Do IS Curricular Guidelines Match Employer Expectations in Swedish IS Job Ads?

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Abstract

This study examines whether the IS 2010 Curriculum Guidelines and IS2020 Competency Model match employer expectations in Sweden. This is done by content analysis of 12 358 IS job advertisements, focusing on occupations, dispositions, technical skills, architecture, and the importance of programming. We find that: 1. The occupation group of ICT System Administration is much more important than in the IS 2010 and the IS2020 reports; 2. Enterprise Architecture is important in the ads and in the IS 2010 but not in the IS2020 report; 3. The most important personal dispositions in the ads are more important than in the IS 2010 and IS2020 reports; 4. Overall programming skills are important, but with less depth and extension than the IS2020 report specifies. 5. The IS2020 report's technical stance over a more business-focused one is only partly supported. These differences might reflect the pre-dominantly US perspectives underlying the curricular guidelines.

Keywords: IS education, IS curricula, IS/IT employer expectations, IS curricula & employers' expectation match.

1. Introduction

Information Systems (IS) and the use of IS could be argued to be one of the most important, if not *the* most important, emblematic, and ubiquitous technologies in our modern society. This implies that teaching and understanding of how IS interacts with business and society should be of central importance. Even though academic programs catering to IS knowledge started to appear in the late 1960's, the major professional body, i.e., the Association of Information Systems (AIS), was not established until the mid-1990's.

This indicates that the field is still young and one representation of this can be seen in the fact that we find academic programs centred around IS in many different faculties as well as different departments within the faculties [1, 2]. IS permeates everything in our everyday life, and the way we interact with different systems and technology increases every day and, in that capacity, it should be apparent that an up to date and functioning IS curriculum is of vital importance.

The latest guideline for IS curriculum [3] came right before the global pandemic and the second newest [4] is now 13 years old. In between these years a few studies have been done in order to verify to what degree academic programs adhere to the IS 2010 guidelines, most notably [2] did a comprehensive study on the Australian undergraduate Information System curricula as a comparative study towards other studies done in a similar fashion. Steen and Pierce [1] did a comparative study from a Swedish context in order to get a clearer view of what courses should be core in a post 2020 setting where one interesting difference was that Swedish programs have a clear focus towards application development

as well as Enterprise Architecture (EA). This is interesting in so much that the IS2020 report has removed EA as a separate competency area and instead increased the focus on IT infrastructure. Since the launch of the IS2020 we have seen both a pandemic and the inroad of everyday use of AI which could be argued to have an effect both on how we should structure our education, but also on the job requirements of the future. IS education in general is focused on different occupations, and as such it is interesting to understand how well IS curriculum guidelines match the employer expectations. The research question in this study therefore is: How well do IS2020 and IS 2010 match employer expectations expressed in IS job advertisements within a Swedish context? The purpose of the study is to compare key aspects within IS2020 Competency Model and IS 2010 Guidelines with the IS job advertisements.

2. IS Curricula Development

Over the decades, there has been a long-standing debate regarding the maturity of the Information Systems field, with some arguing that it even exhibits some uncertainty about its own identity e.g., [5]. However, the rapid pace of technological change on which IS is built suggests that the field must constantly evolve with the developments of Information and Communication technology (ICT) to stay relevant [3]. Topi and Valacich [6, p. 731] argues that: "[…] the professional context in which our graduates do their work has changed considerably over the past decade, and this change should be reflected in the curriculum." This sentiment is echoed by Leidig and Salmela [3] who argue that the exceptional growth and proliferation of digital technologies has meant IT maturation across society and interrelated technologies which will inevitably lead to both quantity and variety of competencies of IS professionals which in itself warrants a continuous evaluation of our IS education.

Over the past decades there has been an ongoing and healthy debate on both how, and when, to update IS curricula. One of the driving factors behind the major revision of the IS curricula, which became IS 2010, was the declining interest in studying IS as a field among students. While some of this decline could be attributed to the dot-com bubble bursting, it is still essential to acknowledge that the IS curriculum needs to be continuously updated due to the constantly changing nature of the subject [e.g., 7, 8, 9].

This has led us to present times where we found, and still find, criticism against the lack of programming in the IS 2010 Curriculum Guidelines, even though a program specifically designed after the IS 2010 Curriculum Guidelines [4] still puts relatively much emphasis om programming and program design.

Criticism has also been raised about the flattened structure of the IS curriculum [10]. According to Reynolds and Ferguson [10] students who studied under the IS 2002 curriculum had a greater depth of knowledge in specific areas compared to those who studied under the IS 2010 curriculum. One of the major changes in the IS 2010 curriculum was the inclusion of EA as a core module, which is considered one of the best ways to align information systems with business needs [11].

While discussions and criticisms about the IS field continue, it is worth noting that in his 2016 as well as 2012 study of the IS curricula in US AACSB-accredited colleges, Yang concludes that IS has become a mature discipline from the perspective of academic institutions [12]. We would argue that ongoing discussions are a natural part of the evolution of the field rather than indicating a crisis or lack of identity. This takes us the to the IS2020 Competency Model that is heralded to provide a valuable framework ensuring that IS curricula continue to evolve and adapt to the changing demands of the profession. We would argue that the 2020 model is an evolution of prior debates and as such there are some differences between the 2010 and 2020 frameworks, the biggest being:

- Focus on emerging technologies: IS2020 emphasizes the importance of emerging technologies such as artificial intelligence, machine learning, big data analytics, and cloud computing. These topics are given more weight compared to IS 2010. This is quite natural considering that we have seen the widespread use of generative AI over the last few years.

- Interdisciplinary approach: IS2020 claim to promote an interdisciplinary approach, emphasizing the importance of collaboration and communication between different disciplines such as computer science, business, and social sciences. This approach is designed to produce graduates who can work effectively in multidisciplinary teams. This could be argued to be another way of saying that IS graduates need to be able to understand how to develop a business which means that you cannot focus solely on technical aspects.
- Enterprise Architecture: IS2020 has removed EA as a separate competency area compared to IS 2010, which is somewhat surprising considering the focus on the interdisciplinary approach that is promoted and the fact that it has been established by for instance [11] that EA could be considered one of the best ways to align information systems with business needs.
- Increased emphasis on ethics: IS2020 places greater emphasis on ethical considerations, including the impact of technology on society, the importance of privacy and security, and the responsible use of data.
- Flexibility: IS2020 claim to offer greater flexibility in terms of course offerings, allowing institutions to tailor their curriculum to meet the needs of their students and local industry.
- More focus on project-based learning: IS2020 emphasizes the importance of project-based learning, encouraging students to work on real-world projects that simulate workplace situations. This approach helps students develop practical skills and prepares them for their future careers.
- Re-establishing programming: IS2020 re-establishes programming as a core concept at the behest of Enterprise Architecture in some sense.

This study sets out to analyse how higher IS education match and meet the skill and competency demands expressed by potential employers in the IS labour market. The primary focus is not on validating the differences between IS2020 and IS2010 but rather to analyse how well the IS curriculum meet employer expectations in actual IS job adverts.

3. Method and Dataset

One way to study what knowledge and skills employers expect of potential employees is by analysing published job ads since they "[…] are a major means by which employers indicate, more or less effectively, what they want from potential employees." [13, p. 340]. To collect job advertisements/postings from various sources and perform different kinds of content analysis to discover various employer expectations specified in the ads has been done several times before and in several different countries and contexts [see e.g., 13, 14, 15, 16, 17, 18, 19, 20, 21]. This method makes it is easier to achieve a big data volume and good coverage and is considered unobtrusive [22].

The dataset for this study is a local database with job ads fetched from Platsbanken ("The Position Bank") administered by the Swedish Public Employment Service (Arbetsförmedlingen – AF) government agency and shared as open data. AF is responsible for the Swedish public service to match job seekers with employers looking for hires. According to AF, Platsbanken is Sweden's largest and most visited employment website.

Employers create job ads that get published in Platsbanken. Everyone in Sweden can look for jobs there via the AF web page: https://arbetsformedlingen.se/other-languages/english-engelska. All the ads are also visible in the Eures portal (https://eures.ec.europa.eu/index_en) in the EU/EES and Switzerland, and all job seekers and employers in these countries can therefore use the service to apply for the positions and post job ads. The data were fetched using several REST services published by the AF subsidiary JobTech Development (https://jobtechdev.se/en) and were then cleansed and stored in a local MS SQL Server database for data coding and analysis.

3.1. Occupation Groups and Occupations

The occupations in Platsbanken are classified by SCB (Statistiska Centralbyrån – Statistics

Sweden) [23] according to the four level classification hierarchy of *Standard för svensk yrkesklassificering* (SSYK 2012). The SSYK 2012 classifications matches the International Standard Classification of Occupations (ISCO-08) by the International Labour Organization (ILO) [24] and the European Skills, Competences, Qualifications and Occupations (ESCO) classification by the European Union [25]. Hence, the occupation groups in the study are internationally recognised with standardised terminology and specification.

In this study, the job ads specify occupations that belong to the Level 2 occupation groups of *Science and Engineering Professionals* (code 21), *Information and Communications Technology Professionals* (code 25), and *Information and Communications Technicians* (code 35). Only ads of occupations that might attract IS/IT job seekers have been collected and stored. Most of the job ads (89.4%) specify an occupation that belongs to the Level 4 occupation groups of *Systems Analysts* (code 2511), *Software Developers* (code 2512), *Web and Multimedia Developers* (code 2513), *Applications Programmers* (code 2513), and *Database Designers and Administrators* (code 2521).

Each job ad in the Public Employment Service data store is further tagged with a Level 5 occupation code by AF, for example "fg7B_yov_smw" for *Systems developer/Programmer* within the *Software Developers* (code 2512) occupation group. This was replicated in the local database and no extra coding was needed to analyse for occupations and occupation titles in the job ads. In total, 91 such occupations are registered in the local database.

Apart from the occupation tag assigned to each job ad, the job ad texts constitute the data. The free-form text may be up to 6 000 characters in length and contains whatever the employer wants to convey to the job seeker. This would typically entail a description of the organization and what it does, the job profile, the work itself, the work environment and culture, expectations of knowledge and skills, expectations of education and experience, and expectations of personal traits and generic skills.

At the time of writing, the database contained 188 702 IS/IT job ads for 71 Level 5 occupations (see Appendix B). Hence, 20 of the Level 5 occupations in the database are not connected to any job ads (see Appendix C). The analysed ads have publication dates between 2017-05-02 and 2023-02-08. The database does not contain any data about type or size of the businesses in the ads.

3.2. Data Analysis

To analyse the ad texts, they were first open coded using SQL LIKE queries with wildcards ('%' and '_') and regular expression (REGEX). These phrases and codes were inductively generated from samples of between approx. 100 and approx. 1000 ad texts from the database. The samples were collected several times using an SQL query that returned random results from the database. The ad texts were copied and pasted into a Word or WordPad document for manual search for keywords and phrases that could be used to code the data for subsequent content analysis. The keywords and phrases were then compiled into SQL LIKE queries as previously described and used to create stored procedures which, when executed, created new analysis tables with ad texts fulfilling the coding criteria. The LIKE phrases thus served as descriptive open codes applied to the data. In this study, 36 phrases were used to code for *Higher IS Education* (see Appendix A), 167 phrases were used to code for *Personal Traits and Generic Skills* (see Appendix E), 82 phrases were used to code for *Technical Skills* (see Appendix F), and 76 phrases were used to code for *Architecture* (see Appendix G).

The analysis tables thus contain data that are descriptively coded, which is interesting, but were also used with JOIN and UNION queries to create further refined analysis tables to construct empirical findings. The open-source Eclipse BI tool BIRT version 4.9 was used for data analysis in the form of data cubes, diagrams, and tables. Reports and other outputs from BIRT were then exported to MS Excel and/or OO Calc for further analysis and table layout.

4. Findings

Of the 188 702 IS/IT/Computing ads in total, 12 358 (circa 6.6%) specify an IS education

(coded according to Appendix A) of the hires. In a few ads the specified education is instead Business Administration, Economics, Business Law, Law, or any other education that are important for many businesses. Many ads do not specify any higher education at all since personality traits, experience, attitude, etc. are considered as more important than or equally important to education. In others, education is not mentioned at all in conjunction with this. Some ads instead of higher education specify a vocational type of education in e.g., IT and computing.

4.1. Top 10 Occupations Specifying an IS Education Background

The top ten occupations in the job ads specifying an IS education as described above are listed in **Table 1**. These occupations account for 69.1% of all the ads specifying an IS education background. The occupation of *Systems Developer/Programmer* is by far the most frequently specified occupation with 45.1% of the job ads in the sample and 31.1% of the total IS education job ads. This occupation is specified more than four times more often than the next most specified occupation. Other system/software development centred occupations are also frequent in the ads with *Software Developer* in third place, *IT Architect/Solutions Architect* in fifth place, and *Back-End Developer* in ninth place. Hence, occupations that have to do with the technical side of IS are prevalent in the ads.

Table 1. Top 10 IS occupations

	IS Edu. Top 10 Occupations AF Level 5 (translated)	Corresponding Occupations ESCO Level 5	n	% of Sample	% of IS Total
1	Systems Developer/Programmer	ICT System Developer	3 848	45.1%	31.1%
2	System Manager	ICT System Administrator	919	10.8%	7.4%
3	Software Developer	Software Developer	776	9.1%	6.3%
4	Project Manager, IT	ICT Project Manager	773	9.1%	6.3%
5	IT Architect/Solutions Architect	ICT System Integration Consultant	550	6.4%	4.5%
6	System Administrator	ICT System Administrator	407	4.8%	3.3%
7	IT Strategist	Software and Applications Developers and Analysts Not Elsewhere Classified	345	4.0%	2.8%
8	System Operator	ICT System Administrator	334	3.9%	2.7%
9	Back-End Developer	Cloud Engineer	295	3.5%	2.4%
10	Business Consultant, IT	ICT Business Analysis Manager	294	3.4%	2.4%
	Total		**8 541**	**100.0%**	**69.1%**

These findings partly support the perspective in the IS2020 report, where a more technical stance is clearly noticeable in the so-called competency architecture in the report [26, p. 51]. It shows a clear interest in data management, technology, and software development.

The table of top ten IS occupations also includes jobs that are more focused on business development with an IS/IT focus. For example, *IT Strategist* in seventh place and *Business Consultant, IT* in tenth place. This suggests that the Swedish IS job market is also looking for hires with skills that are more business-focused, as expected by the field and IS education programs in Sweden. However, this aspect is not covered in depth in the IS2020 competency architecture. While the IS2020 Competency Model's *Organizational Domain* partly covers this area, it is only one of four domains. The three other domains are more technical in nature. Our findings thus only partly support this technical stance over a business-focused one.

The job occupations ranked number two, six, and eight in the list (*System manager, System Administrator,* and *System Operator*) belong to the *ICT System Administrator* occupations according to the ESCO classification and hence the administrative sector of the

IS job market. These occupations are not related to designing and constructing systems and software applications, or with business development. Rather, they are focused on the management of existing systems and their applications. These occupations involve tasks such as keeping the systems running, managing user accounts, and maintaining the systems.

In both the IS2020 Competency Model and the IS 2010 Curriculum Guidelines, *ICT System Administration* is not a domain, core competence, or core course. The IS 2010 Curriculum Guidelines has parts of this under the core course *Enterprise Architecture* and the elective course *IT Audit and Controls*. The IS2020 Competency Model has parts of this in the *IS Management and Strategy* area under the *Organizational Domain* competency realm. However, in the top ten list in **Table 1**, three occupations are in the occupation *ICT System Administrator* (ESCO Level 5) area with the occupation *System Manager* (AF Level 5) as the second most occurring occupation in the ads. The importance of these occupations in the ads is reflected neither in the IS 2010 Curriculum Guidelines nor in the IS2020 Competency Model.

One reason for the discrepancy between foremost the IS2020 report and our findings around occupations, could be the predominance of North American perspectives in the IS2020 report. The *Joint ACM/AIS IS2020 Task Force* responsible for the report is composed of six representatives from North America (USA), one from Europe (Finland), two from Africa (South Africa), one from Oceania (New Zealand), and one from Asia (Singapore). Hence, USA accounts for 55% of the representatives and probably also 55% of the perspectives.

In addition, the report's discussion on occupations and job titles is primarily built on the AIS Job Index, which is a pure US data source. Our study gives reason to believe that the AIS Job Index and the Swedish IS/IT job market, as reflected in Platsbanken, are only partly overlapping. Obviously, a primarily US outlook is less suitable for the Swedish context.

4.2. Personality Traits and Generic Skills

In the ads expecting an IS education, 20 personality traits and generic skills occur 45 861 times in the ads (**Table 2**). Almost all (97.3%) of the IS ads specify at least one of them. It is quite clear from the table that the top three personality traits and generic skills of being *Communicative*, good at *Swedish and/or English, Spoken and Written* (language proficiency broadly speaking) and being *Cooperative* are the most important ones. To the contrary, being *Motivated*, *Goal-Oriented*, *Enthusiastic*, and *Driven* are mentioned in less than 1% of the ads.

Figure 1 shows a word cloud[1] for the personality traits and generic skills in **Table 2**. It makes it visually clearer what the relative importance of the personality traits and generic skills are. Apart from the top trio in **Table 2**, being *social*, *problem solver*, *creative*, and *independent* are clearly important personality traits and generic skills. The IS2020 report [26, p. 41] lists ten dispositions, what we in this study call personality traits and generic skills. That list and our list in **Table 2** only partly overlap and differently to our list, the dispositions in the report are not ranked. In the 2020 report, written and oral communication is "[…] emphasized… [as] relevant and significant" [26, p. 49]. In our analysis in **Table 2** and **Figure 1** it is beyond doubt that to be communicative and have language proficiency in Swedish and English are very important personality traits and generic skills, rather than just relevant and significant.

The analysis also shows quite clearly that *cooperative* (corresponds to *Collaborative* in [26]) is the most important trait and significantly more important than e.g., *meticulous* (*Meticulous* in [26]), *self-going* (similar to *Self-directed* in [26]), *enthusiastic* (similar to *Passionate* in [26]), and *goal-oriented* (similar to *Purpose-driven* in [26]).

[1] https://tagcrowd.com/

Table 2: Personality Traits and Generic Skills

Category	n	%
Cooperative	7 605	16.6%
Communicative	6 806	14.8%
Swedish and/or English, Spoken and Written	6 127	13.4%
Self-Going	3 172	6.9%
Problem Solver	2 716	5.9%
Curious	2 660	5.8%
Analytic	2 436	5.3%
Creative	2 214	4.8%
Structured	2 119	4.6%
Independent	1 935	4.2%
Social	1 935	4.2%
Inventive	1 839	4.0%
Meticulous	1 810	3.9%
Proactive	966	2.1%
Organized	651	1.4%
Motivated	290	0.6%
Goal-Oriented	230	0.5%
Enthusiastic	149	0.3%
Driven	101	0.2%
Stress Resistant	100	0.2%
Total	**45 861**	**100.0%**

Figure 1. Word cloud for Personality Traits and Generic Skills in ads specifying an IS education

Knowledge and Skills in the IS 2010 Curriculum Guidelines, *Leadership and collaboration, Communication,* and *Negotiation* are laid out and explained. Topi et al. [4, p. 21] write:

> […] they are very important for Information Systems programs because it is impossible for IS graduates to exhibit the required high-level IS capabilities without these foundational knowledge and skills.

From this perspective, the IS2020 report is not a step forward compared to the IS 2010 guidelines and is furthermore not in line with the findings from our data analysis.

4.3. Technical Skills

An analysis of 25 technical skills categorized into nine skill areas in the IS ads was performed and the results are shown in **Table 3**. The table clearly shows that *Cloud Infrastructure, Operating Systems,* and *Software Development, Issue Tracker, and Versioning Infrastructure* are the most important technical skill areas when combined. Much less important technical skill areas are e.g., *Database Software / RDBMS* and *Office and Personal Productivity Software.*

The skill areas in **Table 3** to some extent support the conclusions in the IS2020 report [26]: *Cloud Infrastructure*, *Application Servers*, and *Operating Systems* are relevant parts of the *Technology competency realm* while *Software Development, Issue Tracker, and Versioning Infrastructure*, and *Cooperation and Team Workspace Infrastructure* are relevant parts of the *Development competency realm*.

Significantly less support is given by the *Database Software / RDBMS* and the *Web Service Protocols* skill areas. These are respectively relevant for database technology and IT infrastructure/IT Architecture. These are in turn parts of *Data and Information Management* and *IT infrastructure* (discussed further down) competency areas in the IS2020 report [26].

Table 3: Technical skill areas mentioned in the IS ads

Skill Area	n	%
Cloud Infrastructure (MS Cloud/Azure, AWS, VMware, Google Cloud, HDP/Cloudera)	1 786	14.5%
Operating Systems (Linux, MS Windows, Unix, Android, iOS)	1 706	13.8%
Software Development, Issue Tracker, and Versioning Infrastructure (Docker, Jira, Git/Maven/Bitbucket)	1 123	9.1%
Cooperation and Team Workspace Infrastructure (SharePoint/Dynamics 365, Confluence)	450	3.6%
Application Servers (WebSphere, Tomcat, Apache Server, WebLogic, JBoss, Microsoft Dynamics, Microsoft Business Solutions)	242	2.0%
Database Software / RDBMS (MySQL, MS SQL Server, Oracle, Postgres)	88	0.7%
Office and Personal Productivity Software (MS Office, Photoshop)	29	0.2%
Mainframe	28	0.2%
Web Service Protocols (REST, SOAP)	4	0.0%
Total	**5 456**	**44.1%**

Our impression of the IS2020 Competency Model is that designing, building, and using databases are quite important competencies and skill areas. In our analysis of job ads per occupation, *Database Developer* is in place 46 out of 71 with 0.8% of the IS job ads and *Database Modelling* is mentioned in 2.7% of the IS job ads. Less technical and more conceptual and business-related *Data Modelling* and *Information Modelling* are together mentioned in 65.3% of the IS job ads. Hence, it seems rather more important to have the skill to make conceptual *data* models than physical *database* models. This could of course be

down to that database design and development are inherent in information and data modelling. Even so, emphasis on databases and database technology does not seem very relevant in comparison to data and information models, based on the findings in our study.

4.4. Architecture

In the IS 2010 Curriculum Guidelines [4] *Enterprise Architecture* (EA) is important and a core course. In the IS2020 Competency Model [26] is EA not included as a competency area for undergraduate programs and is referred to graduate studies.

Our job ads data analysis shows that *Enterprise Architecture*, *Business Architecture*, *Systems Architecture*, and *Service Architecture*, which together more or less constitute the term EA in the IS 2010 Curriculum Guidelines [4], are mentioned in 15.1 % (1 868) of the IS job ads. Hence, various types of architecture under the bigger umbrella of EA are quite important in the ads.

Considering the undergraduate/graduate dichotomy of the IS2020 report [26] and that EA would be referred to graduate studies, we analysed the data to see whether this would be supported. Of the 12 358 IS education ads, 2 032 (16.4%) specify an undergraduate (2.7%) or graduate (13.7%) IS education. Within these two groups 15.9% of the undergraduate and 12.6% of the graduate ads mention the four EA architecture types above. Based on these small numbers we may not draw the conclusion that EA in fact is as important as in the IS 2010 Curriculum Guidelines [4], but it is interesting to see that EA is equally present in ads expecting an IS undergraduate as in ads expecting an IS graduate education. Hence, we do not find support for the position expressed in the IS2020 report [26] that EA should not be included as a required competency area and be primarily addressed at Master level of IS education.

In the IS2020 Competency Model [26, p. 54] the *IT infrastructure area* of the *Technology competency realm* is considered as a core competency area in IS programs. A quick look in Wikipedia reveals that *IT infrastructure* may be subsumed under the broader term of *IT architecture*. In our analysis, 6.8% of the IS ads mention *IT architecture*, which is less than *Service Architecture* (8.0%) and less than half of the percentage for the combined architectures (15.1%) under the EA umbrella discussed above. The type of IT infrastructure that the IS ads consider important according to **Table 3** is *Cloud Infrastructur*e and the various major suppliers of that. Contrary to the IS2020 report's [26] de-emphasis of EA and interest in IT infrastructure, we instead see more interest in EA and less in IT infrastructure apart from Cloud Infrastructure. As with the occupations discussed earlier, this could have to do with the difference between the primarily US perspectives in the IS2020 report and the Swedish perspectives in this study, and hence that US perspectives might not be as universal as they seem to be in the IS2020 report.

4.5. Programming or Not?

Another important topic in the IS2020 Competency Model [26] is the re-introduction of program and software development as a core competency. This was left out from the IS 2010 Curriculum Guidelines' [4] core courses, which has been discussed and criticized in e.g., the IS2020 report [26] itself and in [7, 8, 9]. In the IS2020 report [26], *Object-Orientation*, *Web development*, and *Mobile development* are discussed. Under these headings quite a few details are specified, e.g., encapsulation, design patterns, and back-end programming, as needed knowledge and understanding in the *Application Development and Programming* area.

Our analysis suggest that the broader area of programming indeed is important in the IS ads since 25.4% of them mention programming in some form and 76.2% of them list any of 12 programming languages (see Appendix D). However, parts of what the IS2020 report [26] include under the *Application Development and Programming* area could be considered as *Software Architectur*e and our analysis finds that only 1.2% of the IS ads specify such architecture. In addition to this, 32.2% of the IS ads specifically do not mention the word "programming" in any form. Hence, our conclusion is that software development and programming knowledge and skills on a general level are important in IS ads,

but maybe not important with the depth and extension that the IS2020 Competency Model [26] specifies. This is especially true given the very recent and current development within generative AI, where for instance GPT-4 can write code and work with many of the details that the IS2020 Competency Model specifies as baseline competencies.

5. Conclusions

In this study we have compared employer expectations of IS hires expressed in Swedish job ads with important skills and competencies specified in foremost the IS2020 Competency Model [26] but also the IS 2010 Curriculum Guidelines [4].

This is done through content analysis of 12 358 texts in job ads specifying an IS education background out of 188 702 IS/IT/Computing ads. The job ads were collected from the Swedish Public Employment Service (Arbetsförmedlingen – AF) government agency's open data and were published in the agency's employer service Platsbanken ("The Position Bank") between 2017-05-02 and 2023-02-08.

An overall conclusion from the findings is that the 12 358 ads specifying an IS education comprise only 6.6% of the total amount of collected IS/IT/Computing ads. Hence, a small fraction of the ads specifically specifies a higher IS education background of the hires. We have no explanation for this other than that the IS/IT/Computing labour market in Sweden to a lesser degree seem to value a formal higher IS education.

We analysed the data for the top ten occupations specified in the ads specifying an IS education background and found three broad categories: *Systems and application development*; *Business Development with an IS/IT focus*; and *ICT Systems Administration*. Compared with the IS 2010 Curriculum Guidelines and the IS2020 report the two first categories of occupations are matched by core subjects and, to some extent, competency realms. In the case of *Business Development with an IS/IT focus* the IS2020 report is a bit less specific and elaborated. *ICT Systems Administration* is a core in neither the IS 2010 guidelines nor the IS2020 report, which matches poorly with the occupation top list where this occupation category is specified in 13.4% of the IS education ads.

The second interesting result in this study is that the personality traits and generic skills of *Cooperative*, *Communicative*, and *Language proficiency* are very important in the ads. Even if the IS2020 report on one hand acknowledges this to some extent, it does not give these skills/dispositions attention to the same extent as the ads do. On the other hand, the IS2020 report considers technical skills to be quite important. We find some support for this position in our empirical results, but we also find that skills in database software and IT infrastructure are less important in the ads than they are in the IS2020 report.

The third interesting result in this study is the relatively high importance of *Enterprise Architecture* (EA). In the IS 2010 Curriculum Guidelines, EA was a core subject but in the IS2020 report EA is mostly delegated to Master level. We do not find support for this position in our study since we find that 15.1% of the IS education ads mention an architecture area that fits under the broader category of EA in IS 2010 Curriculum Guidelines. *IT Infrastructure* (subsumed under *IT Architecture*) is however not nearly as prevalent in the ads, which casts doubt on the advice in the IS2020 report. In a Swedish context it seems that the IS 2010 Curriculum Guidelines were more right in promoting EA than the IS2020 report is in demoting EA and promoting *IT Architecture*.

The final interesting result in this study pertains to application development and programming that was demoted to a non-core subject in the IS 2010 Curriculum Guidelines, which was criticised by many, and hence was promoted back to a core competency in the IS2020 Competency Model. Our empirical results only partly support this position, since we find that the broader area of programming is important in the IS education ads, but that the depth and extension of this in the report is not supported by the findings. Close to a third (32.2%) of the IS ad texts do not mention any form of the word "programming". The very recent and current development within generative AI exemplified in GPT-4 even further strengthens this: IS students need general programming skills, but not with the relative depth that the IS2020 Competency Model expresses.

One overarching conclusion that we draw, which might explain some of the differences, is that the IS2020 report builds on primarily US perspectives, with six out of eleven representatives in the IS2020 report task force from universities in the USA and the US specific AIS Job Index as a primary data source for occupations. Even if there obviously are similarities between Sweden and USA when it comes to the IS/IT labour market, there also seems to be obvious differences that play out in top IS occupations, the difference in architecture profiles, the different weights given to personal traits and generic skills/dispositions, and the different value of basic and deeper programming skills. It might be that the IS2020 perspectives are less universal than expected, and therefore the curriculum guidelines of the IS2020 report might also be less universal.

6. Future Work

If our overarching conclusion about the dominant US perspective in the IS2020 report is valid, then it seems quite important that studies like ours are done in other countries to broaden the perspective and establish a less one-sighted view on IS labour markets and employer expectations, and the consequences this has for curriculum guidelines. Maybe there should not be one such guideline but several tailored for different contextual characteristics, or even a more flexible and component-oriented approach to the guidelines than both the IS 2010 and IS2020 provide.

It would also be interesting to collect first-hand data on employer expectation through e.g., interviews to study whether this would give another picture vis-à-vis the job ads data and the IS 2010 and IS2020 reports.

Appendices A, B, C, D, E, F, G: https://www.dropbox.com/s/9d7c1263cgzzfkp/ISD%202023%20Appendices.pdf?dl=0

References

1. Steen, O. and Pierce, P.: Swedish Undergraduate Information Systems Curricula: A Comparative Study in Advances in Information Systems Development: Information Systems Beyond 2020, A. Siarheyeva, et al., Editors, Springer Nature: Chennai, India. 131-145 (2020)
2. Richardson, J., et al.: Australian Undergraduate Information Systems Curricula: a Comparative Study. In the proocedings of The 27th International Conference on Information Systems Development (ISD2018). Lund University, Sweden (2018)
3. Leidig, P. and Salmela, H.: The ACM/AIS IS2020 Competency Model for Undergraduate Programs in Information Systems: A Joint ACM/AIS Task Force Report. Communications of the Association for Information Systems. Retrieved from https://doi.org/10.17705/1CAIS.05021 (2020)
4. Topi, H., et al.: IS 2010 Curriculum guidelines for undergraduate degree programs in information systems. Communications of the Association for Information Systems. 26(1) (2010)
5. Stefanidis, A. and Fitzgerald, G.: Mapping the Information Systems Curricula in UK Universities. Journal of Information Systems Education. 21(4) (2010)
6. Topi, H., et al.: Revising the IS Model Curriculum: Rethinking the Approach and the Process. Communications of the Association for Information Systems. 20: 728-740 (2007)
7. Babb, J.S., et al.: Confronting the issues of programming in information systems curricula: The goal is success. Information Systems Education Journal. 12(1): 42 (2014)
8. Baugh, J.M. and Kovacs, P.J.: PROGRAMING NOT REQUIRED? DID THE IS-MODEL CURRICULUM GET IT RIGHT? Issues in Information Systems. 15(1) (2014)
9. Rosenthal, P., Dhariwal, K., and Whitehouse, J.: IS'15-A Model Curriculum

reflecting the emerging IS Profession. In the proocedings of Proceedings of the Information Systems Educators Conference ISSN. Citeseer (2013)
10. Reynolds, J.H., Ferguson, R.C., and Leidig, P.M.: A Tale of Two Curricula: The Case for Pre-requisites in the IS Model Curriculum. In the proocedings of Proceedings of the EDSIG Conference. (2015)
11. Schell, G.: Early Results-Including an Enterprise Architecture Course in Information Systems Curricula. In the proocedings of SAIS 2014. (2014)
12. Yang, S.C.: The core curricula of information systems undergraduate programs: A survey of AACSB-accredited colleges in the United States. Journal of Education for Business. 91(5): 258-266 (2016)
13. Kennan, M.A., et al.: IS early career job advertisements: A content analysis. In the proocedings of PACIS 2007. (2007)
14. Gallivan, M.J., Truex III, D.P., and Kvasny, L.: Changing patterns in IT skill sets 1988-2003: a content analysis of classified advertising. ACM SIGMIS Database: the DATABASE for Advances in Information Systems. 35(3): 64-87 (2004)
15. Litecky, C., Igou, A.J., and Aken, A.: Skills in the management oriented IS and enterprise system job markets in the 50th annual conference on Computers and People Research, Association for Computing Machinery: Milwaukee, Wisconsin, USA. 35–44 (2012)
16. Prabhakar, B., Litecky, C.R., and Arnett, K.: IT skills in a tough job market. Communications of the ACM. 48(10): 91-94 (2005)
17. Todd, P.A., McKeen, J.D., and Gallupe, R.B.: The Evolution of IS Job Skills: A Content Analysis of IS Job Advertisements from 1970 to 1990. MIS Quarterly. 19(1): 1-27 (1995)
18. Aldenhoven, C.M., et al.: Differences in Skill Requirements for Agile Workers in the German and the US IT Industries. In the proocedings of. Cham: Springer International Publishing (2021)
19. Burns, T.J., et al.: Do the Knowledge and Skills Required By Employers of Recent Graduates of Undergraduate Information Systems Programs Match the Current ACM/AIS Information Systems Curriculum Guidelines? Information Systems Education Journal. 16(5): 56 (2018)
20. Dong, T. and Triche, J.: A longitudinal analysis of job skills for entry-level data analysts. Journal of Information Systems Education. 31(4): 312 (2020)
21. Mardis, M.A., et al.: Assessing alignment between information technology educational opportunities, professional requirements, and industry demands. Education and Information Technologies. 23(4): 1547-1584 (2018)
22. Litecky, C.R., Arnett, K.P., and Prabhakar, B.: The paradox of soft skills versus technical skills in IS hiring. Journal of Computer Information Systems. 45(1): 69-76 (2004)
23. SCB: Standard för svensk yrkesklassificering (SSYK). [cited 2023-03-08]; Available from: https://www.scb.se/dokumentation/klassifikationer-och-standarder/standard-for-svensk-yrkesklassificering-ssyk/ (2023)
24. Interntaional Labour Organization (ILO): The International Standard Classification of Occupations (ISCO). [cited 2023-03-08]; Available from: https://www.ilo.org/public/english/bureau/stat/isco/index.htm (2023)
25. European Commission: European Skills, Competences, and Occupations (ESCO). [cited 2023-03-28]; Available from: https://esco.ec.europa.eu/en (2023)
26. Leidig, P., et al.: IS2020 A Competency Model for Undergraduate Programs in Information Systems. Association for Computing Machinery and Association of Information Systems. Retrieved from https://www.acm.org/binaries/content/assets/education/curricula-recommendations/is2020.pdf (2021)