



What Soft Skills Does the Software Industry *Really* Want? An Exploratory Study of Software Positions in New Zealand

Matthias Galster
University of Canterbury
New Zealand
mgalster@iee.org

Antonija Mitrovic
University of Canterbury
New Zealand
tanja.mitrovic@canterbury.ac.nz

Sanna Malinen
University of Canterbury
New Zealand
sanna.malinen@canterbury.ac.nz

Jay Holland
University of Canterbury
New Zealand
jay.holland@canterbury.ac.nz

ABSTRACT

Background: Soft skills of software professionals (e.g., communication, interpersonal skills) significantly contribute to project and product success. **Aims:** We aim to understand (a) what are relevant soft skills in software engineering, (b) how soft skills relate to types of software engineering positions, and (c) how soft skills relate to characteristics of hiring organizations. We focus on organizations in New Zealand, a country with a relatively small but growing software sector characterized by a skills shortage and embedded in a bi-cultural context. **Method:** We used a qualitative research method and manually analyzed 530 job adverts from New Zealand’s largest job portal for technology-related positions. We identified soft skills following an inductive approach, i.e., without a pre-defined set of soft skills. **Results:** We found explicit references to soft skills in 82% of adverts. We identified 17 soft skills and proposed a contextualized software engineering description. Communication-related soft skills are most in demand, regardless of the type of position. Soft skills related to broader human or societal values (e.g., empathy or cultural awareness) or distributed development are not frequently requested. Soft skills do not depend on company size or core business. **Conclusions:** Employers explicitly ask for soft skills. Our findings support previous studies that highlight the importance of communication. Characteristics specific to New Zealand do not impact the demand for soft skills. Our findings benefit researchers in human aspects of software engineering and to those responsible for staff, curricula and professional development.

CCS CONCEPTS

• **Social and professional topics** → *Employment issues; Computing occupations; Computing organizations*; • **Software and its engineering**;



This work is licensed under a Creative Commons Attribution International 4.0 License.

ESEM '22, September 19–23, 2022, Helsinki, Finland
© 2022 Copyright held by the owner/author(s).
ACM ISBN 978-1-4503-9427-7/22/09.
<https://doi.org/10.1145/3544902.3546247>

KEYWORDS

Soft skills, Software engineering practice, Job adverts, Exploratory study

ACM Reference Format:

Matthias Galster, Antonija Mitrovic, Sanna Malinen, and Jay Holland. 2022. What Soft Skills Does the Software Industry *Really* Want? An Exploratory Study of Software Positions in New Zealand. In *ACM / IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM) (ESEM '22)*, September 19–23, 2022, Helsinki, Finland. ACM, New York, NY, USA, 11 pages. <https://doi.org/10.1145/3544902.3546247>

1 INTRODUCTION

1.1 Background and Motivation

Software development is a human-centered activity and *soft skills* (e.g., team and communication skills; see Section 2.1 for a more detailed definition) contribute significantly to project and product success, quality and developer productivity [40]. For example, productivity is affected by meeting skills [33], team work [39], and communication [40]. Furthermore, productivity of hard skills (e.g., programming) stems from their combination with soft skills [1, 3, 10, 13]. Finally, soft skills contribute to a successful career [20] and impact job satisfaction [15]. Most practitioners prefer excellent social skills and average technical skills over excellent technical skills and average social skills [16], and many challenges are about human aspects [4], in particular in global and distributed projects [37].

While the importance of soft skills is acknowledged in both software engineering research and practice, there are no empirically grounded insights about *soft skills that industry demands*. One source for analyzing soft skills are online job adverts. Adverts are typically written by managers or human resource specialists together with the hiring managers who define the expected responsibilities, competencies and experience for a position [21, 32].

1.2 Paper Goals and Research Questions

This paper aims to contribute insights into soft skills in demand in the New Zealand software industry. This is the first study of what New Zealand employers demand from professionals beyond “hard skills” related to design, programming, etc. As Basili et al. [5] argue, human, domain and organizational factors define the context in which software engineering methodologies and technologies are applied. Previous studies have shown differences between regions

and software development “communities” with certain behaviors and customs. New Zealand’s software industry is relatively small (in numbers of companies), dominated by smaller companies, but is growing fast and has become a major export factor [25, 43, 44]. This is similar to regions like Turkey [11], Finland [31], Estonia¹, Brazil and Chile [27]. Also, New Zealand’s software industry relies on off-shoring parts of its development due to a skills shortage on-shore. Finally, New Zealand is an example of a bi-cultural society with a commitment to recognize language and culture of the Indigenous peoples, Māori: Software and how software is developed need to be culturally responsive and inclusive [38].

To understand soft skills in New Zealand, we analyze job adverts. There are already studies of adverts in other regions and for different purposes. For example, to understand roles of requirements engineers, studies analyzed adverts in Germany [14], Netherlands [9], Brazil and Mexico [6], Canada [41] and China [42]. While these studies recognize the importance of soft skills, they do not explore them in detail. Therefore, we ask the following research questions:

- **RQ1: What are relevant soft skills in the New Zealand software industry?** Unlike studies that investigated soft skills via surveys or as one skill amongst others, we identify soft skills based on what companies “ask for.” This helps us understand the actual demand, rather than what individuals think is relevant. In New Zealand’s context, it allows us to understand if broader societal values (e.g., bi-culturalism) or distributed work are reflected in required soft skills.
- **RQ2: How does the demand for soft skills relate to types of software engineering positions?** Software engineering involves different types of activities that range from technical (e.g., design and programming) to less technical activities (e.g., requirements interviews). Also, positions differ in seniority level and years of required experience. We explore whether soft skills differ for types of positions.
- **RQ3: How does the demand for soft skills relate to characteristics of organizations?** We explore whether the demand for soft skills depends on who posts adverts, e.g., recruitment agencies on behalf of hiring companies or hiring companies themselves. We also explore whether soft skills differ based on the size and core business (software or non-software) of hiring companies.

For our study we define software positions rather broadly and include any position related to the planning, implementation, delivery and operation of a software-intensive product or service. Hence, our definition goes beyond that of a software developer involved in implementation and testing, but also includes management and operational roles (e.g., support, system administration).

1.3 Contributions

Our findings are of interest to researchers in human aspects of software engineering, to those in industry responsible for staffing and staff, and to curriculum and professional development designers:

- We perform a manual analysis of 530 adverts from the most popular job page for software professionals in New Zealand. The manual analysis ensured that we fully understood the

context for in-depth insights into employers needs. We take a “snapshot” of adverts and since adverts appear at irregular intervals, we do not analyze how soft skills evolve.

- We identify 17 soft skills and propose a contextualized software engineering description for each. These descriptions could empower software engineering researchers and practitioners to integrate soft skills into methods for position development, recruitment and professional development.

The rest of the paper is organized as follows. In Section 2 we provide an overview of key concepts of our research as well as related work. In Section 3 we outline our research method and present results in Section 4. We discuss our findings (including validity threats) in Section 5 and conclude in Section 6.

2 BACKGROUND AND RELATED WORK

2.1 Soft Skills

There is no commonly agreed definition of soft skills (sometimes called “transferable” or “qualitative” skills) and also no formally agreed upon set of soft skills [22]. Soft skills as understood in this work are “intra- and inter-personal (socio-emotional) skills” essential for personal development, social participation and workplace success [18] and include “nontechnical, domain-independent skills that underpin our behavior in the workplace [22].” Some research offers a broad definition of soft skills, inclusive of “abilities, attitudes, habits, and personality traits that allow people to perform better in the workplace, complementing the technical skills [...] and influencing the way they behave and interact with others” [23], but we exclude personality traits from the scope our study. This is because personality traits (e.g., neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness) tend to be more stable over time, and are more difficult to teach (for example, we may improve communication skills but still remain introverts) [2].

2.2 Soft Skills in Software Engineering

Soft skills have been researched from different perspectives. For example, Richa and Tewari [30] reviewed software engineering curricula and found references to soft skills such as communication and leadership. In another secondary study, Matturro et al. [23] identified research on soft skills and what soft skills are considered relevant to software engineering practice. Based on 44 papers, the study identified 30 main categories of soft skills. At least half of the reviewed studies mention five skills: communication, teamwork, analytical, organizational, and interpersonal skills. The mapping study also identified the data collection methods used for research with job advert analysis and surveys as the main methods. Daneva et al. [8] conducted a focus group to identify soft skills for software requirements engineers. The study found communication, team and analytical skills as the top three soft skills. In Section 5 we compare our findings with Matturro et al. and Daneva et al.

2.3 Software Engineering Job Adverts Analysis

Khaouja et al. [19] presented a literature survey on skills identification from online job adverts across different domains, including IT. The study reviewed 108 papers and identified the type of extracted skills, skill identification methods and studied sectors. None of the

¹<https://investinestonia.com/business-opportunities/it-rd/> [last access: April 4, 2022]

reviewed studies provided details of soft skills in the software industry or New Zealand. Papoutsoglou et al. [28] conducted a mapping study on extracting knowledge from online sources for the software engineering labor market. Based on 86 studies, it concluded that job adverts and software development sites (e.g., Stack Overflow, GitHub) are suitable sources for skills for software professionals.

Several country-specific studies in software engineering focus on skills for requirements engineers in Germany in 2013 [14], Netherlands in 2017 [9], Brazil and Mexico in 2017 [6], Canada in 2018 [41] and China in 2020 [42]. For example, Wang et al. [41] analyzed 190 adverts in Canada from one job portal. Results suggest that the most in-demand skills were related to requirements engineering methods and to project management aspects affecting requirements. In addition, employers placed more emphasis on experience – both requirements engineering-specific and broad software engineering experience, than on higher education. In a follow-up study in 2020, Wang et al. [42] analyzed job adverts for requirements engineering-related roles in China. The study analyzed 535 job adverts from China’s two largest job portals. It reported 23 requirements engineering tasks and found (like the study in Canada) that employers emphasize requirements engineering and industry experience. While these studies acknowledge the importance of soft skills, they do not explore soft skills in detail.

3 RESEARCH METHOD

To answer the research questions (Section 1), we performed qualitative data collection and analysis based on job adverts from a job portal. Job portals are accepted sources for job analyses [28]. Our research is exploratory in nature: While it was informed by related work, we do not test specific hypotheses or start with any pre-conceived ideas of the answers to the research questions. Instead, our study discovers how soft skills are conceptualized and required in New Zealand’s companies that employ software professionals and whose core business is software or heavily supported by software. Therefore, our study may not necessarily be generalizable and confirmatory, and we do not aim to replicate previous studies to see if we can reproduce results from other countries (as for example suggested for experimental studies [12]). However, we compare our findings with those in other countries and studies.

3.1 Data Collection and Search for Job Adverts

We analyzed adverts on SEEK NZ², the largest employment page in New Zealand, in particular for technology-related positions. Other portals such as Trade Me Jobs³ target a broader range of jobs. Also, software-related positions on Trade Me usually appear on SEEK.

Rather than applying keywords for searching adverts like other studies (e.g., [41, 42]), we used built-in search criteria to identify software-related adverts. This also allowed us to gather insights into skills required from different types of software-related positions (rather than for example just focusing on requirements engineers, software architects or programmers). The search criteria⁴ were as follows: (1) What: no keywords; (2) Category: Information & Communication Technology; (3) Where: no location provided; (4)

Work type: Full time; (5) Paying range: unlimited (most adverts did not include pay ranges); (6) Time listed: unlimited. Searches were conducted on February 22, 2022. We created a Python script to save PDFs and HTML of adverts into a folder using advert IDs as file names. The Python script also stored the full text of adverts as raw text and extracted some key information from each advert into a spreadsheet (job ID, SEEK subcategory, position, company name, see Section 3.2). The above search resulted in 2,904 adverts.

Since we performed a manual analysis, we could not analyze all job adverts. As proposed by Wang et al. [42], we defined a sample size (sample size generator⁵, margin of error of 3%, confidence level at 95%) of 781 adverts. Then, as suggested by Wang et al. [42] and since we were interested in recent developments in the job market, we reduced the sample size by focusing on the most recent adverts and selected adverts posted between February 10 and February 22, 2022. We then excluded adverts only vaguely related to software engineering-related jobs (e.g., selling computers). This resulted in 530 adverts. This is similar to other software engineering studies with 200 [14], 101 [9], 190 [41] or 535 [42] adverts.

3.2 Data Extraction

We read each advert and extracted data as shown in Table 1. Each advert was analyzed by two researchers and discussed with all four researchers who were experts in software engineering, skills development, organisational behaviour and psychology. SEEK adverts do not follow a consistent structure to separate responsibilities, job description, required qualifications and skills, etc. (beyond a basic structure separating job title, company and location from a longer textual description), so we read the full adverts.

Table 1: Advert data extraction

Data item	Description	RQ
Soft skill(s)	Soft skill(s) as mentioned in advert; one advert can mention no, one or multiple soft skills.	RQ1
Position	Job title as mentioned in advert.	RQ2
SEEK subcategory	Subcategory of SEEK’s classification of “Information & Communication Technology” jobs.	RQ2
Responsibilities	Duty areas and responsibilities as described in advert.	RQ2
Seniority level	Seniority level as mentioned in advert (not mentioned in all adverts).	RQ2
Experience	Years of required experience as mentioned in advert (not mentioned in all adverts).	RQ2
Company	Name of hiring company (i.e., company which hires employees) or recruitment agency (i.e., agencies that act on behalf of hiring company).	RQ3

Below we discuss details for some of the data items in Table 1:

²<https://www.seek.co.nz/>

³<https://www.trademe.co.nz/jobs>

⁴Search criteria as supported at the time of the search.

⁵<https://www.checkmarket.com/sample-size-calculator/>

- **Soft skill(s):** Soft skills were only recorded if an advert explicitly requested them. For example, “the candidate should be a good team player” would count as the teamwork soft skill; “Our company works in small teams” would not. More details of how we analyzed soft skills are in Section 3.3.
- **SEEK subcategory:** Adverts also included one subcategory as selected by the poster from a list of categories offered on SEEK (e.g., “Information & Communication Technology – Consultants”). We recorded the subcategory to get a better understanding for the type of position (e.g., “Consultants”).
- **Responsibilities:** In contrast to “Position” (see Table 1), responsibilities are behaviors, competencies and actions that may be linked temporarily to a job, or more permanently to a portfolio of jobs. Position and responsibilities may overlap, but they are usually not identical. One position may involve different duty areas or responsibilities and they can vary as per current need. For example, a senior software engineer (position) may be involved in design and quality assurance (responsibilities). We used responsibilities to confirm types of positions based on the SEEK subcategories (as we discuss in Section 5.3 when acknowledging validity threats, SEEK subcategories were not always precise).
- **Seniority level:** If mentioned in adverts, we mapped seniority levels to categories junior, intermediate and senior. For example, adverts that mention lead, manager or principal roles were mapped to the senior level. Similarly, adverts that referred to entry-level or graduate positions were mapped to the junior level. Some adverts provided a range of seniority levels, e.g., junior or intermediate. To take a conservative approach, we mapped these to the lower level.
- **Experience:** Some adverts that mentioned required years of experience used a range, e.g., 5-7 years or 5+. As before, we mapped the years to the minimum number of years (e.g., 5 for a range of 5-7 years).
- **Company:** Based on company names we identified who posted an advert (e.g., hiring companies directly or recruitment agencies). Since most adverts did not include information about the size of hiring companies or whether their core business is software, we identified this information based on company names. Recruitment agencies did not include information about the hiring company but typically referred to their “client”. Therefore, we could not obtain information about the hiring company for these adverts. For adverts posted by hiring companies directly, we collected their size (number of employees) and if they were software companies (e.g., Xero) or non-software companies recruiting software professionals (e.g., Air New Zealand recruiting for their internal development teams). This allowed us to relate soft skills to company characteristics. We collected company information from public sources, mostly websites and New Zealand government definitions of sectors [24].

3.3 Data Analysis

Data analysis included all four researchers. For analyzing soft skills, we followed an inductive, data-driven approach. That is, we did not define a set of soft skills up-front and checked whether adverts

mention them. Instead, we used qualitative analysis to extract and select codes for textual data from the adverts “bottom-up”. We applied coding techniques to the textual descriptions, drawing on suggestions from the literature [34]. This allowed us to categorize conceptual elements (from coding) into soft skills. Also, categories of soft skills emerged and evolved during analysis (Table 2 shows the final list of soft skills). Furthermore, we formulated the contextualized description of soft skills based on a qualitative analysis of the adverts. The description of each soft skill was conceptualised from the adverts and represents how they could be manifested in software engineering. This is similar to the approach of Nurwidyantoro et al. [26], who provided contextual descriptions of “value themes” based on how developers discuss them in software development artefacts. We include examples of the analysis in Section 4.2 and Table 2 (for each example we also include the SEEK advert ID).

We followed a similar approach when analyzing responsibilities, i.e., we did not define responsibilities up-front (and did not have a pre-defined coding protocol) and checked whether the adverts mention them (e.g., does the advert mention coding or testing). As the level of detail of adverts varied, for some adverts (e.g., “Apply software engineering practices to deliver analysis-ready data [...]” in advert 55970801) we could only identify “generic” responsibilities.

We used descriptive statistics to identify frequencies and “relationships” between data items. Since our analysis was qualitative, we did not apply further statistical analyses.

4 RESULTS

4.1 Overview

The 530 adverts were posted by 215 different hiring companies and 51 recruitment agencies. Of the 215 hiring companies, 27% were software companies (e.g., Catalyst IT) while 73% were software developing companies whose core business is not software (e.g., Bank of New Zealand).

4.2 RQ1: Soft Skills in Software Engineering

Ninety-three adverts (18%) did not mention soft skills. The number of soft skills in adverts ranged from one to eight, with an average of 2.3. Table 2 lists soft skills and a description for each to contextualize them for software engineering based on the analyzed adverts. Some descriptions are similar to generic descriptions of soft skills found elsewhere (e.g., [23]), while some are more narrow, relating to the context of software engineering. In Table 2 we show the distribution of soft skills across adverts. The percentages indicate the percentage of adverts that referred to a skill (since an advert can mention multiple skills, the total exceeds 100%). We did not find patterns of soft skills that occur together.

Some skills were obvious in the wording of adverts, while others required interpretation (e.g., “time management skills” or “being a self-starter [...] finding what needs to be done” point to independence). We included three communication-related skills: *Communication (general)*, *Communication (oral)* and *Communication (written)*. This is because some adverts only referred to “communication” without details, while some explicitly referred to written or oral communication (e.g., skills related to presenting to clients). Skills are not necessarily independent from each other and one may be a “subskill” of another one. However, we list skills separately as

they appeared separately and often in the same advert. For example, *Problem solving* could be considered a combination of other skills, e.g., *Analytical skills* and *Creativity*. We included it as a separate skill as it was referenced explicitly. Also, given our definition of soft skills in Section 2.1, we did not include desired behaviours or attitudes as soft skills (e.g., “growth mindset”, or “keen to learn”).

As can be seen in Table 2, *Cultural awareness* was not very frequent. One example is an advert for a project coordinator at Auckland University of Technology which emphasized that “Focusing on the cultural aspects of the implementation as well as the software will be critical.” (56011955). Another example is an advert for an intermediate/senior analyst developer at the University of Canterbury which explicitly referenced a bi-cultural context: “Recognising Te Ao Ngāi Tūāhuriri - values, tikanga (processes), kawa (rules) of cultural practice and traditions and valuing Te Reo Māori.” (56012506). Similarly, *Empathy*, which, together with *Cultural awareness* could be related to broader human and societal values such as fairness and inclusion [45], did not appear frequently. However, it is possible that skills such as communication or interpersonal skills are perceived to encompass these. Similarly, we could not identify any soft skills specific to globally distributed development or off-shoring, beyond general communication skills and, to some degree, an acknowledgment of culture and diversity.

Key insights for RQ1: Communication-related skills are most frequent, followed by independence and interpersonal skills. Skills related to New Zealand’s characteristics (i.e., related to broader societal values, bi-culturalism or global and distributed software development) are rarely referenced.

4.3 RQ2: Soft Skills and Types of Positions

4.3.1 Position Categories. We analyzed SEEK subcategories. Table 3 shows the number of adverts per subcategory and example positions. Dominating subcategories were “Developers/Programmers”, “Business/Systems Analysts” and “Engineering – Software”. As stated in Section 3.1, we did not filter adverts based on these subcategories. Other subcategories also included software-related positions (see examples in Table 3). This reflects the diverse nature of software engineering positions. Due to space limitations and to provide insights based on more frequently occurring subcategories, in the following we only analyse subcategories with more than 30 adverts in our sample (except “Other” which includes diverse positions).

Table 4 shows how often a soft skill appeared in adverts in job categories with more than 30 adverts. Percentages indicate the ratio of adverts for a subcategory that referred to a skill. For example, 24% of adverts for Business/Systems Analysts referred to analytical skills, while analytical skills appeared in 13 of the 55 Business/Systems Analysts adverts (see Table 3). As Table 4 shows (grey cells), communication skills dominated regardless of the subcategory. Analytical skills were prominent in Testing & Quality Assurance-related adverts. Interestingly, collaboration skills were not present in adverts for consulting roles. However, consulting-related adverts frequently mentioned oral and written communication (rather than just communication) and interpersonal skills. For Programme & Project

Management-related adverts, generic communication dominated, but independence and interpersonal skills also appeared frequently.

4.3.2 Seniority Level and Years of Experience. Sixty percent of adverts did not mention the *seniority level*, while 34% of adverts referred to the senior level (only 2% and 5% referred to junior and intermediate levels). Hence, we only investigated whether any soft skills are particularly standing out for senior roles. The only soft skill that stood out was communication (general) which appeared in 38% of adverts for senior roles. On the other hand, cultural awareness did not appear in any advert specifically for senior roles.

Fifty-five percent of adverts did not specify the *years of experience*. From the remaining adverts, many require two years (51 adverts, 10%), three years (57 adverts, 11%) or five years (73 adverts, 14%). Interestingly, independence was mentioned in more adverts that explicitly asked for more than two years of experience (39%) compared to adverts that required at least three or five years (26% and 34%). Leadership demand increased with years of experience (4% in adverts that required at least two years, 12% that required at least three, and 26% that required at least five years).

Key insights for RQ2: Except for communication skills, no soft skill dominated for either types of position, seniority levels or years of required experience. However, adverts for consultants frequently also referred to interpersonal skills; adverts that required few years of experience still referred to independence and (not surprisingly) the demand for leadership increased with the years of required experience.

4.4 RQ3: Soft Skills and Organizations

4.4.1 Hiring Companies versus Recruitment Agencies. Ninety-two of the analyzed adverts (22%) were posted by recruitment agencies. The average length (in words) of adverts from recruitment agencies was 300 (versus 535 for company adverts). This could be due to less company-specific information in adverts from recruitment agencies, but also due to fewer job details. The number of soft skills in adverts from recruitment agencies was slightly smaller than in adverts from companies (1.8 on average versus 2.5). Also, 30% of adverts from recruitment agencies did not mention soft skills (versus 14% of adverts from companies). Figure 1 shows that adverts from agencies tend to mention fewer skills (dropping grey line with percentages of adverts per number of mentioned skills).

We did not observe different trends regarding the soft skills mentioned by either a recruitment agency or by a hiring company, e.g., communication skills were demanded frequently in adverts from agencies and hiring companies; cultural awareness and empathy were not common in adverts from agencies or companies.

4.4.2 Characteristics of Hiring Companies. For adverts posted directly by hiring companies, we analyzed size and core business (software/non-software), see Section 3.2. Sizes ranged from two to 700,000 employees, with an average of 8,187. We found no correlation between the number of soft skills and size. To investigate which soft skills are more relevant for companies of different sizes, we mapped the number of employees to small (fewer than 20 employees), medium (20 to 100) and large (more than 100 employees) [25].

Table 2: Identified soft skills in alphabetical order (numbers in brackets indicate SEEK advert ID)

Soft skill	Description	Example quote	Frequency
Analytical	Ability to think critically, analyze different types of information and from different sources	“Have excellent analytical skills and be methodical” (55934622)	15%
Collaboration	Qualities and competencies to collectively progress toward a common goal with other stakeholders	“Strong collaborative focus.” (55997187)	14%
Communication (generic)	Ability to communicate with others in “two-way process”, i.e., by exchanging (“sending” and “receiving”) information	“Excellent communication skills [...] to explain technical issues in a non technical manner.” (55996923)	33%
Communication (oral)	Ability to to exchange (“send” and “receive”) information in different form orally (e.g., in formal presentations or informal conversations)	“Strong written, verbal and presentation skills” (55965677)	22%
Communication (written)	Ability to exchange (“send” and “receive”) information in different forms of writing (e.g., technical documentation or customer documents)	“Good communication skills with the ability to write clearly” (55964542)	24%
Cultural awareness	Awareness and acceptance of other cultures and cultural identities related to the software itself (e.g., cultural responsiveness of apps) and its development and maintenance (e.g., culturally diverse teams)	“Cultural agility” (55963749)	5%
Creativity	Ability to imagine and for original ideas to create something new and potentially innovative	“... ability to think outside of the box...” (55885160)	1%
Diversity	Ability to engage with people from a range of different social, educational, professional and ethnic backgrounds and of different genders	“... ability to work effectively with a wide range of individuals in a diverse community” (55882970)	6%
Empathy	Capacity to understand or feel what another person (including subordinates, peers, managers, clients) is experiencing from within their frame of reference (cognitively, emotionally and compassionately)	“You have empathy for customers, teammates, and other stakeholders” (55988058)	3%
Independence	Ability to act free from the influence or control of another person, group or organization (e.g., without detailed instructions from team leads, clients or peers)	“Have demonstrated experience of self-managing and prioritising your work.” (55996346)	26%
Interpersonal	Ability to being in, establishing, relating to, or involving relations between individuals or groups of persons (e.g., customers, clients)	“Relationship management skills.” (55996384)	23%
Leadership	Ability to influence and guide, motivate and inspire other members of a team, organization or community, including project, business, practice and technology leadership	“[...] command respect and to create a sense of community amongst the members of the project teams.” (55978397)	15%
Listening	Ability to receive language from other stakeholders (internal and external) without judgment or immediate response (unlike communication, listening is a “one-way” process and could be considered a “subskill” of communication)	“Exceptional communicator. You listen intently to customers and colleagues.” (55967867)	2%
Mentoring	Ability to form meaningful relationship with other individuals or groups (usually at the same or lower levels of hierarchy, experience or expertise) with the goal of professional, technology and personal development	“Good leadership skills to train, guide and mentor the work of less experienced personnel.” (5996815)	6%
Negotiation	Ability to efficiently and effectively have discussions aimed to reach agreement (not necessarily consensus) while handling (not necessarily resolving) conflicts with internal and external stakeholders	“Strong problem solving, negotiation and decision-making skills.” (55996249)	2%
Problem solving	Ability to determine why an “issue” is happening and how to resolve it by defining and measuring a problem, analysing the problem and ultimately addressing the problem	“Expert-level troubleshooting & problem-solving skills” (56002657)	17%
Team	Ability to work well with others during conversations, projects, meetings or other collaborations	“... resilient and adaptable team player...” (55995239)	20%

Table 3: SEEK subcategories (percentages are rounded)

SEEK subcategory	Frequency	Example positions
Architects	13 (2%)	Solutions Architect; Principal Microsoft Integration Architect
Business/Systems Analysts	55 (10%)	Business Analyst; Senior Business Intelligence Analyst
Computer Operators	0 (0%)	n/a
Consultants	39 (7%)	Functional Consultant; Technical Consultant – Diagnostic Informatics
Database Development & Administration	13 (2%)	Data and Systems Administrator; Database Specialist
Developers/Programmers	119 (22%)	Software Developer; Senior Java Developer; Mobile Developer IOS
Engineering – Hardware	4 (1%)	Senior Systems Engineer
Engineering – Network	12 (2%)	IT Systems Engineer; Infrastructure and Security Engineer
Engineering – Software	46 (9%)	Senior Software Engineer; Enterprise Engineer; DevOps Engineer
Help Desk & IT Support	32 (6%)	IT Support Engineer; IT & Event Operations
Management	19 (4%)	Support Manager
Networks & Systems Administration	14 (3%)	Linux System Administrator
Product Management & Development	14 (3%)	Product Specialist; Product Owner; Application Support Coordinator
Programme & Project Management	31 (6%)	Customer Service Delivery Manager; Project Manager (ICT/Data)
Sales - Pre & Post	4 (1%)	Software Sales Manager; Account Manager
Security	21 (4%)	IT Security Analyst; Cybersecurity Consultant; Security Architect
Software	2 (0%)	Enterprise Applications Engineer
Team Leaders	6 (1%)	Delivery Manager; Engineering Team Lead; ICT Service Team Lead
Technical Writing	1 (0%)	Professional writers
Telecommunications	8 (2%)	Customer Service Specialist; Regional Manager
Testing & Quality Assurance	34 (6%)	Software Test Analyst; .NET Test Engineer; Test Automation Engineer
Web Development & Production	6 (1%)	Web Design Project Manager; Senior UX/UI Designer
Other	37 (7%)	Senior SAP Basis Specialist; BI Analyst; Visualisation Specialist

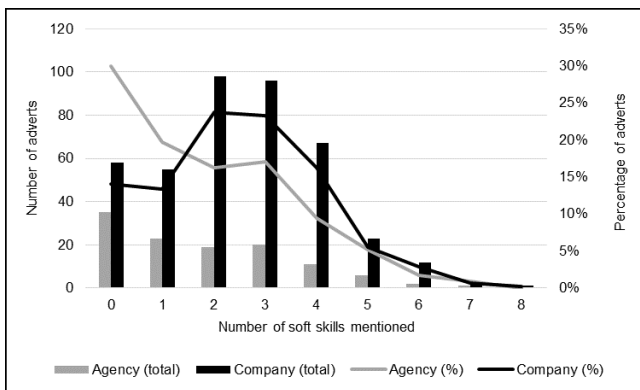


Figure 1: Number (and %) of adverts that mention soft skills

Seventy-nine percent of adverts were from large companies, 15% from medium-sized companies and 7% from small companies. Furthermore, 32% were software companies while the core business of 78% was not software. We show the distribution of skills by sizes and core business in Table 5. Percentages indicate how many adverts of small, medium or large, or software or non-software companies refer to a skill (we highlight highest percentages in grey). General communication skills appeared most, regardless of the size or core business. Interestingly, independence appeared frequently in small companies. Similarly, collaboration appeared more frequently

in small companies, while interpersonal skills appeared more frequently in large companies. Non-software companies demanded written communication more frequently than software companies.

Key insights for RQ3: Adverts from recruitment agencies tend to mention fewer soft skills. There are no significant differences in the demanded soft skills based on company size or core business. Communication skills dominate in all categories. However, collaboration and interpersonal skills differ based on the size of companies, and non-software companies emphasize written communication.

5 DISCUSSION

Our findings contribute to understanding soft skills of software professionals in software developing organizations in New Zealand. Some of our findings may not be surprising (e.g., the dominance of communication skills). However, our study offers a picture of reality and reality is rarely surprising. Our goal was to offer empirical evidence that goes beyond anecdotal evidence. Also, our study offers practical recommendations based on the findings (see below).

For RQ1 we show that companies in New Zealand explicitly refer to soft skills in adverts. Most adverts refer to general communication skills without details what that entails. Also, even though New Zealand is a bi-cultural society and relies on distributed and global software development (see Section 1), cultural awareness was not prominent in adverts (see Section 4.2). Based on RQ1 we also add to the body of knowledge a contextualized description of soft skills;

Table 4: Soft skills that appear in SEEK subcategories with more than 30 adverts

Soft skill	Business/ Systems Analysts	Consultants	Developers/ Programmers	Engineering - Software	Help Desk & IT Support	Programme & Project Man.	Testing & Quality Assurance
Analytical	13 (24%)	11 (28%)	6 (5%)	5 (11%)	4 (13%)	1 (3%)	12 (35%)
Collaboration	8 (15%)	0 (0%)	21 (18%)	12 (26%)	0 (0%)	8 (26%)	4 (12%)
Communication (generic)	15 (27%)	13 (33%)	30 (25%)	19 (41%)	10 (31%)	14 (45%)	15 (44%)
Communication (oral)	22 (40%)	20 (51%)	14 (12%)	11 (24%)	11 (34%)	4 (13%)	7 (21%)
Communication (written)	22 (40%)	21 (54%)	12 (10%)	11 (24%)	10 (31%)	4 (13%)	9 (26%)
Creativity	3 (5%)	1 (3%)	4 (3%)	4 (9%)	2 (6%)	3 (10%)	2 (6%)
Cultural awareness	1 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (3%)	1 (3%)
Diversity	4 (7%)	4 (10%)	7 (6%)	1 (2%)	3 (9%)	2 (6%)	1 (3%)
Empathy	2 (4%)	0 (0%)	2 (2%)	2 (4%)	1 (3%)	1 (3%)	1 (3%)
Independence	18 (33%)	11 (28%)	27 (23%)	11 (24%)	8 (25%)	13 (42%)	7 (21%)
Interpersonal	14 (25%)	24 (62%)	14 (12%)	5 (11%)	4 (13%)	13 (42%)	7 (21%)
Leadership	9 (16%)	2 (5%)	12 (10%)	7 (15%)	1 (3%)	7 (23%)	2 (6%)
Listening	0 (0%)	0 (0%)	0 (0%)	1 (2%)	3 (9%)	2 (6%)	1 (3%)
Mentoring	3 (5%)	3 (8%)	8 (7%)	3 (7%)	1 (3%)	4 (13%)	2 (6%)
Negotiation	0 (0%)	0 (0%)	1 (1%)	0 (0%)	0 (0%)	4 (13%)	0 (0%)
Problem solving	15 (27%)	2 (5%)	13 (11%)	13 (28%)	8 (25%)	7 (23%)	4 (12%)
Team	9 (16%)	9 (23%)	27 (23%)	11 (24%)	8 (25%)	6 (19%)	9 (26%)

Table 5: Soft skills that appear in adverts from different types of companies

Soft skill	Small	Medium	Large	Software	Non-software
Analytical	4 (15%)	11 (18%)	52 (16%)	13 (10%)	54 (19%)
Collaboration	6 (22%)	6 (10%)	49 (15%)	21 (16%)	40 (14%)
Communication (generic)	9 (33%)	21 (35%)	114 (35%)	47 (35%)	97 (35%)
Communication (oral)	6 (22%)	14 (23%)	75 (23%)	24 (18%)	71 (25%)
Communication (written)	7 (26%)	15 (25%)	86 (26%)	25 (19%)	83 (30%)
Creativity	1 (4%)	0 (0%)	20 (6%)	3 (2%)	18 (6%)
Cultural awareness	0 (0%)	1 (2%)	3 (1%)	0 (0%)	4 (1%)
Diversity	1 (4%)	2 (3%)	21 (6%)	4 (3%)	20 (7%)
Empathy	0 (0%)	4 (7%)	6 (2%)	3 (2%)	7 (3%)
Independence	9 (33%)	19 (32%)	84 (26%)	34 (25%)	78 (28%)
Interpersonal	5 (19%)	7 (12%)	96 (29%)	31 (23%)	77 (28%)
Leadership	1 (4%)	5 (8%)	56 (17%)	17 (13%)	45 (16%)
Listening	2 (7%)	3 (5%)	3 (1%)	4 (3%)	4 (1%)
Mentoring	2 (7%)	6 (10%)	20 (6%)	6 (4%)	22 (8%)
Negotiation	0 (0%)	1 (2%)	9 (3%)	2 (1%)	8 (3%)
Problem solving	4 (15%)	13 (22%)	57 (17%)	23 (17%)	51 (18%)
Team	7 (26%)	9 (15%)	71 (22%)	24 (18%)	63 (23%)

this addresses the lack of practical definitions of soft skills for software engineering. While the descriptions can be developed further, these initial descriptions can help consider soft skills more systematically in software engineering practices. For RQ2 we found that no soft skill dominates based on category of position, seniority level or years of experience. Finally, for RQ3 we did not find big

differences in soft skills of hiring companies based on their size or core business. However, we found a difference in soft skills in adverts from recruitment agencies and hiring companies.

5.1 Comparison with Previous Works

The results of our analysis allow us to contrast what literature states as fundamental soft skills with the soft skills the software engineering industry puts in high demand. For example, as discussed in Section 2, Matturo et al. [23] presented a systematic mapping of soft skills in software engineering. In Table 6 we map the soft skills identified in our study to 30 soft skills identified by Matturo et al. As can be seen, some soft skills of Matturo et al. do not directly map to our soft skills (given their description in Table 2), but spread across soft skills (highlighted in bold in Table 6). On the other hand, some soft skills from Matturo et al. could not be mapped: Change management, Commitment/Responsibility, Stress management, Customer orientation, Flexibility, Ethics, Motivation, Willingness to learn, Fast learner and Time management. However, some of these skills are likely related to some of our soft skills (e.g., customer orientation could be about communication and interpersonal skills), but express attitudes and personality traits rather than soft skills. Similarly, some of the soft skills we identified cannot be mapped to Matturo et al. (“*not mapped*” in Table 6).

In an analysis of job adverts for requirements engineers in China, Wang et al. found regarding soft skills that communication and team work are the most frequent skills. Interestingly, Wang et al. found ethics as a soft skill. We did not find this skill. Similarly, Daneva et al. [8] conducted a focus group to identify soft skills for requirements engineers. Communication, team and analytical skills were the top three skills. All these skills also appear in our analysis. Daneva et al. also identified empathy with users as a soft skill (in the context of customer orientation). However, some soft skills identified by Daneva et al. (flexibility, self-confidence, self-organization, English, willingness to travel) appear more related to related to attitudes, personality traits or even hard skills.

5.2 Implications

Our results can guide researchers and practitioners in various ways:

- Software engineering advert design: Kanij et al. [17] suggested improvements to software engineering job adverts, which include emphasizing team and organisational culture, clarifying leadership skills, and being cautious about overstating technical skills and experience required. As we have found, the range of soft skills is rather limited, focusing on communication. Therefore, adverts may include more diverse soft skills to provide a balanced and detailed list of non-technical skills. The soft skills identified in our study can give hiring managers and project managers a better idea of the roles of software engineering candidates. They can consider these skills before they design the job advertisements by conducting a systematic job analysis, and assess these skills in during the recruitment process. For example, as Kanij et al. found [17], software engineering candidates have two major styles of reading adverts, selectively and sequentially. This indicates that adverts should present information in a way that important information stands out and is not lost by those using selective reading. Similarly, long and dense text may contain all information for candidates, but information critical for decision making regarding non-technical skills may be lost. Interestingly, we found that

recruitment agencies are less explicit about the soft skills mentioned in adverts (possibly due to only including competencies in adverts that can be easily screened for from an application alone).

- Software engineering role design: Soft skills as well as their contextualized definitions can help managers design requirements for their software engineering roles. Furthermore, the contextualized descriptions of soft skills may be useful for staff development, mentoring and coaching purposes. Also, managers can use the descriptions when building software engineering teams and work practices.
- Skills development and training: Understanding what soft skills are required in the software industry can help us develop programs for professional development, but also for tertiary institutions. While software engineering programs tend to emphasize communication and team skills, other soft skills such as empathy and cultural awareness are typically less of a concern. However, to what degree exactly the soft skills identified in our study are covered in software engineering curricula is subject for future work. This also requires that we differentiate between personality traits and soft skills: Soft skills may be taught (even though it is difficult), while personality traits are more difficult and slow to change. However, as others have argued, certain personality traits may impact how well soft skills are acquired, e.g., regarding negotiation skills Chapman argues that “without formal training, we argue that certain person and situation factors make someone more or less likely to acquire a particular negotiation skill set [7].”

5.3 Threats to Validity

We checked our study design and execution against the ACM Empirical Standards⁶ (general guideline). Still, our exploratory study has limitations. First, we searched for software engineering-related positions based on SEEK’s “Information & Communication Technology” category. Therefore, we may have missed software-related adverts posted under different categories. Also, since New Zealand is a small country, not all jobs (in particular for senior roles) would appear on SEEK. Senior experts and managers often obtain new positions by via their professional network or by being “headhunted”, or via internal recommendations. Also, new graduates are often recruited via internships and campus recruitment.

Second, we used a sample of 530 job adverts. Results may differ if we analyze more adverts. However, after analyzing around 100 adverts we observed that no new skills were added. This means that analyzing more adverts may lead to different frequency distributions, but the list of soft skills is less likely to change.

Third, we could not create a balanced sample of adverts (e.g., based on time published or positions). This was because adverts are published at irregular intervals. Furthermore, certain positions may appear more than others. Hence, we only took a “snapshot” of skills at a certain time rather than study their evolution.

Fourth, to ensure reliability of the identified soft skills, multiple researchers analyzed adverts. The description of soft skills was discussed among all researchers and refined accordingly. However,

⁶<https://github.com/acmsigsoft/EmpiricalStandards>

Table 6: Comparison of soft skills identified in our study with previous research

Soft skills (our study)	Soft skills in Matturro et al. [23]
Analytical	Analytical skills; Methodical
Collaboration	<i>Not mapped</i>
Communication (generic)	Communication skills; Conflict management
Communication (oral)	Presentation skills
Communication (written)	<i>Not mapped</i>
Creativity	Creativity; Innovation; Critical thinking
Cultural awareness	<i>Not mapped</i>
Diversity	<i>Not mapped</i>
Empathy	<i>Not mapped</i>
Independence	Autonomy; Initiative; Organizational/Planning skills
Interpersonal	Interpersonal skills
Leadership	Leadership; Decision-making; Organizational/Planning skills; Team management
Listening	Listening skills
Mentoring	<i>Not mapped</i>
Negotiation	Negotiation skills; Conflict management
Problem solving	Problem-solving skills; Decision-making; Results orientation; Methodical
Team	Team work

some data may still be subject to reliability issues. For example, the number of employees of companies used to categorize companies based on size was taken from publicly available sources. It was not always clear whether the reported numbers refer to the number of employees in New Zealand or worldwide. Similarly, to analyze types of positions, we relied on the subcategories of the SEEK job portal. However, some of these categories were not defined well. For example, subcategory “Security” describes a domain, whereas a subcategory like “Architects” describes a type of position or role. However, adverts on SEEK can only belong to one subcategory. To increase our confidence in the categorization (and in particular the seven categories with more than 30 adverts used for analysis in Section 4.3, we also manually extracted information about responsibilities involved in roles (see Section 3.2).

Fifth, required soft skills may be impacted by the working situations of individuals and conditions of organizations. Such situations and conditions were impacted by COVID-19 [29]. Our findings do not provide insights into whether required soft skills changed. However, comparing our findings with other literature confirmed results of previous studies, leading us to hypothesize that soft skills are rather “stable.” Also, soft skills that could help in difficult working situations (e.g., empathy, diversity) did not appear frequently.

Sixth, we did not analyze how soft skills relate companies based on whether they are domestic or international companies. This was because it is difficult to decide what international and domestic mean. For example, is it about where a company’s offices are located or is it about target markets and clients of companies?

Finally, adverts might be written by Human Resource departments who reuse templates without clear relevance for the actual the position. This means, soft skills in adverts may not be relevant for the position, and soft skills that are actually relevant may not be included in adverts. Also, those who write adverts may have a different understanding of soft skills. We mitigated this by considering the full context of an advert when interpreting skills.

6 CONCLUSIONS

This is the first study to provide an empirical analysis of soft skills from job adverts in New Zealand, including a contextualized description of these soft skills. As such, it adds to the collective body of knowledge on the software engineering profession.

In summary, (1) in general regarding *which* soft skills are in demand, our study supports previous studies and therefore adds to the body of knowledge to strengthen the empirical evidence for soft skills; and more specifically, we (2) contribute contextualized descriptions of soft skills for software engineering; (3) discuss soft skills in a particular cultural and industry context not studied before; (4) provide insights into what soft skills are demanded depending on the type of position/organization. Our findings benefit employers and employees by capturing trends which can facilitate continuous learning and training, support of better match between positions and candidates, and skill detection and development.

As future work, we plan to collect and analyze more job adverts using automated approaches (e.g., [35]). Also, we will conduct interviews with companies in New Zealand, including with Human Resources professionals, job incumbents and technical and non-technical managers. Finally, based on these analyses and grounded theory [36] we can define taxonomies of soft skills in software engineering to understand relationships, dependencies and influences between soft skills (e.g., “subskills” that contribute to a higher skill as mentioned in Section 2.1) and how soft skills (or their combinations) complement each other. These efforts will help us towards theory building in the software engineering profession [4, 46].

ACKNOWLEDGMENTS

This research was supported by the MBIE Endeavour Fund.

REFERENCES

- [1] S. Angelov, M. Meesters, and M. Galster. 2016. Architects in Scrum: What Challenges Do They Face?. In *European Conference on Software Architecture (ECSA)*, 229–237.

- [2] M. Ardel. 2000. Still Stable After All These Years? Personality Stability Theory Revisited. *Social Psychology Quarterly* 63 (2000), 392–495.
- [3] J. Balcar. 2016. Is It Better to Invest in Hard or Soft Skills? *The Economic and Labour Relations Review* 27, 4 (2016), 453–70.
- [4] S. Baltes and S. Diehl. 2018. Towards a Theory of Software Development Expertise. In *26th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE)*. 187–200.
- [5] V. Basili, L. Briand, D. Bianculli, S. Nejati, F. Pastore, and M. Sabetzadeh. 2018. Software Engineering Research and Industry: A Symbiotic Relationship to Foster Impact. *IEEE Software* 35 (2018), 44–49.
- [6] A. Calazans, R. Paldes, E. Masson, I. Brito, K. Rezende, E. Braosi, and N. Pereira. 2017. Software Requirements Analyst Profile: a Descriptive Study of Brazil and Mexico. In *25th International Requirements Engineering Conference (RE)*. 196–204.
- [7] E. Chapman. 2017. A Proposed Model for Effective Negotiation Skills Development. *Journal of Management Development* 36 (2017), 940–958.
- [8] M. Daneva, A. Herrmann, N. Condori-Fernandez, and C. Wang. 2019. Understanding the Most In-Demand Soft Skills in Requirements Engineering Practice: Insights from Two Focus Groups. In *23rd Conference on Evaluation and Assessment on Software Engineering (EASE)*. 284–290.
- [9] M. Daneva, C. Wang, and P. Hoener. 2017. What the Job Market Wants From Requirements Engineers? an Empirical Analysis of Online Job Ads From the Netherlands. In *11th International Symposium on Empirical Software Engineering and Measurement (ESEM)*. 448–453.
- [10] M. Erder and P. Pureur. 2017. What Type of People Are Software Architects? *IEEE Software* 34, 4 (2017), 20–22.
- [11] V. Garousi, A. Coscuney, A. Betin-Can, and Onur Demirs. 2015. A Survey of Software Engineering Practices in Turkey. *Journal of Systems and Software* 108 (2015), 148–177.
- [12] O. Gómez, N. Juristo, and S. Vegas. 2010. Replications Types in Experimental Disciplines. In *4th International Symposium on Empirical Software Engineering and Measurement (ESEM)*. 1–10.
- [13] A. Hendarman and J. Hidayat. 2012. Relationship among Soft Skills, Hard Skills, and Innovativeness of Knowledge Workers in the Knowledge Economy Era. *Procedia – Social and Behavioral Sciences* 52 (2012), 35–44.
- [14] A. Hermann. 2013. Requirements Engineering in Practice: There is no Requirements Engineer Position. In *19th International Working Conference on Requirements Engineering: Foundations for Software Quality (REFSQ)*. 347–361.
- [15] T. James, M. Galster, K. Blincoe, and G. Miller. 2017. What is the Perception of Female and Male Software Professionals on Performance, Team Dynamics and Job Satisfaction? Insights from the Trenches. In *International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP)*. 13–22.
- [16] E. Kalliamvakou, C. Bird, T. Zimmermann, A. Begel, R. DeLine, and D. German. 2019. What Makes a Great Manager of Software Engineers? *IEEE Transactions on Software Engineering* 45, 1 (2019), 87–106.
- [17] T. Kanij, J. Grundy, J. McIntosh, A. Sarma, and G. Aniruddha. 2022. A New Approach Towards Ensuring Gender Inclusive SE Job Advertisements. In *IEEE/ACM International Conference on Software Engineering (ICSE)*. 1–11.
- [18] K. Kechagias. 2011. *Teaching and Assessing Soft Skills*. MASS Project - European Union's Lifelong Learning Programme.
- [19] I. Khauja, I. Kassou, and M. Ghogho. 2021. A Survey on Skill Identification From Online Job Ads. *IEEE Access* 9 (2021), 118134–118153.
- [20] R. Krishnamurthy. 2017. Breezing my Way as a Solution Architect: A Retrospective on Skill Development and Use. *IEEE Software* 34, 3 (2017), 9–13.
- [21] N. Kumari. 2014. A Case Study on Position Descriptions for the Testing Department at CESC Limited. *East Asian Journal of Business Management* 4 (2014), 19–26.
- [22] M. Matteson, L. Anderson, and C. Boyden. 2016. Soft Skills: A Phrase in Search of Meaning. *portal: Libraries and the Academy* 16, 1 (2016), 71–88.
- [23] G. Maturro, F. Raschetti, and C. Rontan. 2019. A Systematic Mapping Study on Soft Skills in Software Engineering. *Journal of Universal Computer Science* 25, 1 (2019), 16–41.
- [24] Ministry of Business, Innovation and Employment (MBIE) New Zealand. 2014. The New Zealand Sectors Report 2014 – Main Report.
- [25] Ministry of Business, Innovation and Employment (MBIE) New Zealand. 2017. ICT Sector Report.
- [26] A. Nurwidyanoro, M. Shahin, M. Chaudron, W. Hussain, R. Shams, H. Perera, G. Oliver, and J. Whittle. 2021. Human Values in Software Development Artefacts: A Case Study on Issue Discussions in Three Android Applications. *Information and Software Technology* 141 (2021), 1–16.
- [27] S. Ochoa, R. Robbes, M. Marques, L. Silvestre, and A. Quispe. 2017. What Differentiates Chilean Niche Software Companies: Business Knowledge and Reputation. *IEEE Software* 34, 3 (2017), 96–103.
- [28] M. Papoutsoglou, A. Ampatzoglou, N. Mittas, and L. Angelis. 2019. Extracting Knowledge From On-line Sources for Software Engineering Labor Market: a Mapping Study. *IEEE Access* 7 (2019), 157595–157613.
- [29] P. Ralph, S. Baltes, G. Adisaputri, R. Torkar, V. Kovalenko, M. Kalinowski, N. Novielli, S. Yoo, X. Devroey, X. Tan, M. Zhou, B. Turhan, R. Hoda, H. Hata, G. Robles, A. Milani Fard, and R. Alkadhi. 2020. Pandemic Programming: How COVID-19 Affects Software Developers and How Their Organizations Can Help. *Empirical Software Engineering* 25 (2020), 4927–4961.
- [30] S. Richa and V. Tewari. 2016. A Systematic Review of Relevant Soft Skills in Software Engineering Curricula. In *International Conference on Education and New Learning Technologies (Edulearn)*. 8880–8888.
- [31] P. Rodriguez, J. Markkula, M. Oivo, and K. Turula. 2012. Survey on Agile and Lean Usage in Finnish Software Industry. In *International Symposium on Empirical Software Engineering and Measurement (ESEM)*. 139–148.
- [32] A. Rosener, E. Frigo, M. O'Kelly, E. Psyck, and K. Ranger. 2016. A Tale of Two Position Descriptions: Writing a New Liaison Librarian Position Description. 30 (2016), 1–11.
- [33] C. Sadowski, M. Storey, and R. Feldt. 2019. A Software Development Productivity Framework. In *Rethinking Productivity in Software Engineering*, C. Sadowski and T. Zimmermann (Eds.). Apress, Berkeley, CA, 39–47.
- [34] J. Saldana. 2011. *The Coding Manual for Qualitative Researchers*. Sage.
- [35] M. Sibarani and S. Scerri. 2020. SCODIS: Job Advert-derived Time Series for High-demand Skillset Discovery and Prediction. In *31st International Conference on Database and Expert Systems Applications (DEXA)*. 366–384.
- [36] K. Stol, P. Ralph, and B. Fitzgerald. 2016. Grounded Theory in Software Engineering Research: A Critical Review and Guidelines. In *2016 IEEE/ACM 38th International Conference on Software Engineering (ICSE)*. 120–131.
- [37] V. Stray and N. B. Moe. 2020. Understanding Coordination in Global Software Engineering: A Mixed-methods Study on the Use of Meetings and Slack. *Journal of Systems and Software* 170 (2020), 1–20.
- [38] Technology Investment Network. 2020. The Investor's Guide to the New Zealand Technology Sector.
- [39] C. Treude and F. Filho. 2019. How Team Awareness Influences Perceptions of Developer Productivity. In *Rethinking Productivity in Software Engineering*, C. Sadowski and T. Zimmermann (Eds.). Apress, Berkeley, CA, 169–178.
- [40] S. Wagner and E. Murphy-Hill. 2019. Factors That Influence Productivity: A Checklist. In *Rethinking Productivity in Software Engineering*, C. Sadowski and T. Zimmermann (Eds.). Apress, Berkeley, CA, 69–84.
- [41] C. Wang, P. Cui, M. Daneva, and M. Kassab. 2018. Understanding What Industry Wants from Requirements Engineers: an Exploration of RE Jobs in Canada. In *12th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM)*. 1–10.
- [42] C. Wang, Y. Tang, P. Liang, M. Daneva, and M. van Sinderen. 2020. What Industry Wants from Requirements Engineers in China?: An Exploratory and Comparative Study on RE Job Ads. In *14th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM)*. 1–11.
- [43] D. Wang and M. Galster. 2018. Development Processes and Practices in a Small but Growing Software Industry: a Practitioner Survey in New Zealand. In *12th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM)*. 1–10.
- [44] D. Wang and M. Galster. 2018. An Exploratory Study on Software Products and Development Organizations in New Zealand. In *19th International Conference on Product-Focused Software Process Improvement (PROFES)*. 141–149.
- [45] J. Whittle, M. Ferrario, W. Simm, and W. Hussain. 2019. A Case for Human Values in Software Engineering. *IEEE Software* 38 (2019), 106–113.
- [46] R. Wieringa and M. Daneva. 2015. Six Strategies for Generalizing Software Engineering Theories. *Science of Computer Programming* 101 (2015), 136–152.