# Following the Stream of Digitalisation

## Text mining the Swedish Armed Forces' job advertisements over the period 2006-2021

MONIA LOUGUI

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# Sammanfattning

Tidigare studier har utforskat effekten av teknikutveckling i form av digitalisering, automatisering och artificiell intelligens på arbetsmarknadsstrukturen, yrken, och arbetsuppgifter. Även det militära yrket förväntas beröras av dessa faktorer.

Denna rapport syftar till att undersöka digitaliseringens inverkan på Försvarsmaktens kompetensbehov. Genom en textanalys av Försvarsmaktens jobbannonser under perioden 2006-2021 bekräftar rapporten en ökad efterfråga på digital kompetens. Utöver den generella trenden med ökad efterfråga på digital kompetens hos Försvarsmakten, utmärker sig två tydliga toppar i efterfrågan runt 2009 och 2019. En ökad efterfråga på digital kompetens tolkas som en ökad digitalisering inom organisationen.

Genom en ökad digitalisering uppstår även personalrelaterade utmaningar när det kommer till att rekrytera och behålla personal. Dessutom ställs krav på kontinuerlig utbildning av befintlig personal. Rapporten understryker även Försvarsmaktens uppdrag gällande utvecklingen och främjandet av digitalisering inom organisationen.

Nyckelord: Digitalisering, digital kompetens, jobbannonser, textanalys, militära professionen, personalförsörjning

## Summary

Previous studies examine the change in the structure of the labour market, the nature of tasks and required skills of professions as an outcome of technological development and changes. Such technological changes drive the level of digitalisation, automation and use of artificial intelligence in professions. This is also relevant for the military profession.

The aim of this study is to examine the impact of digitalisation as an outcome of technological change on the Swedish Armed Forces' needs for digital skills. A text analysis is applied to job advertisements published by the Swedish Armed Forces over the period 2006-2021. The results confirm a general increased demand for digital skills during the studied period. In addition to the general increasing trends of demand for digital skills, the results distinguish two pronounced peaks around 2009 and 2019. This increased demand for digital skills reflects an increased digitalisation of the Swedish Armed Forces.

The observed increased demand for digital skills suggests that the Swedish Armed Forces is likely to face employee retention challenges. In addition, it challenges the organisation in its mission related to training of personnel. Finally, this report accentuates the Swedish Armed Forces' responsibility in driving the digitalisation of the organisation.


Keywords: Digitalisation, digital skills, job advertisments, text analysis, military profession, personnel management

## Acknowledgement

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# Contents

# 1 Introduction

The repercussions of the digital revolution are reflected in several aspects of the economy. It could be considered as a driver of innovation, an enhancer of productivity, but also a perturbing element on the labour market. Amid these transformations, the concern for the future of work organisation and jobs has taken a central part in the discussion related to the outcome of the revolution (Acemoglu & Restrepo, 2020; Arntz et al., 2016; Morikawa, 2016). The Swedish Armed Forces (SwAF) is no exception and the current study contributes to the understanding of the implications such revolution has on the military profession and the demand for skills.

Technological advancement has been a fundamental part of economic analysis, not least in labour market analysis. Automation, digitalisation and artificial intelligence (AI), because of their displacement effect, are technological changes stirring the labour market and appealing for investigations and research. Indeed, there is no lack of historical evidence confirming the displacement outcome of such technological changes. The automation in the spinning and weaving industry (Mokyr, 1990, as cited in Acemoglu & Restrepo, 2019) and mechanisation of agriculture (Rasmussen, 1982) are typical examples of technological innovations yielding a change in labour and technological distribution. Despite the evidence from previous research, there is limited research with focus on labour impact of technological change in the military profession. Some indicators, such as the tooth-to-tail ratio[1], potentially reflect changes related to technological change in the military. According to Lake (2019), the U.S. Army witnesses a decrease of allocated resources to the tooth (combat forces) on behalf of the increase of allocated resources to the tail (support forces). During the US Civil War (1861-1865), the combat troops consisted of more than 90 percent of the troops in the Union Army. The share of combat forces dropped to about 53 percent during the First World War and continued decreasing to reach 25 percent in the Operation Iraqi Freedom[2] (Lake, 2019). Another index for change in the structure of labour in the military profession is Binkin (1986, as cited in Johansson, 2021) observed increase of *"white collars"* and decrease of *"blue collars"* in the U.S. Armed Forces.[3] According to Binkin (1986, as cited in Johansson, 2021), 19 percent of the blue collar jobs in the U.S. Armed Forces have shifted to white collar jobs during the period 1945-1985.

As these previous studies illustrate a change in the allocation of labour force in light of technological change, there are reasons to assume a change in profession and demand for skills. The transition towards an autonomous and digital workplace has the potential to drive organisations to increase their digital skills through internal training and recruitment. As a result, there will be a polarisation on the labour market where the demand for high skills (including digital and IT skills) increases in order to accomplish the task imposed by new technologies. Simultaneously, the demand for low and medium skills decreases (Berger & Frey, 2015).

The current study emanates from the notion that digitalisation leads to an increase in an organisation's demand for digital skills. It examines the job ads published by the SwAF and the demand for digital skills expressed therein. The considered job ads cover the period 2006-2021 and are published through the Swedish Public Employment Service (SPES). The methodology I employ in this report is inspired by Hegelund (2021). In his report, Hegelund applies a quantitative text analysis to all job ads published during the period 2006-2020. The different steps of the text analysis are explained in the methodology section of this study.

Previous studies take on an approach where the adoption and the practice of digitalisation is considered as a tool to assess the digitalisation of a nation or an organisation. This study adds the demand for digital skills as a measurement of increased digitalisation or a shift

[1] The tooth-to-tail ratio is the allocation of resources between combat forces and support functions.
[2] When accounting for support troops in the immediate region and the support provided by contractors.
[3] White collars workers are usually found in offices working in administrative or management settings. Blue collar workers are usually engage in manual labour such as construction or manufacturing.

towards a digitalised organisation. As digitalisation necessitates new and different skills, organisations are pushed to recruit individuals with particular digital competences. Hence, the demand for digital skills mirrors the level of digitalisation of an organisation.

The study is motivated by the SwAF's need for a better understanding and knowledge of how technological advancement affects the demand for personnel. Even though previous research has established the consequences of digitalisation and AI on the labour market in general, there is little evidence of the outcome of such technologies on the military profession and military organisation. Therefore, by adopting a descriptive approach of the demand of digital skills in the SwAF, this study is explorative and one of the first attempts to illustrate the organisation's exposure to digitalisation. In the current study there is no distinction between the SwAF's demand for digital skills in military and civilian occupations.

The report is outlined as follows. First, the purpose of the study together with the research questions are presented in section 1. Following, the theoretical context is explored in section 2. Next, section 3 describes the empirical context before I give a description of the data and the empirical approach in section 4. The results are then analysed in section 5. In section 6, I interpret the results and their implications for the SwAF. Finally, I expose the limitations and suggest future studies in section 7.

## 1.1 Purpose of the Study

The purpose of the study is, primarily, to explore the digital trend of the SwAF by examining the demand for digital skills as an indication of the digital advancement of the organisation. In addition, the analysis of the collected data reveals potential general changes related to the military profession.

Through the empirical approach, this study illustrates alternative methodologies and data sources aiming at investigating the research questions. Hence, the empirical setting aims at illustrating the potential of the used methodologies and the value of the investigated data.

The results of the study are indicators of the adjustments of the military profession imposed by digitalisation.

## 1.2 Research Design and Research Questions

The study is a quantitative text analysis of the job ads published by the SwAF. The research is explorative, aiming at answering the following research questions:

RQ1: Is there an increasing trend in the SwAF's demand for digital skills?

RQ2: Which digital skills does the SwAF primarily request?

# 2 Theoretical Context: Unravelling Artificial Intelligence, Automation, Machine Learning, Digitalisation, and the Future of Work

This section delimits the study's theoretical framework by presenting previous findings and introducing relevant concepts. I introduce this section by briefly discussing the implications of technological change on the labour market. Second, I describe and distinguish the concepts *artificial intelligence*, *digitalisation*, *automation* and *machine learning*. Finally, I focus on digital skills and competences as a prerequisite for the exploitation of these concepts.

## 2.1 Technological Change and Labour Adjustment

The focus of this study is the adjustment of labour as an outcome of technological change. This focal point appears straightforward and simple, yet the process of adjustment goes through a number of stages. Indeed, it is argued that in order to understand the implications of technological change on work, a task-based framework is required (Acemoglu & Restrepo, 2019).

The task-based approach as explained in Acemoglu & Restrepo (2019), emanates from the assumption that production is a sequence of tasks. Each task unites labour and capital as a production function. Hence, a final good (or service) is the result of tasks allocated to labour (humans) and capital (machines). The allocation of tasks to these factors of production is referred to as *task content of production*. With technological advancement, the value added of capital can improve, leading to a displacement of the labour factor in the production process. Hence, according to Acemoglu & Restrepo (2019) a primary adjustment of tasks in light of technological advancement is the ratio labour/capital of particular tasks where the proportion of capital increases.

In addition to the shift to more capital-intensive tasks, there is an adjustment in the nature of labour input. According to Autor et al. (2003), technological change implies a redistribution between cognitive and manual tasks and non-routine tasks. As new technologies tend to replace manual tasks and complement non-routine tasks,[4] so does the required skillset for particular tasks change. This is referred to in the literature (see Adermon & Gustavsson, 2015) as task-biased technological change (TBTC).

The notion of TBTC suggests a change in the tasks as a result of technological change which eventually would incite a disruption on the occupational level. Indeed, the development of tasks entails an adjustment in the nature of the profession. Previous findings suggest a general decrease in managerial positions and an increase in the non-managerial positions (Dixon et al., 2021). Within the non-managerial positions, there is a decrease in the low-skilled labour force and an increase in the high-skilled labour force (Xie et al., 2021). Hence, technological advancement disrupt professions by perturbing the distribution of the nature of tasks (managerial vs non-managerial tasks and high-skill demanding tasks and low-skill demanding tasks).

Moreover, it is argued that the TBTC is a driver of job polarisation. Indeed, Adermon & Gustavsson (2015) justify, empirically, the connection between TBTC and the observed job polarisation on the Swedish labour market during later periods of the investigated time span (1975-2005). These results assume that disruptions, in light of technological change, can be observed on the labour market.

[4] Routine tasks are repetitive tasks executed on a regular basis. Non-routine tasks are less frequent task and often require certain transferable skills such as analytical skills.

Technological change, in particular the introduction of machines into production processes, often raises concerns related to unemployment and dismissals on labour demand. However, studies reveal that such dismissals are rather temporary and that a new equilibrium is reached on the labour market; yet with a shift in the nature of skills demanded. Indeed, according to previous studies, technological change drives the polarisation on the labour market where the middle-wage jobs are replaced by higher- and lower-paid jobs (Adermon & Gustavsson, 2015).

Summarising previous literature, it can be concluded that through technological change, there is a shift in the nature of performed tasks, which redefines occupations and professions leading to a different structure on the labour market.

## 2.2 Artificial Intelligence, Automation, Machine Learning, and Digitalisation – What is the Difference?

The literature frequently uses the notions of AI, digitalisation, automation, and machine learning interchangeably in different settings. Nevertheless, these terms have distinct meanings, all referring to different processes and concepts. The current part summarises the definitions of the concepts and discusses their connection.

Kaplan & Haenlein (2019) define AI as '*a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation*' (p.17). A key expression in this definition is *flexible adaptation*, suggesting that the system is evolving and adjustable. Moreover, according to the definition provided by OECD, AI achieves its specific goals with "*some degree of autonomy*" (High-Level Independent Group on Artificial Intelligence (AI HLEG), 2019, p.1). *Autonomy* therefore becomes, in addition to *flexibility*, another key characteristic of AI.

Flexibility, as expressed in the definition above, insinuates that AI is capable of adjusting to a given environment and of improving by learning from experience. Such a feature requires the existence of a flow of information and situations defining the learning base from which the AI systems acquire experience. Hence, there is a learning process sustaining the functionality of the AI. This process is referred to as machine learning.

As a subset of AI, machine learning learns and improves by imitating the experience and learning of human beings through the use of computational algorithms (Krueger et al., 2020). Machine learning can then be considered as the art of training systems, which allows the AI to be adaptive.

To summarise, automation is reached through the training of AI systems using machine learning. Automation therefore becomes a consequence of the development of AI with machine learning being the fuel of such development. A prerequisite for these three concepts is digitalisation.

Digitalisation refers to processes where digital techniques and computers are either introduced or more frequently used (Wachel, 1971; Castells, 2010, as cited in Larsson & Teigland, 2020). Consequently, digitalisation calls for the acquisition of new digital skills or the development of the existing digital skills. Thus, it appears that although there is a distinction between the concepts AI, automation, machine learning, and digitalisation, they share a common crucial determinant for their operationalisation: digital skills.

Digital skills as defined by Wiggberg et al. (2022) are the aptitude of individuals to apply digital solutions when searching and communicating information. Moreover, it is the knowledge and awareness of abilities and risks associated with digital tools. The acquired digital competences facilitates the understanding and the manipulation of the previously mentioned concepts: AI, automation, machine learning, and digitalisation. As these concepts develop and spread their application area, so does the demand for digital skills.

## 2.3 Digital Skills and Competences

Digital skills derive from the invention of computers and the breakthrough of personal computers. These skills have undergone an evolution following the technological evolvement. At first, skills required by digital technologies were limited to basic skills such as switching the computer on and off or opening and saving files into a folder. With the expansion of the use of information and communication technologies (ICTs), technological skills have increased in complexity to comprise the management of software and digital devices. The increased digitalisation in the society has driven the upsurge of digital skills as a part of the 21st century skills (van Laar et al., 2017) and the establishment of new concepts such as digital literacy. Indeed, it is argued that while digitalisation certainly increases the demand for digital and technology-related skills, there is a call for non-cognitive skills (Morandini et al., 2020). Digital competence therefore goes beyond technological skills (such as switching the computer on and off) and includes complementary skills such as information management, collaboration, communication and sharing, creation of content and knowledge, ethics and responsibility, evaluation, and problem-solving (Ferrari, 2012). In addition, The European Parliament and the European Council define digital competence as a combination of knowledge, skills and attitudes leading to a concept that includes more than just operational skills (European Council, 2006).

The definition provided by the European Parliament and the European Council merges the concept of technical digital competence and digital literacy as defined by Gilster (1997). Indeed, Gilster introduced digital literacy as "*the ability to understand and use information in multiple formats from a wide variety of sources when it is presented via computers*" (Gilster, in Pool 1997, p.6).

Digital literacy is generally considered a crucial skill for integration and participation in the society. From being a capability facilitating the use of new and digital technologies with the aim to ease everyday life activities, digital skills have become a strong advantage on the labour market and even a prerequisite in certain professions (Curtarelli et al., 2016). The increased acknowledgement of the digital economy is an example of the importance of digital competences.

## 2.4 Measuring the Digitalisation of Organisations

Despite the challenge of measuring and quantifying the level of digitalisation, several attempts to do so have been made.

The digital economy and society index (DESI) summarises the digital progress of EU member states. The indicator for digitalisation referred to concern human capital, connectivity, integration of digital technology, and digital public services (European Commission, 2022), and allows for an international comparison of digitalisation. With the similar intentions, i.e. to compare nations, Katz & Koutroumpis (2013) present a digitalisation index consisting of six elements (such as capacity and usage) and twenty-three indicators (such as 3G penetration and skilled labour). A global perspective on digitalisation is studied in Billon et al. (2010) using a digitalisation index that captures ICT indicators such as personal computers, international internet bandwidth, internet users, secure internet servers, mobile phone subscribers, and broadband subscribers.

Furthermore, studies investigate digitalisation on a national level using a variety of measurements of digitalisation.

The Swedish Agency for Digital Government presents the level of digitalisation in Sweden based on the inhabitants' digital skills, the national broadband infrastructure, and the digital adjustments of firms and public administrations (Agency for Digital Government, 2022).

In Germany, the Federal Statistical Office of Germany measures the digitalisation level of firms through a survey collecting data such as the firms' procession of website or the use of social media (Axenbeck & Breithaupt, 2022).

Using a less conventional methodology, Ashouri et al. (2022) construct a digitalisation score based on web-scraped firm-level data. By aggregating the digital indices of the products of a firm, the overall digitalisation score represents an indicator of the digitalisation level of the company.

# 3 Empirical Context

In this section, I provide a brief description of the context of advertising vacancies in Sweden with the aim to motivate the selected data and applied methodology.

In the current study, I rely on job advertisements announced by the SPES on behalf of the SwAF. The selection of the SPES as the source to collect data related to SwAF's job ads mainly depends on the Swedish employment ordinance, Section 6.[5] According to this section, any governmental authority has the obligation to announce a vacancy in such matter that the ad is made accessible to any individual interested in applying. In other words, when publishing a job ad, it is assumed that a governmental authority selects a platform (or platforms) with wide accessibility. Such is the case of the SPES's free online platform *job bank*. It is therefore fair to assume that the majority of SwAF's ads are published and made accessible through the SPES's online platform.

The ads analysed in this study do not include vacancies aimed for internal recruitment. Moreover, the information contained in the ads is provided by the hiring organisation and hence the data in the ads do not keep the same quality and there might be differences in available information.

The ads published on the online platform contain the information presented in table 1, sorted in alphabetic order.

Table 1 Labels and description of information retrieved from the job ads

| Label | Description |
|---|---|
| Access to own car | The applicant should have access to own car |
| Application deadline | The deadline of the application |
| Application details | Details such as email, url |
| Description | Containing company information, conditions, and the text representing the content of the ad |
| Driving license | If the position favours or requires a driving license |
| Duration | Employment duration |
| Employer | Containing information related to the employer such as e-mail, name of the employer, organization number, phone number |
| Employment type | The type of employment (such as temporary or permanent employment) |
| Experience required | If the position requires any previous experience |
| External id | An ID number |
| Headline | Headline of the ad |
| Id: Id of the ad | ID number of the ad |
| Required | Required language proficiency, skills and work experience |
| Desired | Desired language proficiency, skills and work experience |
| Number of vacancies | Number of vacancies per ad |
| Occupation | Title of the occupation |
| Occupation field | Field of occupation (industry or sector) |

[5] https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/anstallningsforordning-1994373_sfs-1994-373/

| | |
|---|---|
| Occupation group | Occupation group (such as manager) |
| Publication date | The date of publication |
| Removed | If the add has been removed |
| Removed date | The date the add was removed from the platform |
| Salary description | The salary |
| Salary type | Salary type (such as monthly or hourly) |
| Scope of work | Maximum and minimum of working hours |
| Webpage url | Employers webpage |
| Working hours type | Full time or part time position |
| Workplace address | Workplace address |

# 4 Data and Empirical Approach

## 4.1 Data

In this study, I conduct empirical analyses on job advertisements published through the SPES. The choice of data source is not only motivated by the prominent use of the SPES online platform by job applicants[6] but is also related to the easy accessibility of the data. In addition, the data is semi-structured: Job ads published on SPES's online platform are structured in such way that the identification of relevant variables is straightforward, which facilitates text analysis (Gassler et al., 2014). In each ad, there is information related to the employer, the position, and the required profile of the candidates.

In total, 16 450 ads are included in the study. Table 2 illustrates of the number of analysed ads by year over the period 2006-2021.

Table 2 Distribution of number of ads over the period 2006-2021

| Year | Number of ads |
|---|---|
| 2006 | 244 |
| 2007 | 260 |
| 2008 | 109 |
| 2009 | 197 |
| 2010 | 314 |
| 2011 | 853 |
| 2012 | 854 |
| 2013 | 985 |
| 2014 | 652 |
| 2015 | 741 |
| 2016 | 1 061 |
| 2017 | 1 353 |
| 2018 | 1 822 |
| 2019 | 2 526 |
| 2020 | 2 145 |
| 2021 | 2 334 |

## 4.2 Digital Skills

I retrieved the list of digital skills (used as search terms in the ads) from Hegelund's (2021) previous work with similar research questions. The list of terms representing digital skills in Hegelund (2021) was elaborated based on the opinion and input of experienced personnel in the digital industry.

Hegelund (2021) classified the terms used to identify digital skills into three levels. First, there is the basic level of skills containing terms reflecting general and mundane digital skills such as "*computer literacy*", or terms related to commonly used software such as "*Microsoft*" or "*PowerPoint*". Second, there are terms aimed at capturing programing skills such as "*C++*", "*SQL*", and "*Python*". Finally, the third level of terms concerned advanced software knowledge with more targeted and specific programming languages such as "*3D-Studio*", "*gitlab*" and "*MATLAB*". Both the second and third levels represent advanced digital skills, while the first level aims at capturing basic digital skills.

As the analysed ads are in Swedish, I compiled the list of digital skills using terms in Swedish. However, for the readers to comprehend the terms and for replicability purposes, table 4 attached to the appendix consists of a translated list. The original list in Swedish is presented in Hegelund (2021).

[6] In 2014, the SPES estimated that approximately 30-50 percent of the published job vacancies on the Swedish labour market were published on their online platform (Hegelund, 2021).

## 4.3 Methodology and Empirical Approach

I apply a quantitative text analysis to the text describing the position in the ad. The methodology consists of a count of number of ads mentioning at least one of the search terms identified as representing digital skills.

Because of the richness of the data available in job ads, there is an increase of the use of text mining of job ads among scholars. Indeed, the methodology has been used to examine, for example, general trends on the labour market (Karakatsanis et al., 2017), discrimination in job application process (Ningrum et al., 2020), sector and industry changes (Fareri et al., 2020; Pejic-Bach et al., 2020; Todd et al., 1995) and job requirements (Verma et al., 2022).

The empirical approach of this study follows three steps:

(a) Processing the data
(b) Mining the text with position description
(c) Analysing the data: counting the occurrences

### 4.3.1 Processing the Data

The initial data contains all job ads made available by the SPES over the studied period. The data is available in a JSON Lines format[7] and is processed in the integrated development environment RStudio.[8]

As a first step, three additional lists were created. The first additional list contains different name constellations representing the SwAF. This list takes into consideration factors that might mislead the identification process such as spelling mistakes.[9]

A second additional list contains the different constellation of the legal registration number specific to the SwAF.[10]

The third list is a list of employers' names created as an extra filter to remove any of the ads that passes through the two first lists. This list is compiled manually by screening the name of employers appearing among the ads after filtering based on the two first lists mentioned above.

Next, the ads are exposed to a data cleaning process where the ads are adjusted to the text analysis operation. Modifications that were applied in this process were for example the removal of any double spacing between words, upper-case letters were transformed into lower-case letters and some special characters such as + and # were replaced by their equivalent in words (e.g., 'plus' and 'sharp', respectively).[11] The terms in the list with digital skills were used in different constellation (for example, the search for skills specific to the use of the application Excel, the term "*ms excel"* was also searched for as "*excel*" and "*ms_excel*").

A quality assessment is applied to the data to ensure that no ads other than those published by the SwAF are included. This quality assessment consists of a final scrutiny of the list of employers.

### 4.3.2 Mining the Text

Once the data has been processed and the raw database transformed into a data frame restricted to job ads published by the SwAF with relevant data appropriate to investigate the research questions of this study, a text analysis is applied.

[7] JSON is a text file format convenient for storing structured data
[8] RStudio is a tool for data analysis, transforming data, machine learning, regressions, plotting, and to make predictions on data.
[9] Example of words contained in this list: *Forsvarsmakten. FM, Forsvarmakt, Armén,*
[10] Example of constellations of legal registration numbers contained in this list: *2021004615, 202100-46*
[11] These are just three examples of modifications applied to the data.

The data mining process starts with a first step, which consists of the tokenisation of the text in the ads. By tokenisation, the text of the ad is split into individual words or tokens. These tokens are then matched with the list of skills. If any of these skills appear in the text, the ad is classified into at least one of the three categories: (1) ad demanding basic skills, (2) ad demanding programming language skills, and (3) ad demanding software skills. An ad can therefore be classified into none, one, two, or three categories.

### 4.3.3 Analysing the Data

The first two steps of the empirical approach, although the most time demanding steps of the text mining process, are critical phases to ensure accurate analyses.

The analysis of the data consists of counting the occurrences of demand for digital skills.

# 5 The Digital Trends in the Swedish Armed Forces

In the current section, I present the results of the text analysis of the job ads. First I explore the SwAF's trend in demand for digital skills during the period 2006-2021. Second, I analyse the SwAF's most commonly demanded digital skills during the studied period.

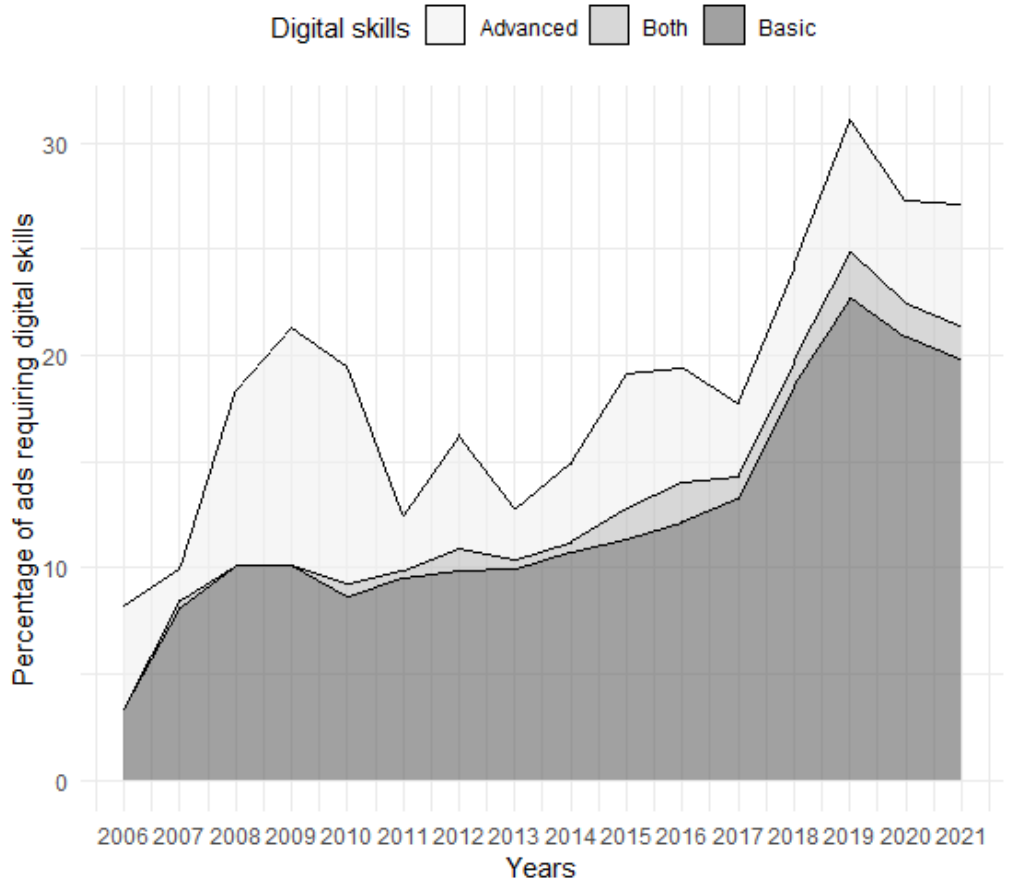
## 5.1 The Trend in Request for Digital Skills

The distribution of the SwAF's requested digital skills, as presented in graph 1, indicates a fluctuation over the period 2006-2021 with pronounced peaks in 2009 and 2019.


Graph 1 Distribution of percentage of SwAF's ads requiring any digital skills over the period 2006-2021

The increase, in particular starting from 2017 and with a peak in 2019, is in accordance with the overall increase of digitalisation in the society. Indeed, it coincides with the Swedish digitalisation strategy launched in 2017 with the vision of Sweden being a leading nation when it comes to the exploitation of digital opportunities (Towards a sustainable digitilised Sweden: a digitalisation strategy, 2017). It can then explain the general increasing need for digital skills as incited by the broad increased digitalisation effort and improvement in the society.

In order to understand and explain the observed fluctuation and peaks such as the peak in 2009, further investigation of the nature of the demanded skills is required. With the aim to provide additional information, I analyse the nature of digital skills demanded in the ads.




Graph 2 Distribution of the SwAF's demand for digital skills over the period 2006-2021

In graph 2 above there is a distinction between the demand for basic, advanced, and both basic and advanced digital skills requested in the job ads published by the SwAF during the period 2006-2021. This distinction gives a hint of the type of skills driving the general observed increase of demand for digital skills. During the last ten years of the studied period, it appears to be the demand for basic digital skills that is most frequently requested in the ads published by the SwAF. As opposed to what is observed during the last ten years, the demand for advanced digital skills dominates the SwAF's demanded digital skills during the years 2008-2009.

This study and the text analysis is merely descriptive and does not provide any causal insights to the circumstances behind the observed trends. However, it is clear that graph 1, representing the distribution of the SwAF's demand for digital skills, denotes two main peaks during the period 2006-2021.

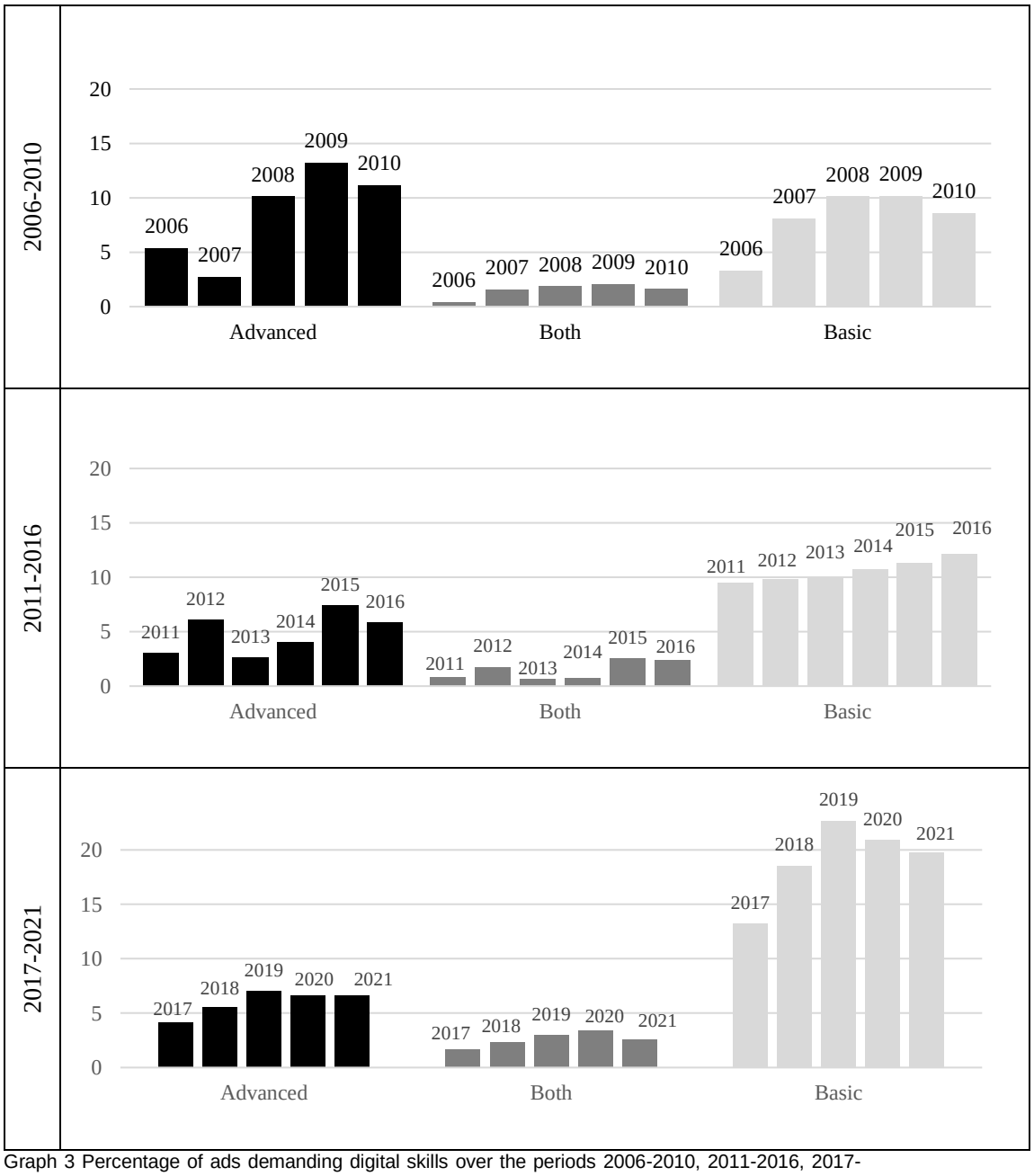
The first peak is observed in 2009 and concerns mainly advanced digital skills. This period corresponds to the integration of a new digital SAP-based enterprise resource planning system (named *Prio*) in the SwAF. The extensive increase in demand for advanced digital skills, relatively to the increased demand for basic skills, could be explained by the need for individuals with IT system development skills in order to facilitate the adoption and the integration of the new digital system.

The second peak concerns both advanced and basic skills in 2019 (the increase starts in 2017). Apart from an extensive Swedish digitalisation strategy, launched during that period, the increased investment in cyber defence starting in 2015 can be a contributing factor to the sharply increased demand.

The distribution of demand for digital skills illustrated in graphs 1 and 2 above suggest that the trend in demand can be split into three periods. The first period concerns the years 2006-

2010, the second stretches over the years 2011-2016, and the last period covers the years 2017-2021. For simplicity, the period 2006-2010 is referred to as period 1, the period 2011-2016 as period 2 and the period 2017-2021 as period 3.

To further understand the trends and peaks in these three periods, the demand for digital skills in each period is separately presented in graph 3 below.




Graph 3 Percentage of ads demanding digital skills over the periods 2006-2010, 2011-2016, 2017-2021

As illustrated in graph 3, the demand for advanced digital skills in period 1 registers a peak in 2009 which explains the observed peak in the total demand for digital skills in graph 1 and graph 2. Moreover, period 1 also registers an increase in the demand for basic digital skills with a less significant peak in 2008 and 2009. Hence, the increase of demand for digital skills during period 1 is grounded by a total increase in the demand for basic digital skills. Meanwhile, the peak observed during this same period is and mainly driven by the peaking demand for advanced digital skills.

As of the period 2, there is a steady increase in the demand for basic digital skills with a notable surge in demand for advanced digital skills 2012 and 2015.

During the period 3, we can observe an important increase in the demand for basic digital skills with a peak in 2019.

In graph 3, it appears to be the steady increase in the demand for basic digital skills that drives the SwAF's general increase in demand for digital skills. The demand for advanced digital skills seems to be more pronounced during particular periods which explains the observed peaks.

## 5.2 The Demanded Digital Skills

In addition to the trend analysis over time, the study investigates which skills are most commonly requested by the SwAF during the period 2006-2021.

By analysing the skills contributing to the observed trends in the demand for digital skills, the study contributes to the understanding of the digital needs of the SwAF and hence its digitalisation level and ultimately the changes on the level of the military profession.

### 5.2.1 The Swedish Armed Forces' most demanded digital skills over the period 2006-2021

Table 3 below presents the most commonly requested basic and advanced digital skills. For simplicity only the three most commonly requested digital skills are reported.

Table 3 The three most commonly requested digital skills

| | Basic digital skills | Advanced digital skills | |
|---|---|---|---|
| | | Advanced software skills | Programming skills |
| 1 | Computer literacy | Business management system | Java |
| 2 | Microsoft | Powershell | Python |
| 3 | Office package | Photoshop and Subversion | Javascript |

Among the ads requesting basic digital skills, the most commonly used terms are: 'Computer literacy', 'Microsoft', and 'Office package'. The equivalent list with advanced digital skills consist of the following terms: 'Business management system', 'Powershell', 'Photoshop', 'Subversion', 'Java', 'Python', and 'Javascript'.

These terms depict the essential digital needs of the SwAF as expressed in their job ads over the period 2006-2021. Computer literacy and management of basic Office package appear to be of interest for the organisation. These skills are elementary and basic skills which are often wide spread as opposed to certain advanced skills requiring a formal education. As of the advanced skills, the particular software skills demanded suggest that the SwAF has a need for employees with knowledge of developing software, task automation, managing webpages, and general programming skills.

The demand for these basic and advanced skills suggests that the SwAF expects their employees to be digitally literate and to be able to manage basic digital systems (such as the Office package). There is also an expectation that some employees should be able to develop systems (indicated through their demand of programing skills such as Python) and manage advanced digital systems (as skills such as Powershell, Subversion and Javascript are frequently requested during the studied period).

To further explain the peaks observed during the studied period, the three most demanded digital skills are analysed independently during the three periods 2006-2010, 2011-2016, and 2017-2021.

### 5.2.2 The Swedish Armed Forces' most demanded digital skills over the periods 2006-2010, 2011-2016, 2017-2021

As each of the three discussed periods are distinguished by particular peaks and trends, the following in depth analyses of demanded digital skills for each period illustrate the driving skills behind the observed trend.

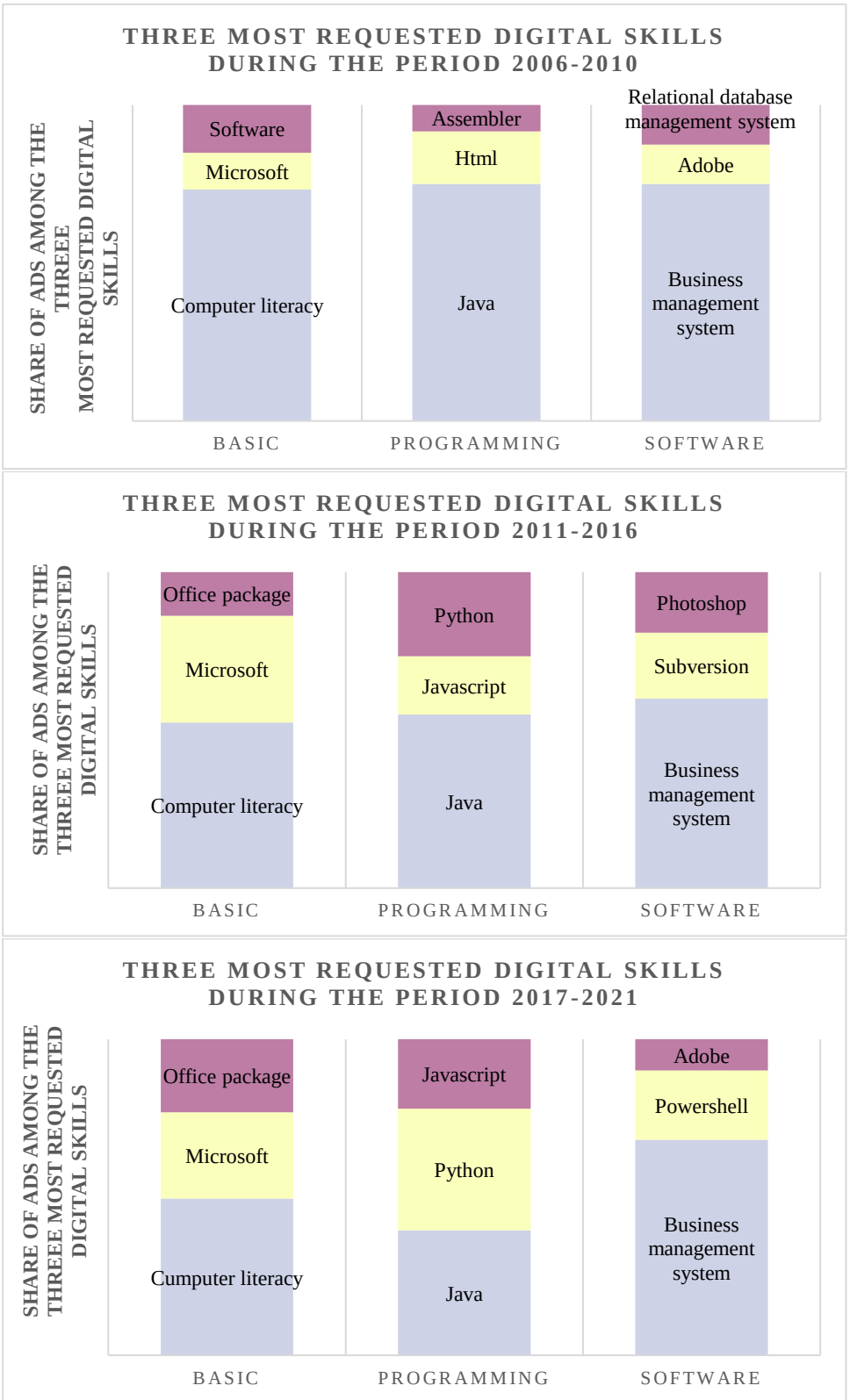
As illustrated in graphs 2 and 3, the peak in period 1 and the increase in demand for digital skills in period 2, are mainly driven by demand for advanced digital skills while the peak in period 3 is foremost the product of an increase in the demand for basic digital skills. From graph 4 below, it appears that in both period 1 and 2, the dominating demanded advanced digital skills are business management system and java. These requested skills suggest that the SwAF is engaging in the digitalisation of the organisation through the introduction and development of digital processes. In addition it could also be an indication of the SwAF's ambition to adjust to the general development and digitalisation of the society.

The demand for advanced digital skills during period 1 and 2 seems to serve two main purposes. First, there is a demand for skills considered essential for the organisation's internal digitalisation. Second, some of these advanced digital skills are relevant for the development of the external interface such as web development and digital design.

The peak during period 1 and the increase during period 2 driven by the demand for advanced digital skills (graph 2 and 3) such as Java, Python and Javascript indicate that the SwAF is engaged in internal system development.

Graph 4 shows that the SwAF mainly requires more or less similar basic digital skills in their ads over the three periods. The major difference is then not in the type of demanded basic digital skills but the number of ads published requiring the skills. This might be a signal of a successful increased integration of digital tools in the organisation and the requirement that the employees are able to manage these tools.

The distribution of the SwAF's requested digital skills over the period 2006-2021 confirms a general increase in the demand for digital skills. Among these requested skills, it appears to be basic skills that are most often demanded by the SwAF.




Graph 4 Top 3 demanded basic, programming, and software skills during the periods 2006-2010, 2011-2016, 2017-2021

# 6 Conclusions and Implications for the Swedish Armed Forces' Personnel Management

From previous research, it is indisputable that technological changes impact the labour market, job characteristics, and organisations. The results of the text analysis of job ads published by the SwAF confirm such adjustments by revealing the organisation's increased need for digital skills. It can then be concluded that technological change drives the shift in required digital skills for the military profession.[12]

The results of this study shows that the SwAF has had an increased demand for digital skills which is in line with expectations deriving from previous research concerning changes in the composition of labour in the military profession such as described in Lake (2019). According to Lake (2019), the increase of support functions in the U.S. Army suggests a paradigm shift in the military profession where initially the combat forces were the main labour force. With a general increased digitalisation in the society, there is a belief that among the support functions, in addition to administrative, maintenance, and supply support, IT-support becomes a growing part.

The SwAF's demand for digital skills is characterized by the organisation's vulnerability to two types of changes: internal and external. Internal organisational changes such as the implementation of new digital systems urges the SwAF to adjust its activities and introduce tasks requiring digital skills. As the analysis of the job ads suggests, and under the assumption that the increase in demand for digital skills is related to the implementation of a new digital system, the SwAF is pushed to continuously introduce new digital tasks into its activities.

External trends and shocks are likely to influence the SwAF as well. As suggested in Ydén (2008), the SwAF is formed by national financial management and actual political topics of interest. This highlights the idea that the SwAF is not an isolated unit in its digitalisation journey but is influenced by the general trends. It also confirms previous research claiming the need to integrate the activities and development of the organisation with the development of society in general (Dahlbom, 2018). This suggests that the organisation could be able to foresee its future changes and hence its future needs by following the general trends.

As of the type of digital skills demanded by the SwAF, basic skills being the dominant requested competence suggests that the SwAF does not engage in the development of digital solution or systems but adapts to the increased digitalisation of the society.

In what follows, I analyse the implications of the observed results on the SwAF's personnel management. I start with recruitment and retention challenges. Second, I discuss the implications of an observed increased digitalisation trend on training of personnel. Finally, I analyse the requirements of developing skills for maintenance associated with increased digitalisation.

## 6.1 Recruitment and Retention Challenges

As the analysis of the text mined from the SwAF's job ads reveals an increased demand for digital skills, the organisation might be facing a continuous need for digital skills. A perpetual need for digital skills entails a change in the requirements and profile of potential candidates for the SwAF. Hence, the technological change and digital transformation, drive the organisation to explore new and different segments of the labour market. It implies that the SwAF is urged to continue recruiting candidates with digital skills and therefore finds itself competing against civil organisations and private companies. This clearly becomes a

[12] The military profession in this context consist of both civilian and military employed by the SwAF

challenge for the SwAF, as expressed by Matz Felix at the SwAFs Communication Information System Command (FMTIS) "*When it comes to IT staff, we find it difficult to offer salaries that even newly graduated people would accept, so it is very difficult to retain individuals"* (Danielsson, 2022, para 8). Consequently, the policies implemented by the organisation should aim at both increasing the attractiveness of the SwAF as a future employer for candidates with digital skills, and at increasing its ability to retain employees with such skills.

Indeed, the particularity of the SwAF's activities increases the organisation's vulnerability when it comes to its competitive advantage on the labour market and its capacity to retain crucial and high-skilled labour force. Among the supply of labour force, the accessible and potential future employees are limited as the organisation has particular requirements suitable for the field of defence and armed forces. This narrows down the SwAF's options on the labour market.

The challenge is therefore not restricted to the attraction and the recruitment but continues once the individuals have been engaged. There is therefore a need for the SwAF to ensure the professional development of the recruited personnel with digital skills.

## 6.2 Training of Actual Employed Personnel

An increased digitalisation of an organisation requires the employer to engage currently employed personnel on their journey in order to ensure a smooth initiation and steady development.

The SwAF is an organisation distinguished by its doctrine and ethos. The employees are formed to adjust to the existing strong organisational culture and norms with structured and deeply embedded routines. Consequently, any major changes require a particular effort from the organisation.

The digitalisation and the introduction of new technologies is not a process that ends with the investment in the systems and by employing staff with adequate skills. The process includes the training of tenured personnel with the purpose to increase their feeling of engagement and to ensure the sustainability of the new systems as the users (both tenured and new employees) exploit and suggest improvements (Cetindamar et al., 2021). In addition, it is argued that the employees hold a crucial role in the digital transformation of an organisation.

Moreover, the inclusion of tenured employees in the transformation might benefit the introduction phase of new technologies (Tabrizi et al., 2019). Indeed, these employees are most likely capable of rapidly detecting pitfalls and suggest modifications and improvements to adjust the new technologies to the specific business of the organisation. In contrast, new employees tend to suggest improvement and "best practice" solutions without considering the context of the organisation.

## 6.3 Driving Technological Advancement and Digitalisation in the Organisation

An increasing digitalisation in the SwAF furthermore implies an increased effort to maintain and develop the implemented technologies and systems. As technologies easily become obsolete and require a substantial sustainment, there is a need for further development of the acquired systems and technologies. The maintenance of these technologies does not only increase their life cycle and the returns on investments but ensures the competitive advantage of the SwAF on the labour market. Such maintenance requests the engagement of concerned personnel striving to improve the application fields and upgrading the technologies. In his analysis of the implementation of unmanned aerial vehicule (UAV) in the

SwAF, Johansson (2022) highlights the organisation's challenge in finding an equilibrium between exploration and exploitation.[13]

Hence, for a successful integration of new technologies and systems, there is a need to equip the personnel with sufficient knowledge and skills related to these technologies (exploitation). It is also crucial to provide the personnel with the opportunities to explore the potential of new technologies and the liberty to suggest improvements and upgrades related to the technology in question and the fields of application (exploration).

The SwAF faces the challenge to engage its employees in the adoption and improvement of technological innovations. Such a challenge can be overcome through proper training of tenured personnel. In addition, the SwAF can insure the recruitment of individuals with appropriate skills and social and cognitive abilities such as creativeness, good communication skills, and proactivity. With regard to the demanded digital skills, it would be expected to see a shift from basic to programming and software management skills. In order for the SwAF to develop, improve and adjust new technologies and systems to its activities, there is a need for these advanced skills. In addition, as the digital literacy of the society increases, basic digital skills are more commonly spread and is furthermore supported by the inclusion of digitalisation in the schools curricula in Sweden (Swedish National Agency for Education, 2022). Therefore, the specific demand for basic digital skills might decrease (as it is assumed to be acquired by any individual with a secondary education) in favour of an increase in the demand for advanced digital skills such as programing.

## 6.4 The Military Profession

The general increased digitalisation in the SwAF brings changes to the military profession, the profile of military personnel and the required skills. The traditional combat and field skills might have to be integrated with technical skills to manage the new technologies, communication systems and the integration of digital solutions into the tactical decision making.

The integration of advanced technologies and digital solution might therefore adjust the role of the military personnel and alternate the traditional combat skills with digital and technical abilities. Following Autor's et al., (2003) reasoning related to the redistribution of tasks and the required skills, the digitalisation of an organisation such as the SwAF might well imply a change in the military profession and the required skills of the military personnel.

Digital logistics systems are examples of solutions allowing more efficient flows and hence shifting parts of the military personnel's tasks. In addition to shifting the tasks, such solutions require digitally skilled personnel in order to understand and manage these systems. Digital solutions might therefore contribute to the change in the profile of the military profession by giving the digital literacy and digital skills more importance in the determination of the adequacy of the candidates for the military profession.

Another part of the military profession that might be stimulated by technological advancement and digital solutions is the decision-making process. By introducing digital systems into data processing, the access to data and information is accelerated enabling faster and easier decision making. Hence, it would be expected that the introduction of digital systems as support in decision making might change the tasks of military personnel in different hierarchical position. This might contribute to a flatten hierarchy where decisions and command are driven on an operational level rather than a command level.

[13] The term exploration refers to learning and innovation. The term exploitation refers to use of past knowledge and to an extend the pursuit and acquisition of new knowledge (Gupta et al., 2006).

# 7 Limitations and Future Studies

In this section, I account for some of the limitations of the study and suggest future possible studies.

To start with, due to the nature of the data, I do not in the current study address the difference in SwAF's demand for digital skills in military and civil occupations. It would be of value to separate these two categories of profession. The process of distinguishing military from civil occupations could be performed through the application of a list of terms specific to each category in the text analysis. Ultimately, for each ad, the occupation category as defined by Statistics Sweden could be retrieved.

Furthermore, the observed peaks in the demand for digital skills during the period 2006-2021 deserve a more thorough analysis to clarify the factors behind the increased demand. A study that investigates the organisational changes and external trends driving these peaks would provide a better understanding of the observed trends and the SwAF's needs for digital skills.

In addition, this study only captures the demand for existing and actually held digital skill. Yet, it is common that organisations such as the SwAF provide specific computer and digital training relevant for the particular business and its activities. However, it could be argued that for the employer to successfully instruct and teach the employees their digital systems, the employees need a certain inherent level of digital literacy. Indeed, digital expertise is an invoked skill that often ensures the receptiveness of employees to new digital skills and digital systems.

Another shortage of the study is that the empirical context does not take into consideration the concept of digital excellence such as defined by Wiggberg et al. (2022). Digital excellence proclaims that individuals are not only digitally literate through their digital knowledge but that they have the ability to adjust, improve, and adapt the available technologies. It is argued that such competence is a combination of skills and personality or individual traits such as innovativeness and creativity. In a future study, it would be interesting to analyse the trends in demand of digital expertise. Such studies could be accomplished using a similar methodology to the method used in this report. By adding a sentiment analysis to the current text analysis, the results could depict the demanded traits in the job ads, in addition to the demanded digital skills.

Moreover, it would be interesting to compare the SwAF's demand for digital skills with the demand for similar skills in a different organisation or industry. Such an analysis would provide a better understanding of the digitalisation process of the SwAF.

Finally, a suggestion for future studies concerns the supply of digital skills. As the results from this study suggest that there are an increasing need and demand for digital skills, it would be of interest to explore the SwAF's opportunities to attract individuals with such skills. This is motivated by the increased competition on the labour market, in particular regarding such skills. A suggested study is therefore to understand the needs, motivations and ambitions of the supply side meaning individuals with these desired skills in order to explore the SwAF's possibilities to engage these individuals.

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# Appendix

## List of skills

Table 4 List of digital skills

| | Translated list |
|---|---|
| Basic | computer driving licence, computer programme, computer skill, Google Drive, spreadsheet editor, Microsoft, software, MS Excel, MS PowerPoint, MS Word, the Office package, text editor, Visual Basic |
| Programming languages | .NET, asp.net, assembler, batch script, C, C#, C++, capl, cobol, Cocoa, CodeSys, CoffeeScript, css, delphi, Delphi, ECMA201X, erlang, F#, functional programming, G#, GObject, GraphQL, Groovy, haskell, html, html5, iOS, java, javascript, jax-rs, jax-ws, JSON, LabVIEW, litium, Lua, low-level programming, MULE, objective-c, Object oriented, php, python, qml, R, Rails, RUBY, Ruby on Rails, sass, Scala, shellscipt, SimuLink, scripting, Specman, SQL, Style sheet language, swift, TypeScript, VB-script, VB.NET, VBA, VBScript, Verilog, VHDL, Visual Basic, Visual C++, X++, XAML, XLTS, XML, Xpath |
| Software | 3D-Studio, 3ds Max, AADC, Active Direcory, active directory, ActiveBatch, ActiveMQ, Adobe, Adobe XD, Aerohive, business management systems, Agresso, Aleneo, Alfatesta, Amazon, Angular.js, Ansible, antivirus, Apace Cassandra, Apache Samza, Appian, ArcGIS, ASP, AutoCad, Autofac, AUTOSAR, Axis, Axis video hosting system, Azure, Babylon.js, back-end applications, Backbone.js, BitBake, Bitbucket, BizTalk, BlocksKit, Bluetooth, firewall, CAD, Camel, CANalyzer, Canoe, Cdrator, CFEnginge, Citrix, CLR, CMS, codedUI testing, comtest, container, CorelDraw, CRM, dashboards, debugger, DHCP, Direct3D, DirectX, DISTI, Django, DOCATO, DropWizzard, drupal, DynamoDB, eclipse, eDirectory, EDP Future, EDP Mobile, Efecte, elasticsearch, emacs, Emarketeer, emulering, EPICS, Episerver, Eplan V8, Ethiris, firebird, firmware, flatpack, flinto, flux, FME Server, Gsuite, game, GIS, GIT, gitlab, Glassfish, Google Cloud Platform, GPO, gradle, Grafana, graphite, GraphWalker, gstreamer, H.264, H.265, hadoop, HDFS, HHBASE, Hibernate, IaaS, Icinga, Identity Management, iDesk, iFacts, iFix, ifs, iipax, ILCMS, IMI Supply Chain, Infoblox JUNOS Space version control, IntelliJ IDEA, IOC, Ionic SDK, iPring, Iptables, ipv6, iSeries, jAutomate, javabeans, javascript bibliotek, Jboss, JDBC, jeeves, jenkins, Jetty, jMeter, Joomla, jQuery, json, JUnit, Kanzi, Kaseya,<br>Kassanova, KEMP, knockout.js, LabVIEW, emergency call center software, leanft, LINQ, liquibase, Logstash, Magento, MailChimp, mailserver, mariadb, marionette.js, MATLAB, Maven, MES-system, meteor.js, microfocus_identity_manager, Microservices, Microsoft Dynamics, Microsoft Dynamics AX, mjpeg, mjukvara, mobilapplikationer, MobX, mockingsramverk, MODBUS, mongodb, mono, moq, moshell, Movex, mpeg4, MSSql, MVC, mysql, NetApp, netconf, NewRelic, nftables, Nginx, ngrx, Nhibernate, de.js, nosql, Novaschem, Novell OES, NSURLSession, nuget, NUnit, oauth, octopus deploy, oddgame, op5, OpenCV, OpenGL, OpenID, openJUMP, OpenLayers, opensource, openstack, Oracle Apex, Oracle DB, Oracle WebLogic, Orchestration, orchestrator, pandas, Pardot, PCS7, phdVirtual, photoshop, Postfix, PostGIS, postgresql, Power BI, powershell, PowerVM, procurve, pubsub, Puppet,<br>pytest, QGIS, qlicksense, qlik-nprinting, qlikview, RabbitMQ, react.js, ReactiveX), Redis, Redux, relational database management system, REST API, Rhapsody, robocopy, RPA, Rstudio, RTSP, RVCT, rxjava, RxJS, SaaS, safecom, SafeControl Apron management (SAM), SAP, SCADA, sccm, SCOM, SCSM, SDK, Selenium, serverhantering, servlets, sftp, Sitecore CMS, SMTP, snapchat, Snowdrop, SoapUI, socket.IO, SolidWorks, Solr, SonarQube, sparx ea, Specter Business Management, game development, Splunk, spreadsheets, Spring Boot, springboot, spyglass, SQL-databaser, SQL-server, SQLite, SSAS, SSIS, SSRS, struts, subnet, subversion, Supply Chain Guru, Swagger, swing, Swish, Sybase, Symfony, system applicationz, Tableau, tensorflow, three.js, Thymeleaf, Tibco, TMA GUI, TOAD, Tomcat, trading algorithms, TSQL, Typesafe, UART, UCtool, unity3D, Valgrind, Vcloud, Veeam Backup, revision control system, virtual private network (VPN), Visual Studio, Vklass, VMware, vsphere, Vue.js, watson, WCF, WebGL, Webpack, WebSocket, WebSphere Liberty, Widequick, Wildfly, Windchill PDMLink, Wireshark, WLAN, Wonderware, wordpress, xamarin, Xcode, Xenapp, Xenmobil, XenServer, Xopus XML Editor, XTM Translation Tool, YaRN, Yocto, ZBFW, zend, ZENworks, ZooKeeper, Zurb Foundation |

# The Swedish Employment Ordinance Section Six

The Swedish employment ordinance, Section 6 is as follows:

> "En myndighet som avser att anställa en arbetstagare skall på något lämpligt sätt informera om detta så att de som är intresserade av anställningen kan anmäla det till myndigheten inom en viss tid.
>
> När det gäller en anställning som regeringen skall besluta om efter förslag eller anmälan från en myndighet eller dess chef, skall myndigheten informera om den lediga anställningen.
>
> Någon information behöver inte lämnas, om särskilda skäl talar mot det."[14]

[14] An authority that intends to hire an employee, must inform about this in a suitable way such that the interested in the employment can apply within a certain time.
In case of an employment requiring a decision from the government, following a received proposal or notification from an authority or the head of the authority, the authority must inform about the vacant position. No information needs to be provided if special reasons speak against it.

FOI
Defence Research Agency
SE-164 90 Stockholm

Phone: +46 8 555 030 00
Fax: +46 8 555 031 00

www.foi.se