/
[15] The Confederation of Swedish Enterprise, Report: "Sverige tjänar miljarder på arbetskraftsinvandring" ["Sweden makes billions on labour immigration"], June 2019, https://www.svensktnaringsliv.se/sakomraden/arbetsmarknadspolitik/rapport-sverige-tjanar-miljarder-pa-arbetskraftsinvandring_1136182.html



ONGOING INI
SWEDISH IT AND TE

TECH CHECKS

Individual support for digital competency development

Digital transition leads both to the elimination of tasks and to the creation of new job opportunities. Many adults in Sweden lack the digital skills needed to benefit from the transition.

Swedish IT and Telecom Industries' proposed solution to this is a one-time "tech check book" in the amount of SEK 10,000, available to all individuals of working age, regardless of whether they are employed or not.

The checks can be used for one or more of the following initiatives:

- **Mentoring**
- **Education**
- **Competency development** through informal forms of learning
- **Compensation for loss of income** during the completion of competency initiatives.

You can find more info at:
www.itot.se/2020/10/det-har-ar-tech-check/

STUDY FRIDAY

Enables working people with a degree to study during the day

Many working people with a degree, especially in the technology field, want to further their education. The universities want to offer this but are prevented by regulations and lack of funding.

This would all be made possible if the ability of the universities to offer continuing education were to change as follows:

- **The admission system** is changed to allow for a special track for those who already have a degree.
- **Universities are tasked** with providing continuing education with specially allocated funds.
- **Scheduling can be arranged** so that working people can study during the day along with full-time students.

You can find more info at:
www.sverigesingenjorer.se/anstallning/allt-om-anstallning/study-friday/

TIATIVES OF
LECOM INDUSTRIES

COMPETENCY
DEDUCTION

Makes it easier for companies to invest in their employees

Despite competency development becoming increasingly important from a global perspective, the cost of staff training as a proportion of total cost of labour decreased from 2.1 percent to 1.6 percent between 2005 and 2015. One concern is that staff training is taxed higher than physical investments, since the tax on labour is higher than the tax on capital. In addition, physical investments can be depreciated over time and recognised as an asset in the balance sheet.

To meet the increasing needs for transition, Almega therefore proposes the introduction of a competency deduction:

- **Companies can recover** up to half the cost of courses purchased from external training providers, both public and private.
- **This allows for increased** investments in staff competency development, which facilitates new recruitment as well as the retraining of existing staff.

You can find more info at:
www.almega.se/2018/04/turbodigitaliseringen-tar-job-ben-hog-tid-ett-kompetensavdrag/

WOMENTOR

Business benefits through gender equality

Womentor is an annual programme that aims to promote women's leadership in IT and thereby raise the visibility of female role models in and outside the industry. The companies that have regularly participated in the programme have increased the proportion of female employees from 25 to 35 percent.

The programme comprises two parts:

- **A change programme** where companies receive knowledge, inspiration, and support in their work with change to achieve their own gender equality and inclusion goals.
- **A leadership development** and mentorship programme for female executives with focus on digital, innovative, and equal leadership.

You can find more info at:
www.womentor.se

Survey methodology

Information for the survey has been collected and processed in three stages:

1. An interview and consultation phase in the winter of 2019/2020, during which drivers and competencies were identified. Seven in-depth interviews were conducted, in parallel with the document describing drivers and competencies being distributed and widely discussed.

2. A questionnaire survey in two rounds; a larger questionnaire during February/March, followed by a smaller one in October to follow up on the effects of the corona pandemic. The large (main) questionnaire is based on the drivers and competencies identified during stage 1 and was sent to 345 people working in recruitment and business management, both in and outside the IT and telecom industry and in different parts of the country. The smaller follow-up questionnaire was sent to the 212 people who had responded to the main questionnaire. The questionnaire results, including discussions of their statistical sustainability are presented in the text below, as well as in more detail in Appendix 1.

3. The development and establishment of the proposed measures to combat the competence shortage, carried out during November 2020 in consultation with the IT Competence Council.[16]

The work was led by Fredrik von Essen, working as enterprise policy expert with Swedish IT and Telecom Industries until the end of December 2020.

[16] The IT Competence Council is a network of representatives from the member companies of Swedish IT and Telecom Industries that discuss and propose measures for increased access to digital cutting-edge expertise. https://www.itot.se/radsverksamhet/it-kompetensradet/

References

[1] OECD, Measuring the Digital Transformation, a Roadmap for the Future, March 2019

[2] Statistics Sweden, Trade in services. Exports and imports by item. Year 1982–2019

[3] In the 2017 report referred to as the digital sector.

[4] Industry statistics of Swedish IT and Telecom Industries, https://www.itotelekomforetagen.se/fakta-och-debatt/statistik

[5] The categorisation is a development of that presented in previous reports: IT-kompetensbristen [The IT Competence Shortage] 2017, Akut och strukturell kompetensbrist i IT- och Telekomsektorn [Acute and structural competency shortage in the IT and telecom sector] 2015, and IT-och telekomsektorns kompetensbrist [The IT and telecom sector's competency shortage] 2012

[6] Three more than in the IT Competence Shortage report from 2017. Some of the competencies have also be renamed, such as "Data Science" instead of "Advanced Data Analysis".

[7] Statistics Sweden, The occupational register with occupational statistics

[8] The Confederation of Swedish Enterprise, Rekryteringsenkäten 2018, Jobbskaparna larmar! Kompetensbristen ökar [Recruitment Survey 2018, Job creators raise the alarm! The competence shortage is growing] (p. 8), March 2018 and the Economic Tendency Survey's quarterly series

[10] Chart presentation of competency survey, Swedish IT and Telecom Industries April 2020. Available for download at https://www.itot.se/2020/04/ resultat-fran-kompetensenkat-underlag-for-uppskjuten-rapport/

[11] Study Friday – ny modell för utveckling av ingenjörskompetens [A new model for the development of engineering skills]. The Swedish Association of Graduate Engineers, November 2019, https://www.sverige- singenjorer.se/anstallning/allt-om-anstallning/study-friday/

[12] Sigma IT, Tomorrow Report, 2019, https://www.sigmait.se/tomorrow_report

[13] Swedish IT and Telecom Industries, Det här är tech-check [This is tech check], October 2020, https://www.itot.se/2020/10/det-har-ar-tech-check/

[14] Almega, Turbodigitaliseringen tar jobben - hög tid för ett kompetensavdrag [Rapid digitalisation are taking over jobs – high time for a competency deduction], April 2018, https://www.almega.se/2018/04/ turbodigitaliseringen-tar-jobben-hog-tid-ett-kompetensavdrag/

[15] The Confederation of Swedish Enterprise, Report: Sverige tjänar miljarder på arbetskraftsinvandring [Sweden makes billions on labour immigration], June 2019, https://www.svensktnaringsliv.se/sakomraden/arbetsmarknadspolitik/rapport-sverige-tjanar-miljarder-pa-arbetskrafts-

[16] The IT Competence Council is a network of representatives from the member companies of Swedish IT and Telecom Industries that discuss and propose measures for increased access to digital cutting-edge expertise. https://www.itot.se/radsverksamhet/it-kompetensradet/

Other sources

• **Interviews conducted** during January and February 2020 with representatives from Skandia, Quickspin, Zenuity, Sigma IT, Science Park Mjärdevi, IBM Client Innovation Center, and Telia Company.

• **Questionnaire sent out** in February 2020 to 345 recipients from the following organisations/networks: Swedish IT and Telecom Industries, the Federation of Swedish Innovation Companies (FSIC), Swedsoft, IAMCP, Swedish Games Industry, Swedish Edtech Industry, Business Region Göteborg, Lindholmen Science Park, Mobile Heights, IEC (Växjö), Blue Science Park (Karlskrona), Science Park Mjärdevi, Luleå Science Park, Uminova Innovation (Umeå), Automation Region (Västerås), the Swedish Agency for Government Employers, and eSam. See Appendix 1.

Appendices 1 and 2 to the competence shortage report

Appendix 1: Presentation of survey

General methodology
Conducting surveys that achieve high response rates is undeniably difficult, especially when the questions are complex. Answering what competence needs will look like in a few years' time, and what actions are needed to deal with any gaps, demands a lot from the respondents:

- They should have a good understanding of the impact that technological and commercial changes in the world have on their own business.

- They should have a good overview of their current staff situation.

- They should be well-informed of various educational forms and how these can be adapted to meet changing needs.

Very few people master of all these perspectives. Choosing respondents by random selection, instead of first identifying recipients that master the above perspectives, would give a response rate far too low to be useful.

The method for producing the basis for this report has therefore been to identify the right respondents by sending a preliminary questionnaire to a wider audience. Sent out via various networks in January 2020, (se "Sources" above), this preliminary questionnaire consisted of two questions:

1. Does your company/organisation have a clear need to recruit digital cutting-edge expertise in the next few years?

2. (If yes to question 1) Would you, or someone else in your organisation, be willing to complete a longer questionnaire (15–20 minutes) about your need for digital cutting-edge expertise, which is expected to be sent out around the 20th of February?

The answers to the preliminary questionnaire provided a mailing list for the standard questionnaire (hereinafter referred to as the "main questionnaire") consisting of 345 respondents.

Prior to sending out the main questionnaire, all the respondents received a preparatory memorandum containing background facts on all the questions in the questionnaire.

The main questionnaire
The questionnaire was open during the period from 21 February to 10 March 2020. It was sent as unique links to each of the 345 respondents by e-mail and was also available via an open link distributed via the web, newsletters, and social channels.

A total of 212 responses were received, 194 of which came in via the respondent-unique links. This means a response rate of approximately 56 percent.

Given that the questionnaire was targeted at recipients who had previously expressed their need for IT/digitalisation competence, the survey results cannot be considered statistically significant. The results do give clear indications, however, which we and other sources (e.g. Public Employment Service forecasts, National Institute of Economic Research economic tendency surveys and Confederation of Swedish Enterprise recruitment surveys) believe provide a reliable overall picture. This is further confirmed by the uniformity of the answers in the questionnaire, regardless of region or line of business.

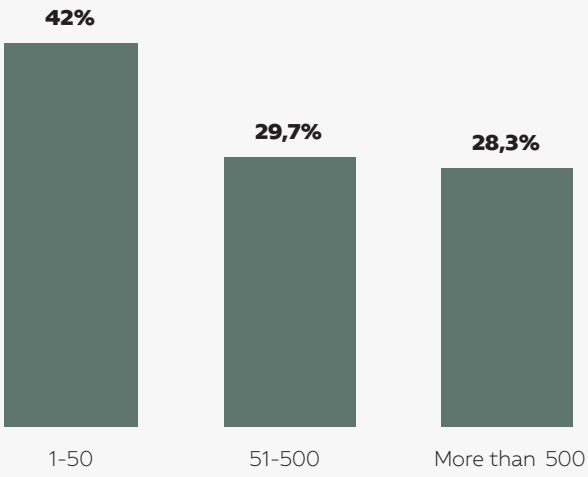
A special comment on the effects of the corona pandemic: The main questionnaire was available to respondents just before the pandemic hit. This report was originally planned for publication in May 2020, but due to the pandemic, Swedish IT and Telecom Industries decided to hold off on the final report. (Charts of the questionnaire answers were, however, presented in April 2020, see below). In October 2020, a follow-up questionnaire was sent to the 212 respondents who had answered the original questionnaire, focusing on only one question, namely what the need for individual competencies looks like in the next 3 to 5 years (i.e. the same as in chart 5 on page 16 in the report). This questionnaire was open during the period from 14 to 26 October, and a total of 137 responses were received, yielding a response rate of 65%.

The comparison between the answers in February/March and those in October showed only minor differences. If, for each competence, you calculate an average change rate in the February/March questionnaire (e.g. for Data Science in chart 5, where, together, the different coloured bar sections indicate an increase rate of 13.1 percent per year) and compare that to the corresponding change rate in the October questionnaire (where the rate for Data Science was 13.4 percent), the answers generally differed less than two percentage points, with no clear rising or falling trend. The average difference was plus 0.8 percentage points.

A detailed presentation of most questionnaire responses was published on the Swedish IT & Telecom Industries website on 14 April 2020, see link https://www.itot.se/2020/04/resultat-fran-kompetensenkat-underlag-for-uppskjuten-rapport/. Presented below are a selection of charts, which, together with the charts in the body of the report, should give a sufficiently detailed overview of the questionnaire responses to assess the report's analysis and proposals.

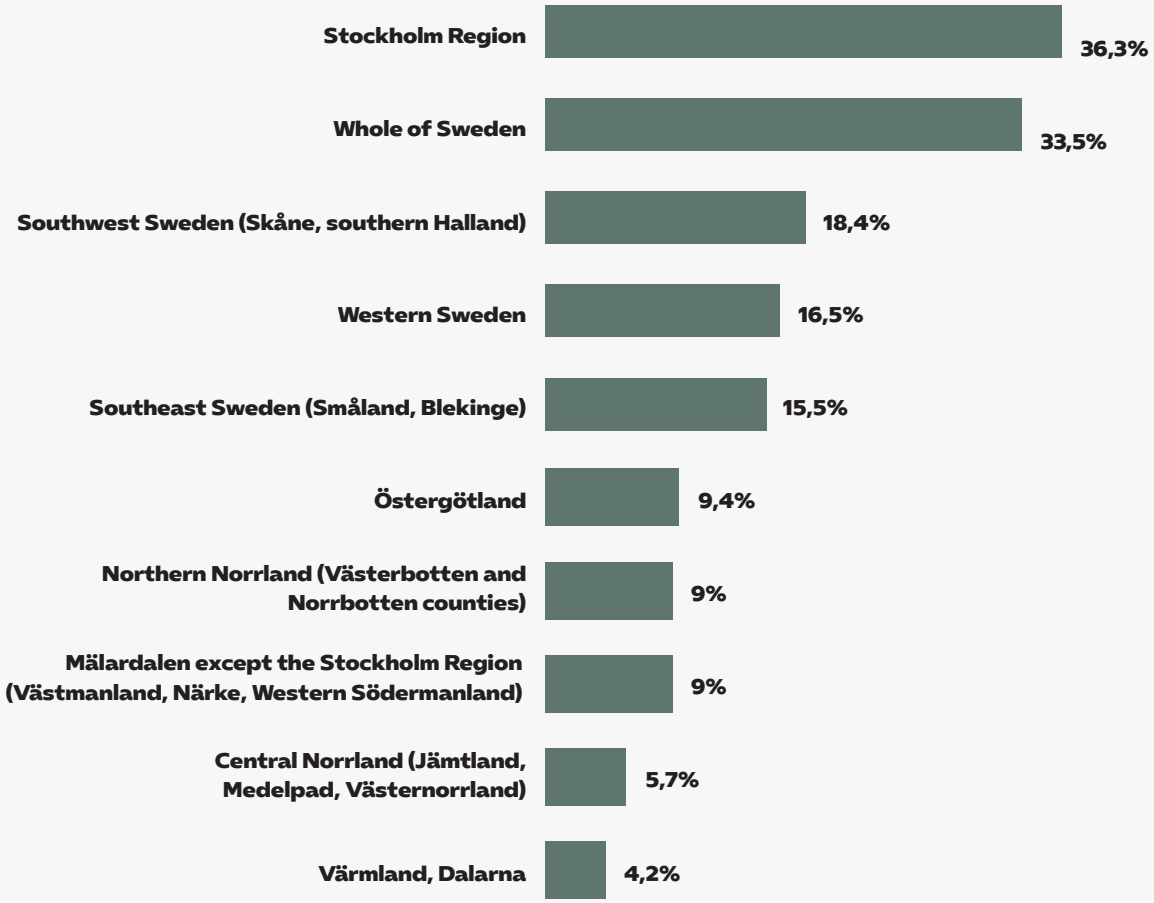
Distribution of size categories

Number of employees in Sweden



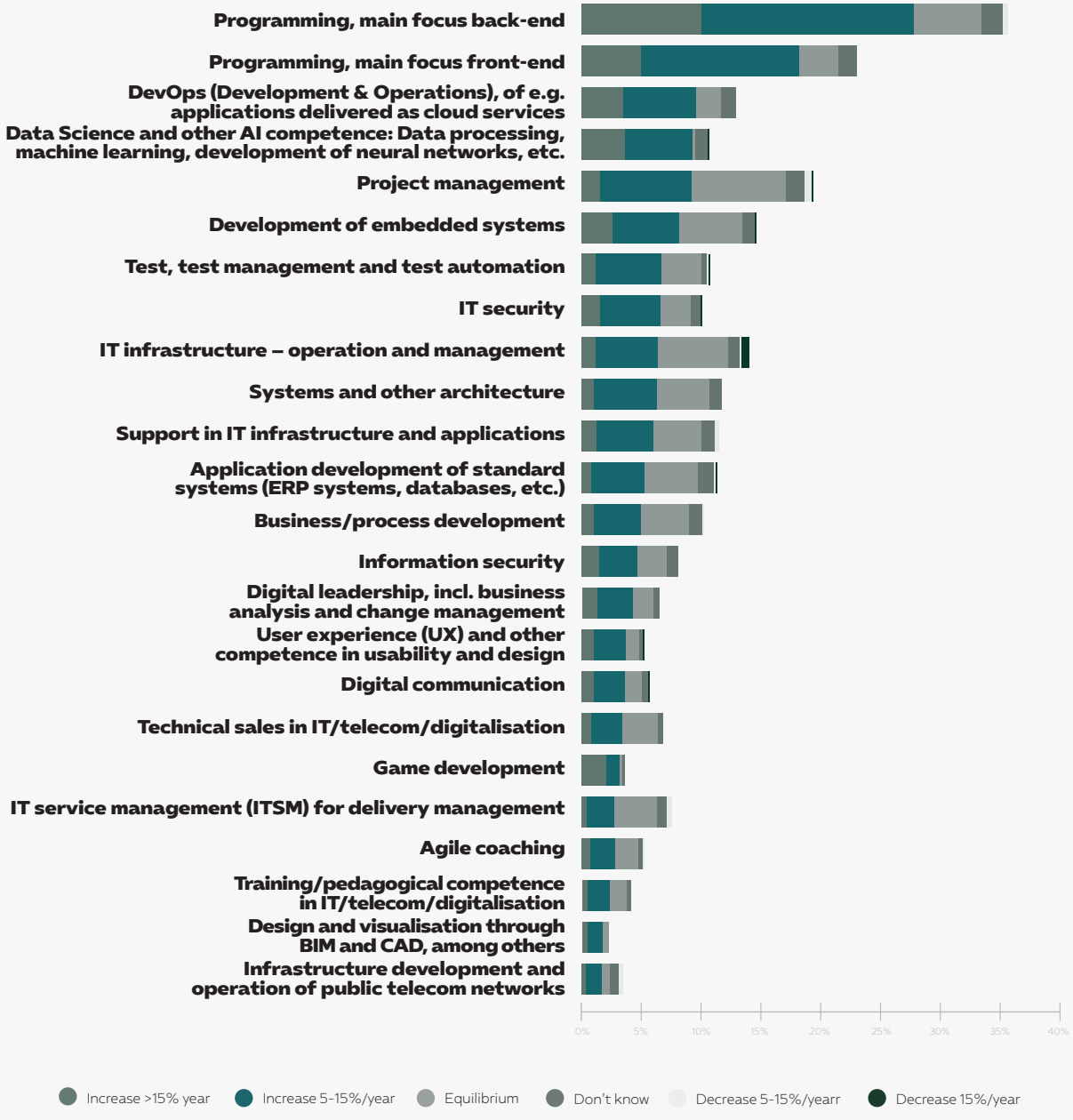
Regional distribution

Questions: "Regions where we have employed staff" (multiple selections possible)



Need for competencies in the next 3–5 years

Question: "What does the need for new recruitment, or competency development, of people with each of the below competencies look like in the next three to five years?" *



*The total length of the bars corresponds to the average number of people currently working in Sweden per organisation. The bars are sorted by total proportion of "Increase by 15% or more per year" + "Increase by approx. 5–15% per year".

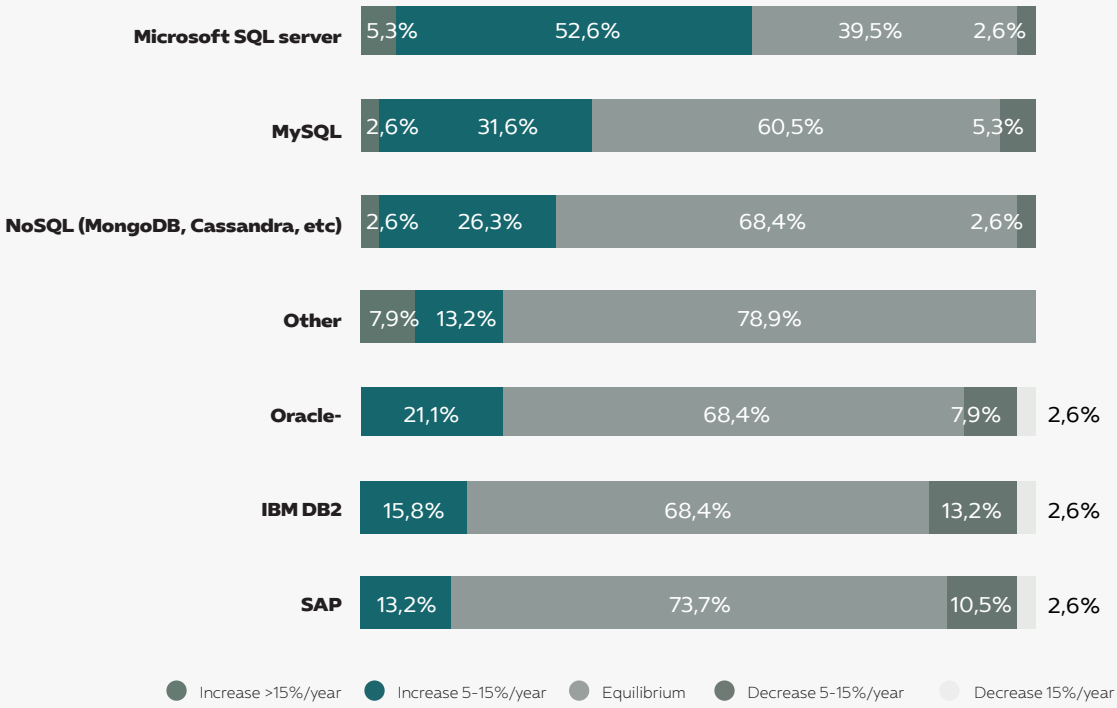
Number of people based abroad who deliver to Sweden

Question: "Approximately how many with each of the below competencies are based abroad (as either employees or consultants) and deliver to Swedish operations?"*

* The question aims to paint a picture of how many could potentially be working in Sweden if the conditions were different (such as it being easier to find the competence in Sweden). The numbers can be compared to the number of people working in Sweden in the corresponding roles, see chart 4 in the body of the report

Database competencies in demand

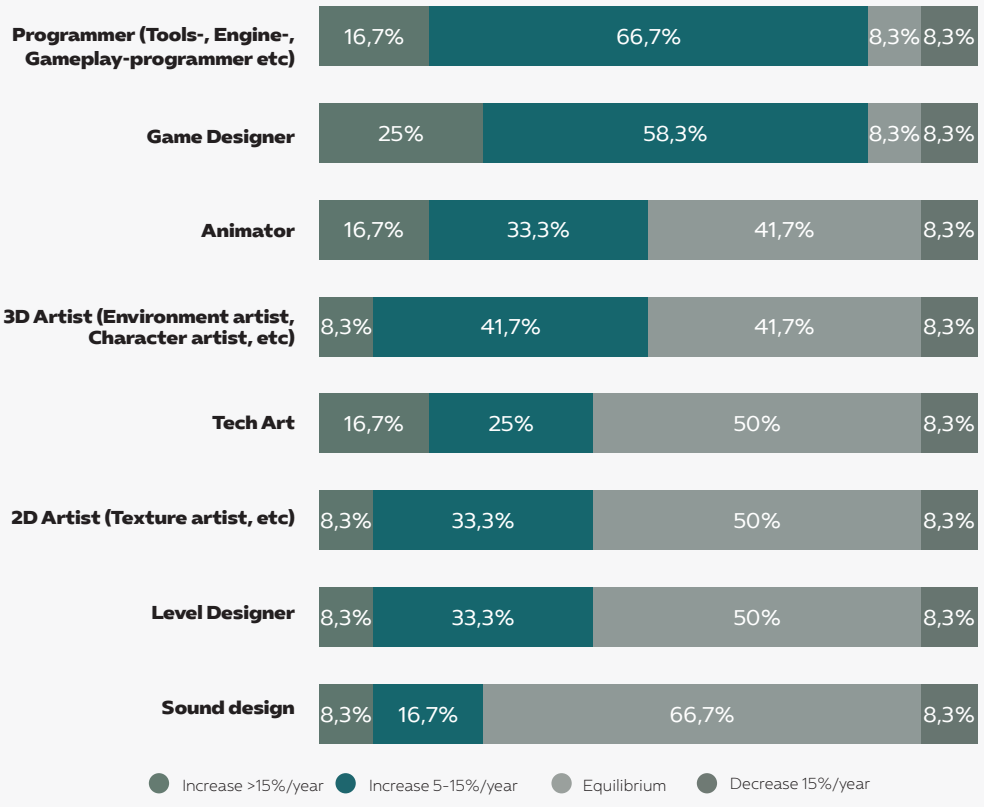
Question: "What does the need for people with the below competencies look like in the next three to five years?"*



*Follow-up question for those who selected any of the "increase" options for the competence "Application development of standard systems"

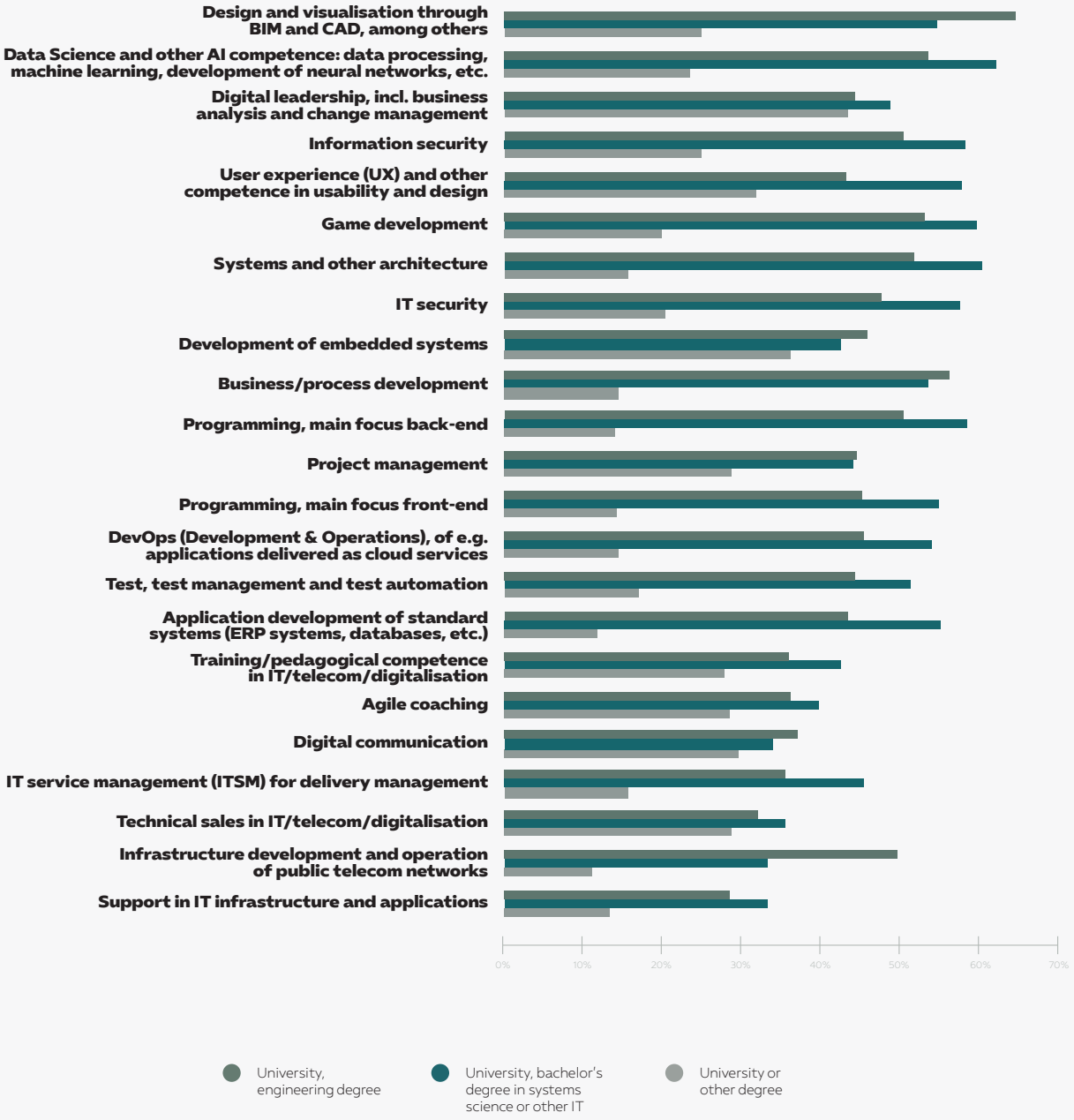
Game development competencies in demand

Question: "What does the need for people with the below competencies look like in the next three to five years?"*



Educational background – answer options university

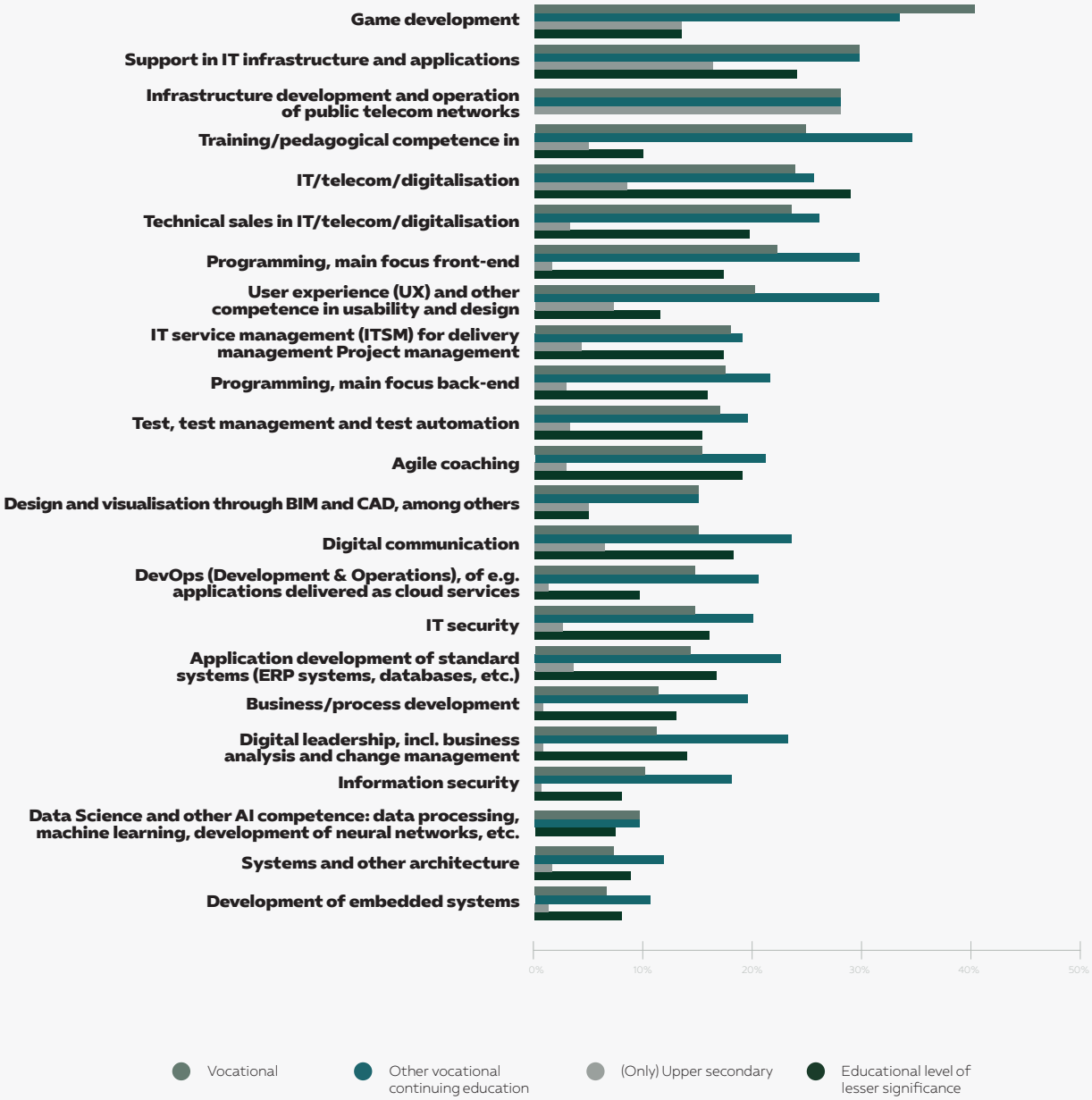
Question: "As a general rule, what educational background should the people needed in the above competencies have? Multiple selections possible."*



* The question had seven answer options in multiple-choice form. This chart shows the answers for the three university options, sorted by the competencies with the most total proportions. For non-university answer options, see the chart above

Educational background – answer options vocational college and other

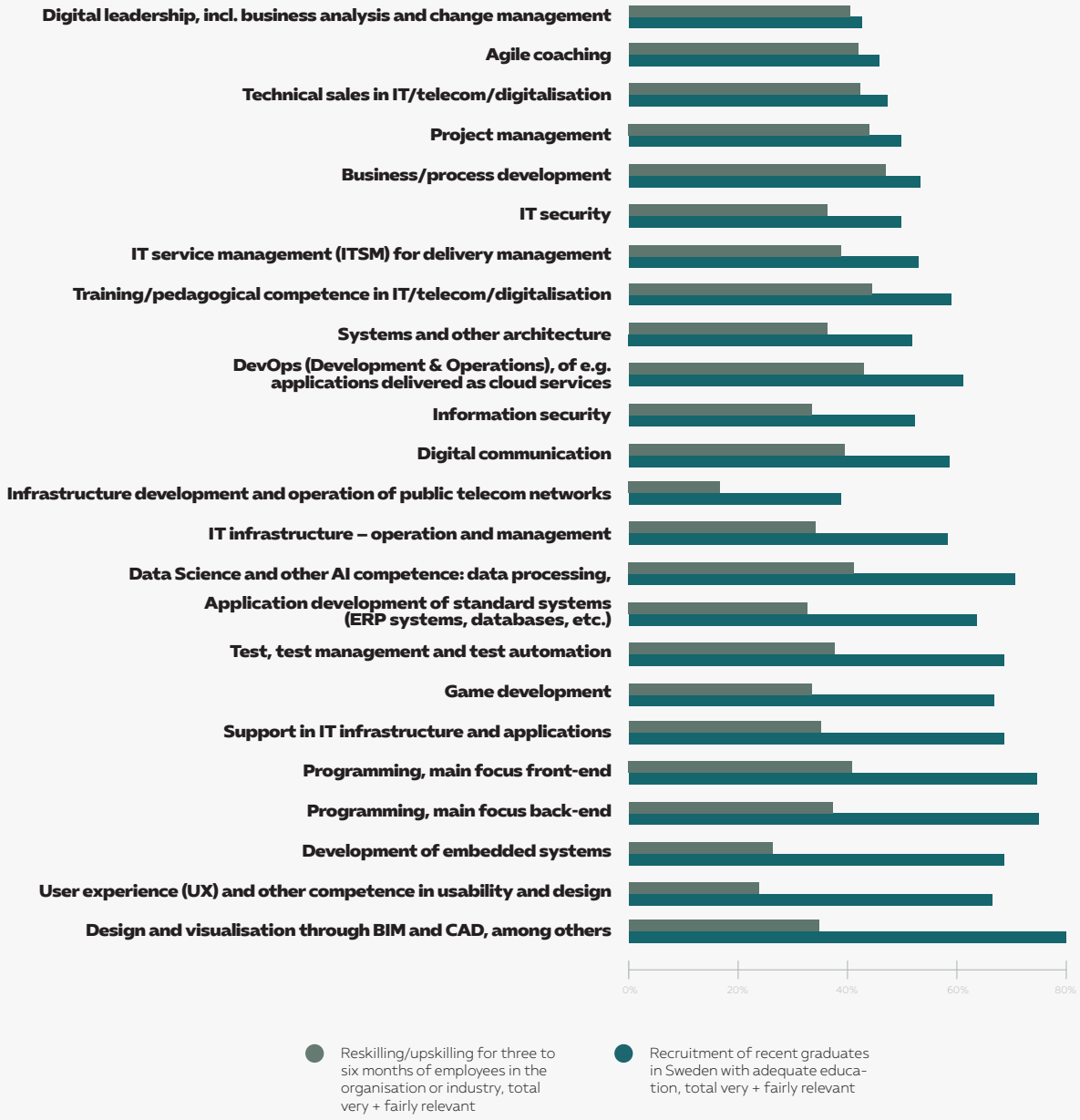
Question: "As a general rule, what educational background should the people needed in the above competencies have? Multiple selections possible."*



*The question had seven answer options in multiple-choice form. This chart shows the answers for the four non-university options. The competences are sorted by largest proportion of "vocational college".

Alternative to recruiting a “finished competence” – comparison between reskilling/upskilling within the industry and recent graduates

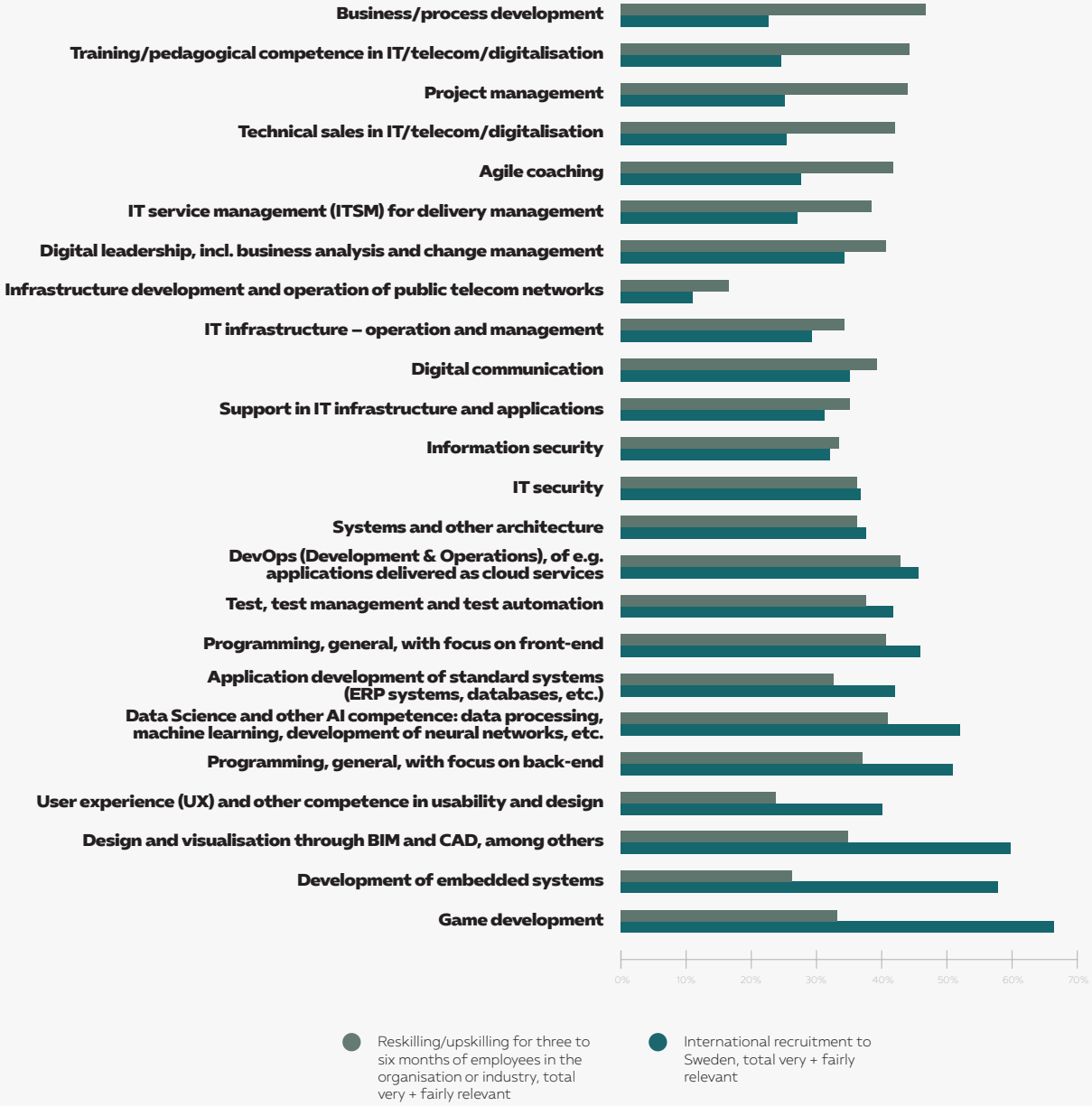
Question: “As an alternative to recruiting a “finished competence” from other companies or hiring consultants in Sweden, how relevant are the following sources, or paths, to increased competence?" *



* In each bar, the proportion of “very relevant” and the proportion of “fairly relevant” answers have been added together. The bars have been sorted by the significance of reskilling/upskilling in relation to recruitment of recent graduates.

Alternative to recruiting a "finished competence" – comparison between international recruitment and reskilling/upskilling within the industry

Question: "As an alternative to recruiting a "finished competence" from other companies or hiring consultants in Sweden, how relevant are the following sources, or paths, to increased competence?"*



* In each bar, the proportion of "very relevant" and the proportion of "fairly relevant" answers have been added together. The bars have been sorted by the significance of reskilling/upskilling in relation to international recruitment.

Appendix 2: Description of occupational roles, the competencies they cover, and expected growth in need.

CATEGORIES IT OCCUPATIONAL ROLES	COMPETENCIES COVERED BY THE ROLE	CORRESPONDING ROLE ACCORDING TO THE SCB SSYK 2012 *)	ESTIMATED TOTAL WORKING TODAY **)	INCREASED NEED IN THE NEXT FOUR YEARS, TOTAL ***)
Software/Systems Developer	·Programming front-end ·Programming back-end ·Development embedded systems ·DevOps, of e.g. applications delivered as cloud services ·Game development	Software and Systems Developers, etc. + Developers in games and digital media	64500	25500
Project Managers	·Project management ·Agile coaching ·Design and visualisation through BIM and CAD, among others		19300	5000
IT Architects	·Systems and other architecture	Systems Analysts and IT Architects, etc. + other IT specialists	7900	2100
Advanced Data Analysts and Database Developers	·Data science and other AI competence ·Application development of standard systems ·IT service management (ITSM)		19900	6300
Business Developers /Business Consultants	·Business/process development	Management and Organisation Developers	5700	1800
Testers	·Test, test management and test automation	Systems Testers and Test Managers	4900	1300
System Managers	·IT infrastructure – operation and management	Systems Managers, etc. + Systems Administrators	10600	2400
Infrastructure Experts, both IT and telecom	·Infrastructure development / operation public telecom networks	Graduate engineer professionals in electrical engineering + Engineers and technicians in electrical engineering	12900	3300
Support Technicians, IT	·Support in IT infrastructure and applications	Operations Technician, IT + Support Technician, IT	21500	4800
Infrastructure Technicians, Telecom	·Infrastructure development and operation of telecom networks	Network and Systems Technicians, etc.	10000	2600
Sellers with business responsibility	·Sales in IT/telecom/digitalisation	B2B Sellers	10500	2000
Information /IT Security Experts	·IT security ·Information security	IT Security Specialists	2300	900
Usability Experts in IT	·User experience (UX), usability, and design	Designers in games and digital media	3200	1000
Digital Leaders / IT Managers	·Digital leadership / IT management, incl. business analysis and change management	IT Managers level 1 + 2	9600	3500
Trainers in IT/telecom	·Training/pedagogical competence in IT/telecom/digitalisation	Other trainers and instructors	230	80
Digital Communicators	·Digital communication	Information Officers, Communicators, and PR Specialists	1800	600
TOTAL			**204 700**	**63 200**

*) The roles in italics are generic, non-IT/telecom specific roles. When the estimated total working people has been calculated, only those in the role who are working in Information and communication (J in Statistics Sweden) are included. This leads to an underestimation, as, for example, digital communicators working in other sectors are not included.

**) The starting point for the assessment is the number working in 2016 and 2017 in the corresponding SSYK category (column on the left) officially recorded by Statistics Sweden. The differences between the 2016 and 2017 figures have conservatively been extrapolated by one year. For the role categories that do not have an exact equivalent in SSYK (e.g. Project Manager), the average number working in the equivalent competency according to the survey (see chart 4) has been used as a distribution key.

***) Assessment based on the questionnaire, with the answers to the questions about the needs in 3-5 years' time as a basis. A downward adjustment of 30 percent has been baked into the calculation, cf. description in the report's main text "This is how we arrived at 70 000".

A REPORT FROM SWEDISH IT&TELECOMINDUSTRIES

The IT Competence Shortage

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