

# Blockchain-Engineers Wanted: an Empirical Analysis on Required Skills, Education and Experience

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**Abstract**—There is an indisputable industrial need for highly skilled individuals in the role of blockchain engineers. However, little is known about the typology of activities which fall under the blockchain engineers’ responsibilities and the competencies and experiences sought from employers’ perspectives. To shed light about the main characteristics of the new roles available in the market, we built and analyzed a dataset of 400 job ads related to software blockchain engineering and development roles in the U.S.. We performed a thorough analysis conducted to find the industrial demand for competencies related to the blockchain engineer role in terms of (i) level of education, training, and experience; (ii) blockchain-related development skills; (iii) technical skills; and (iv) soft-skills. Relevant correlated skills that may influence shaping the profile of the blockchain engineers were also analyzed. We conclude that a new “blockchain engineer” role is shaping up, and that specific skills, educational background, and experience are requested from the job market.

**Index Terms**—blockchain, Industry practices, Survey, job ad, blockchain engineer, Exploratory Study.

## I. INTRODUCTION

The blockchain technology’s transformative capabilities have been rapidly recognized as a turning point in many use case scenarios beyond the financial sector. This emerging technology’s impetus is now being utilized in multiple ways, from global payments to music sharing to managing healthcare records and even tracking diamond sales [1]–[3]. A 2018 study reported 3,000 blockchain software projects hosted on Github in March 2018 [4]. A similar search we conducted on Github in January 2021 yielded around 77,000 projects. The World Economic Forum estimates 10% of the global GDP to be stored using blockchain by 2027. Gartner, estimated investment decisions worth \$3.1 trillion in blockchain technology projected by 2030 [5].

In synchronous with the growing sphere of blockchain, numerous data points testify the increasing demand for blockchain developers, and engineers [6]. Glassdoor, a job review site, found 1,775 blockchain-related job openings in the U.S. in 2018 which is an increase of 300 percent compared to one year earlier [7]. As of December 2020 a search that we conducted for the job title “blockchain engineer” in the U.S. retrieved 4,220 results on LinkedIn. The skyrocketing demand for blockchain-related jobs has also translated into a significant

salary bump. According to Glassdoor [7], the median salary for a blockchain-related job opening is 61.8 percent above the U.S. median salary. The average salary for blockchain jobs is approximately 1.3 times higher than the standard salary for software engineers, according to global statistics provided by Hired.com [8]. Salaries for blockchain engineers are on par with specialists focused on artificial intelligence.

Unlike traditional software development, blockchain engineers need to secure an immutable and decentralized database hosted on distributed nodes connected through a peer-to-peer network without a pre-existing trust relationship [9]. The significant differences between blockchain-oriented development and traditional software development motivated the blockchain community to propose a new development paradigm named Blockchain-Oriented Software Engineering (BOSE) [10], [11]. Conversely, despite the increasing popularity of “blockchain engineer” as an emerging role, there is still a significant incongruity regarding the perceptions of this role, responsibilities, and required competencies in the marketplace. The scarcity of tools, patterns and resources, unavoidable for a new technology, also poses a challenge for this role. Consequently, looking into the existing landscape of the job profiling for “blockchain engineer” becomes of significant importance. The study described in this paper aims to scrutinize the state-of-the-practice of blockchain engineer roles in the U.S. job market.

For this research, we collected 400 job ads related to blockchain engineer role in the U.S.. Scholars in software engineering research and sociology treat job postings as an artefact to analyze the area of occupational research. This is because the job postings are contended to be representations of occupations and carry occupational terminology, making them occupational artefacts [12]. Typical information which can be found in a job advert includes position, essential duties, required skills and competencies, experience, and education/training/certificate/security clearances.

Accordingly, we analyzed the collected data from the 400 job postings to find the industrial demand for competencies for the blockchain engineer role in terms of (i) Level of education, training, and experience; (ii) Blockchain-related skills; (iii) Other technical skills; and (iv) Soft-skills. We also examined

whether any correlated skills may influence shaping the profile of the blockchain engineer role.

The remainder of this paper is structured as follows. In Section 2 we present research questions and describe the research process. Section 3 explains our results. Section 4 provides a discussion on the implications of the findings on research, practice, and teaching, while Section 5 discusses the validity of the results. Finally, Section 6 provides a conclusion.

## II. METHODOLOGY

The emerging term “blockchain engineer” is frequently used in relation to a role with responsibilities of either building applications using blockchain technology, and (or) developing the blockchain technology itself and the elements which interact with it (e.g., new consensus algorithms, smart contracts, or digital currencies).

In this paper, we make a distinction between a “position” and “role”. While the two may functionally overlap, there are differences [13]. The position has a title that the employer uses to describe an employee, while a role, on the other hand, is the actual function an employee fills within an organization. In this study, we used a collection of publicly available job postings from employers searching for talents to fill positions that include blockchain engineer “roles”. These job posts had the “position” titles and included a list of qualifications and skills that the employers deemed important to fill these positions.

This research aims to investigate the landscape of the blockchain engineer role in the U.S. job market, and we aimed at answering the following four research questions (RQs):

- **RQ1:** What “position” titles are posted for blockchain engineer “roles” in the U.S. job market?
- **RQ2:** What type of companies are hiring for blockchain engineer “roles” in the U.S. job market?
- **RQ3:** What skills (blockchain-related, technical, and soft) do blockchain engineers need to possess to match the job demand? Are there correlated skills?
- **RQ4:** What educational attainment (e.g. degree and/or certification) and experience level requirements do employers request for blockchain engineers?

A data collection strategy based on job posts is appropriate for the context when the qualitative data is publicly available to analyze, and when a researcher needs to establish a balance between the study execution effort on one hand and breadth and depth of the study on the other hand [14], [15]. To analyze the state-of-the-practice of blockchain engineer roles in the U.S., we utilized one of the most popular jobs search tools “LinkedIn”. According to Alexa Ranking by Amazon and other sources (e.g., [16]), “LinkedIn” is the most significant engine among its competitors in terms of the traffic volume and the number of jobs posted.

We used a systematic data collection process as defined by Petersen et al. [17], which included the following steps:

- 1) The search string used for this review was defined as (“blockchain engineer”). One of the job search engine amenities includes interpreting the search string, which

TABLE I  
EXTRACTED INFORMATION FROM THE JOB POSTS.

What we extracted	Relevant RQ
<b>General Information</b>	
1. Position title	RQ1
2. Position level	RQ1
3. Position posted date	RQ1
4. Suggested Salary	RQ1
5. Company name	RQ2
6. Company domain of business	RQ2
7. Position location	RQ2
8. Blockchain application the company develops	RQ2
<b>Competencies</b>	
9. Blockchain-related competencies	RQ3
10. Programming languages competencies	RQ3
11. Database management systems competencies	RQ3
12. Development platforms and frameworks competencies	RQ3
13. Other Technical competencies	RQ3
14. Soft-skills competencies	RQ3
15. Educational attainment	RQ4
16. Certifications	RQ4
17. Minimum years of industrial experiences	RQ4

results in a range of relevant jobs related to the search term. Accordingly, we obtained a wide range of position titles using the defined search string, including: Blockchain Developer, Blockchain Platform Architect, Web Developer Blockchain, Tech Lead, Java developer, etc. We performed the search using the above string for each of the 50 States.

- 2) We initially assessed each retrieved job post based on the following inclusion criteria: (a) the job post had blockchain development as one of its core tasks; (b) the job post included details of the demanded specific skills set; and (c) the job post assumes a full-time position. We used these criteria on the text of the entire post (e.g. job title, and descriptions of the responsibilities, tasks, skill set, education, and experience).
- 3) The first eight job ads that met the inclusion criteria from each search (per state) were included in the final set.

We executed the selection process between July and August 2020, and 400 job ads from 50 states were retained in the final set for quantitative coding, analysis, and synthesis for this paper.

To answer the research questions, 17 items of information were extracted from each of the final 400 job postings included in this study, as shown in Table 1. A survey form was built using the “Qualtrics XM Platform” to store the extracted data. The online form is available at the link <http://bit.ly/35BiVd7>.

Because the job posts detail the tasks and responsibilities, we applied qualitative coding techniques to the text descriptions related to competencies and tasks. Drawing upon Saldana’s qualitative data coding process [18], the analysis of each post granularly distinguished between tasks and competencies, and among the different types of competencies (blockchain-specific, technical, and soft-skills).

To analyze the competencies, we executed a free-text analysis that looks at the frequency of terms to determine the

relevant data regarding specific job demands. For the free-text analysis, we used the “Text-iQ” feature provided by “Qualtrics”.

For the quantitative assessment, we used “Stats iQ”, which is supplied with the “Qualtrics platform”. This feature performs a statistical analysis of the extracted data numerical parameters and resulted in the percentage of job posts that advertised each category of responsibilities and competencies. The extracted data file is available online at the link <https://bit.ly/3eucYDY>.

This study aimed to discover the existence of patterns and themes from the subcategories of skills advertised in the posts. A strong correlation of skills emerging from the analysis would indicate the presence of particular blockchain engineer profiles that employers are looking for. Conversely, a lack of this type of pattern would indicate no clear blockchain engineer profiles from the job market. To perform this analysis, we reviewed all of the subcategories of skills in the job posts and constructed cross-tables using the “Crosstabs” feature from Qualtrics.

### III. FINDINGS

#### A. Answers to RQ1: Job Profiles for Blockchain Engineers

At first glance, we can observe the diversity in position titles used to describe a blockchain development role. Around 41.5% of the posts were advertised as “engineer” positions, while 36.5% were advertised as “developer” positions, 8.8% as “architect” and 1.3% as “consultant”. Additionally, some titles (8%) used particular programming languages names to define the position (e.g., Java developer, or Python developer). Only in 25.8% of the advertised positions, the “blockchain” keyword was used in the title.

The majority of the positions (53.5%) were advertised as senior or lead positions, which indicates the demand of level of experience for these positions (see table 2). In contrast, 34% were advertised as junior positions, and the remaining posts didn’t specify the seniority level of the role. Only a small portion of the overall sample indicated whether it is for front-end development (4.1%), back-end development (3.6%), or a full-stack development (8.6%).

TABLE II  
DISTRIBUTION OF THE 400 JOBS TITLES PER CATEGORY AND SENIORITY LEVELS.

	Entry Level	Senior Level	Lead	Not Specified	Total
Engineer	55	50	38	23	166 (41.5%)
Developer	58	47	22	19	146 (36.5%)
Architect	3	10	14	8	35 (8.75%)
Analyst	5	0	1	0	6 (1.5%)
Consultant	0	1	4	0	5 (1.25%)
Other Roles	15	12	15	0	42 (10.5%)
Total	136	120	94	50	400 (100%)

Seventy-Five positions listed the salary. The vast majority of these positions had an annual salary range between 70,000 and 90,000\$.

#### B. Answers to RQ2: Hiring Companies Profiles

Note that among the 400 job posts, the majority (56.9%) came from companies with the main business domain directly related to Information Technology (IT). Nevertheless, a wide range of business domains is still reflected in the extracted set (see Figure 1), such as finance, health, consultancy and logistics, and defence.

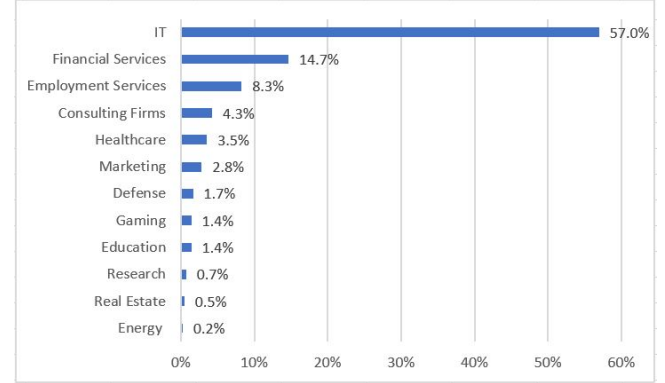


Fig. 1. Distributions of Extracted Ads Across Business Domains.

Apart from enterprises and established businesses, blockchain is of interest to small companies and startups. This is evidenced by the fact that more than half of the job ads from the analyzed sample belong to employers with small to medium sizes (<200 employees) (see Figure 2).

Only 9.1% of the overall sample revealed the blockchain application that the company develops, and only for the 6.8% of the ads, the developed application was cryptocurrency-related.

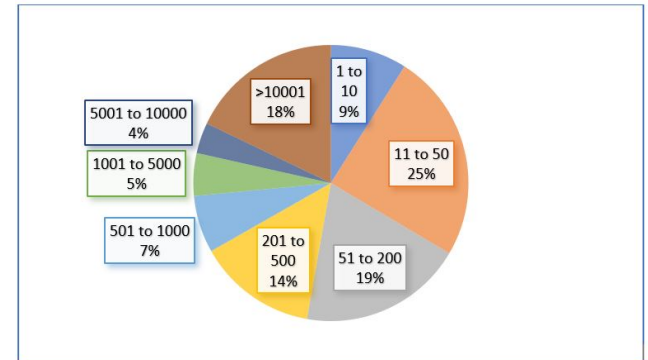


Fig. 2. Distributions of Extracted Ads Across Companies Sizes.

#### C. Answers to RQ3: Required competencies

After analyzing the job description and required tasks in each job post, we mapped these features to the related competencies needed for the jobs. Most employers ask blockchain engineers for a wide span of technical skills that are not specialized in narrow aspects. These skills vary from project

management, development tools and frameworks, programming languages, integration skills, and many more.

1) *Required Competencies in Blockchain*: There were 161 of the extracted ads (40.5% of the overall sample) that explicitly asked for working knowledge of blockchain development. We further analyzed this particular subsample to explore the various blockchain-related competencies that are of interest to employers. The most demand is by far for expertise in cryptocurrencies platforms with 93.2% of ads from this subsample asking for familiarity with one or more cryptocurrencies platforms. Experience with Ether and Ethereum come in the first place (36.6% of this subsample). Ethereum is a decentralized, open-source blockchain featuring smart contract functionality. Ether is the native cryptocurrency of the platform. Competency in the Bitcoin platform came at a second-place (14.9%), and Ripple at third place (4.3%).

The second-highest demand for blockchain-related competencies was for smart contracts (31.6%). A smart contract that is stored on the blockchain can serve as a set of rules that oversee a business transaction and is executed automatically as part of a transaction. Solidity was of particular interest to 16.1% of this subsample. It is an object-oriented programming language for writing smart contracts. It is used for implementing smart contracts on various blockchain platforms, most notably, Ethereum.

The third highest demand was for “Hyperledger” (22.4%) which is an open-source community focused on developing a suite of frameworks, tools, and libraries for enterprise-grade blockchain deployments. The most popular hyperledger in this study was “Fabric” (11.2%). Competency in consensus algorithms came at fourth place with 8%.

2) *Required Technical Skills*: Besides blockchain competencies, the data indicates that employers are mostly interested in professionals with a grip on the entire development process. About 28.9% of the overall employers ask blockchain experts to have working skills related to software design and architecture, and about 14.7% ask for testing skills. There was less demand for skills related to requirements engineering. The majority of the employers (76.2%) require some programming skills, which implies a clear demand for professionals with programming and scripting capabilities. Our results show that Java takes first place with 34.5% of the overall ads ask for it. The second most demanded skill in development languages is JavaScript (30.8%). Third in line is having a Python competency with (27%), while C++ comes in fourth place (20.2%). Table 3 shows that most of the demand is for programming languages.

Thirty Percent of the ads ask for competency in one or more database management systems (Table 3). MongoDB took first place (11.8%) and followed closely by Microsoft SQL Server (11.3%).

Moving our attention to software development tools and frameworks (Table 4), we note some demand for tools supporting cloud computing, continuous integration, build management, and source control management. These tools are not tailored solely for developers but are part of operating

TABLE III  
DEMANDS FOR TECHNICAL SKILLS

Software Development Phases	
Requirements Engineering	2.3%
Software Architecture and Design	28.9%
Programming	76.2%
Software Testing	14.7%
Programming Languages	
Java	34.5%
JavaScript	30.8%
Python	27.0%
C++	20.2%
Go	19.0%
SQL	16.3%
C	11.8%
HTML	11.1%
CSS	8.1%
TypeScript	7.3%
C	5.9%
Solidity	5.4%
Rust	5.2%
Ruby	4.5%
Scala	4.1%
Database Management Systems	
MongoDB	11.8%
Microsoft SQL Server	11.3%
Oracle RDBMS	10.4%
PostgreSQL	6.8%
MySQL	6.6%

a continuous integration model [19], common in Agile and used across multiple roles. The demand level is not high, though, and an explanation for it might be that these tools are easy to operate for standard usage; therefore, specific skills are unnecessary.

About 15.7% of employers are interested in experts with specialized knowledge in cryptography. We also looked at the experience demand for other disruptive technologies. Knowledge of Big Data was requested by the 10.4% of employers. Both Artificial Intelligence and Machine Learning had the same level of demand (6.6% of employers), and only a smaller fraction (2.8%) ask for experience in the Internet of Things.

3) *Required Soft skills*: In our analysis for soft skills in each ad, we executed textual analysis on the job description (as described in Section 2), and then we mapped each advert to one or more soft skills defined in the Soft Skills Taxonomy [20] (see table 5).

In their Evaluation for the Demand for Soft Skills in software development [21], Ahmed et al. analysis revealed that the software industry was not paying much attention to critical soft skills for software developers. Our study shows that about 31.3% of the ads asked for at least one soft skill.

Communication skills comprising presentation skills, reading communication, speaking communication, and writing communication are among the most demanded by employers (See table 5)

TABLE IV  
DEMANDS FOR PLATFORMS AND FRAMEWORKS

AWS	Cloud computing Service	21.8%
Nodejs	JavaScript runtime environment	20.4%
React	JavaScript library	19.3%
Angular	Web application framework	15.9%
Docker	Building distributing applications platform	15.6%
GitHub	Development platform	12.2%
Kubernetes	Open-source system for automating computer application deployment	11.3%
Azure	Cloud computing service	10.2%
Google Cloud	Cloud computing service	8.8%
Spring	Control container for the Java platform	5.6%
Hibernate	Object-relational mapping tool for the Java programming language	4.4%
Kafka	platform for real-time data feeds	2.7%
JIRA	Test management, bug tracking	1.6%

TABLE V  
DISTRIBUTION OF SOFT SKILLS

Communications Skills	Listening communication, presentation skills, reading communication, speaking communication, and writing communication	26.1%
Workplace thinking skills	Analytical thinking, conceptual thinking, critical thinking, decision or problem solving, reasoning	4.9%
Teamwork and Collaboration skills	Coaching, collaboration, cooperative ability, work with others	3.8%
Self intelligence skills	Accurate self-assessment, positive attitude, self-control, self-management	1.7%
Planning and organizing skills	goal management, information management, planning, strategic planning, time management	1.8%
Workplace productivity skills	Achievement, creativity, enterprise skills, life-long learning, outcome oriented	0.2%
Workplace professionalism skills	Commitment, common sense, professionalism	0.7%
Conflict resolution and negotiation	Conflict management, mediation, negotiation	0.2%
Stress management skills	Work under pressure, accepting criticism, adaptability, adversity, change catalyst, change management,	0.9%
Workplace ethics skills	Awareness of ethical values, honesty, integrity, transparency, trustworthiness	0.2%

Workplace thinking skills (e.g., Analytical thinking, conceptual thinking, critical thinking, decision making, decisiveness, problem-solving, reasoning) come in second place with 4.9% of the ads are asking for at least one skill in this category. Teamwork and Collaboration skills come third with 3.8%.

#### D. Answers to R4: Education attainment and certifications

The highest number of job posts (48.8%) ask for completed bachelor degrees as a minimum educational requirement. Only (3.5%) ask for the completion of a master's degree or a Ph.D. While the 47.7% does not specify any degree requirements.

Certifications are a common way to complement a degree. However, the industrial demand for certifications is low when compared to a classic undergraduate or graduate degree. One in ten hiring employers asks for particular certifications. When we scanned these ads thoroughly, we observed that 25% of these mentioned AWS certification making it the most popular (e.g., AWS Solutions, AWS Architect Associate, AWS Cloud Practitioner, AWS Developer Associate).

Only about 15% of the ads requiring any certification referred to any blockchain certification as a requirement. Conversely, despite the low demand for blockchain certificates, it would be expected that demand will increase in this area as the demand for blockchain engineers keeps on increasing. Blockchain training programs have been increasing recently and are now being offered by some of the nation's leading universities, including MIT, Princeton, and Stanford. Many blockchain vendors such as Consensus, Blockapps, the Ethereum Foundation, and Hyperledger also provide training programs and certificates.

The demand for an Oracle certification came in third place at 12.5% of this subsample.

73.8% of the overall posts listed a minimum of years of experience as a requirement, making it one of the most demanded requirements among all. The average number for the minimum years of experience from all posts is 4.8 years.

## IV. DISCUSSIONS

Blockchain is not only about cryptocurrencies anymore, but it is becoming a pervasive established technology shaping new professional roles, jobs, and new fields of research. Porru et al. [22] highlighted the need for specific practices related to Blockchain oriented Software Engineering and identified the most relevant BOSE challenges, and issues originate from them, advocating the need of specific skills for new professional roles related to Blockchain technologies.

In this study, we focused our attention toward this new professional roles, by empirically researching and summarising the primary skills the job market is requesting to the experts in the field. We collected data from 400 job postings in the U.S. to better understand the industrial demand for competencies in terms of the level of education, training, and experience; blockchain-related skills; other technical skills; and soft-skills.

The findings observed that the **“blockchain engineer”** is being shaped as a distinct role which involves several blockchain-related, technical, and soft skills competencies.

Some of the notable observations from analyzing the findings include:

- 1) There is a high demand for blockchain professionals with competency in the whole development process, including software design and architecture. Programming skills are fundamental and required for the role of blockchain engineer.
- 2) Despite being one of the most obvious responsibilities of a blockchain engineer job, fewer job postings explicitly include required experience in blockchain development itself than experiences in programming in general. This is probably because, being the field still new, companies are trying to hire traditional software engineers and then convert them into blockchain engineers along the way.
- 3) The technical experience is valued more than domain-specific knowledge. For example, even though the blockchain is the essence of the infrastructure underlying cryptocurrencies, only 7.5% of the posts require domain knowledge in finance or fintech. This is probably because the technological aspects, at this stage, are still predominant and there is a need for building infrastructure which will then require a finance background.
- 4) Previous experience plays an essential role during the hiring process for a blockchain engineer role and more than the academic degrees and certificates. This is probably due to the (not new) slow-response of the academic world to the market needs. The lack of dedicated educational paths in the blockchain field and the difficulties in shaping a new area of study given the speed these new technologies are growing force the companies interested in these new professional figures to bend towards preferring experience instead of a not specific educational background.
- 5) Even with low demand for formal education or certification in blockchain from the current job market, this demand is likely to increase soon. Research into the educational implications of blockchain is moving rapidly, and several universities have started to offer courses about blockchain [23]. However, it is crucial for academia to intercept the markets’ needs and quickly fill the currently existing gaps.
- 6) Even though a small fraction of the overall posts revealed the blockchain platform that the company develops, we can translate the high demand for competency in cryptocurrency platforms into the assumption that cryptocurrency development still dominates the landscape of

blockchain engineering.

The results of this study indicate that blockchain engineers need to master a wide range of competencies. Our analysis can be used by candidates looking to pursue a technical career in this disruptive technology.

Besides potential engineers, employers can use this study to calibrate their requests for blockchain-related positions when advertising. This study can serve as a mapping tool for employers to identify a spectrum of local teams’ skills and compare these with what is currently in demand in the industry. This mapping can influence the implementation of any necessary training for existing personnel.

Finally, the findings from this study can help improve post-secondary or continuing education courses in the blockchain area. For example, based on this research’s findings, faculty designing and teaching software Engineering programs or corporate blockchain courses should ensure that their courses offer enough coverage of cryptocurrencies and distributed networks.

## V. THREATS TO VALIDITY

The research process used and the results found in this study were compared with various applicable internal, external, conclusion, and construct validity threats as defined in [24].

A potential internal threat is related to selection bias which refers to the “distortion of statistical analysis owing to the criteria used to select the publications” [24]. A multistage process was used to address this, and inclusion criteria were defined in Section 2 to select job ads exclusively relevant to the study. “LinkedIn” is the most popular job search engine in the U.S.; hence, its selection is not biased. The selection of the search keywords “Blockchain Engineer” to form the search string didn’t limit the scope of the search results as the engine interprets the search string and gives relevant results for a range of job posts related to the search terms.

A potential external threat could be related to the “interaction of history and treatment which is the effect of that the data collection is conducted on a special time or day which affects the results” [24]. For this work’s purpose, the data extraction spanned over two months period (July and August 2020) which minimizes the effect of this threat. Another potential external threat is related to the “interaction of selection and treatment which is an effect of having a subject population, not representative of the population we want to generalize to”. Our sample data includes job ads from the 50 states where each state is represented with the first eight job ads that were returned from the search and met the inclusion criteria.

Inaccuracy in data extraction and misclassification refer to “the possibility that information is extracted and interpreted differently by different reviewers” [25]. The full text of each extracted job post was reviewed thoroughly by at least two of the researchers to address this threat. To review the agreements and disagreements raised in the assessments, we conducted researcher consensus meetings during the data evaluation and analysis process. We used existing published taxonomies to

map certain aspects of the results to reduce the misclassification as in the case of mapping the soft skills.

Threats to conclusion validity (e.g. the concern that the “ability to draw the correct conclusion about relations between the treatment and the outcome of an experiment are not possible with the extracted data” [24]) is not a problem for this research. This is supported by the large sample size for this study with 400 job extracted job ads helps to reduce this threat.

## VI. CONCLUSION

Throughout this paper, we have reported a structured inspection of 400 job adverts extracted through a systematic process to analyze the essential industrial demand for competencies needed for the emerging blockchain engineer role in the U.S job market. The emerging role of blockchain engineer is specific, requires dedicated skills, and the education sector needs to set up dedicated study paths to form these new professional figures requested by the market. We intend this study to advance the understanding of this role within the U.S. market and provide much-needed recent data to software engineering practitioners, researchers, and educators. The results for all the raw data from this study are available through the link: <https://bit.ly/3eucYDY>. We encourage researchers and practitioners to replicate the research and execute further analysis of the data. Our subsequent work will include replicating the study for different job markets and compare the findings with the one from this study. We have also planned to replicate this study for the U.S. market in a few years to investigate the changing landscape of profiles of blockchain engineering jobs over time.

## REFERENCES

- [1] M. Kassab, J. DeFranco, T. Malas, P. Laplante, G. Destefanis, and V. V. G. Neto, “Exploring research in blockchain for healthcare and a roadmap for the future,” *IEEE Transactions on Emerging Topics in Computing*, 2019.
- [2] M. Kassab, J. DeFranco, T. Malas, G. Destefanis, and V. V. G. Neto, “Investigating quality requirements for blockchain-based healthcare systems,” in *2019 IEEE/ACM 2nd International Workshop on Emerging Trends in Software Engineering for Blockchain (WETSEB)*. IEEE, 2019, pp. 52–55.
- [3] M. Kassab, J. DeFranco, T. Malas, V. V. G. Neto, and G. Destefanis, “Blockchain: A panacea for electronic health records?” in *2019 IEEE/ACM 1st International Workshop on Software Engineering for Healthcare (SEH)*. IEEE, 2019, pp. 21–24.
- [4] P. Chakraborty, R. Shahriyar, A. Iqbal, and A. Bosu, “Understanding the software development practices of blockchain projects: a survey,” in *Proceedings of the 12th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement*, 2018, pp. 1–10.
- [5] R. Kandaswamy and D. Furlonger. (2018) Blockchain-Based Transformation: A Gartner Trend Insight Report. <https://gtmr.it/2Y0SRmW>.
- [6] R. SHARMA. (2019) The Blockchain Job Market Is Booming. <https://www.investopedia.com/news/blockchain-job-market-booming/>.
- [7] D. Zhao. (2018) The Rise of Bitcoin Blockchain: A Growing Demand for Talent. <https://www.glassdoor.com/research/rise-in-bitcoin-jobs/>.
- [8] Hired.com. (2018) State of Salaries Report. <https://hired.com/state-of-salaries-2018>.
- [9] S. L. Cichosz, M. N. Stausholm, T. Kronborg, P. Vestergaard, and O. Hejlesen, “How to Use Blockchain for Diabetes Health Care Data and Access Management: An Operational Concept,” *Journal of Diabetes Science and Technology*, vol. 13, no. 2, 2018.
- [10] G. Destefanis, M. Marchesi, M. Ortu, R. Tonelli, A. Bracciali, and R. Hierons, “Smart contracts vulnerabilities: a call for blockchain software engineering?” in *2018 International Workshop on Blockchain Oriented Software Engineering (IWBOSE)*. IEEE, 2018, pp. 19–25.
- [11] M. Ortu, M. Orrú, and G. Destefanis, “On comparing software quality metrics of traditional vs blockchain-oriented software: An empirical study,” in *2019 IEEE International Workshop on Blockchain Oriented Software Engineering (IWBOSE)*. IEEE, 2019, pp. 32–37.
- [12] A. Rafaeli and A. L. Oliver, “Employment ads: A configurational research agenda,” *Journal of Management Inquiry*, vol. 7, no. 4, pp. 342–358, 1998.
- [13] T. R. Shaw, S. D. Pawlowski, and J. B. Davis, “Building theory about IT professionals: is a taxonomy or typology the answer?” in *Proceedings of the 2005 ACM SIGMIS CPR conference on Computer personnel research*, 2005, pp. 9–11.
- [14] M. J. Gallivan, D. P. Truex III, and L. Kvasny, “Changing patterns in IT skill sets 1988-2003: a content analysis of classified advertising,” *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, vol. 35, no. 3, pp. 64–87, 2004.
- [15] S. Surakka et al., “Analysis of technical skills in job advertisements targeted at software developers,” *Informatics in Education-An International Journal*, vol. 4, no. 1, pp. 101–122, 2005.
- [16] H. Morgan. (2019) Best Job Search Sites. Available at <https://money.usnews.com/money/blogs/outside-voices-careers/articles/best-job-search-sites>.
- [17] K. Petersen, R. Feldt, S. Mujtaba, and M. Mattsson, “Systematic mapping studies in software engineering,” in *International conference on Evaluation and Assessment in Software Engineering*, vol. 8, 2008, pp. 68–77.
- [18] J. Saldaña, *The coding manual for qualitative researchers*. Sage, 2015.
- [19] S. Elbaum, G. Rothermel, and J. Penix, “Techniques for improving regression testing in continuous integration development environments,” in *Proceedings of the 22nd ACM SIGSOFT International Symposium on Foundations of Software Engineering*, 2014, pp. 235–245.
- [20] J. K. Mahasneh and W. Thabet, “Rethinking construction curriculum: Towards a standard soft skills taxonomy,” in *52nd ASC Annual International Conference, Associated Schools of Construction*, 2016.
- [21] F. Ahmed, L. F. Capretz, and P. Campbell, “Evaluating the demand for soft skills in software development,” *It Professional*, vol. 14, no. 1, pp. 44–49, 2012.
- [22] S. Porru, A. Pinna, M. Marchesi, and R. Tonelli, “Blockchain-oriented software engineering: challenges and new directions,” in *2017 IEEE/ACM 39th International Conference on Software Engineering Companion (ICSE-C)*. IEEE, 2017, pp. 169–171.
- [23] M. Arnold. (2017) Universities add blockchain to course list. Available at <https://www.ft.com/content/f736b04e-3708-11e7-99bd-13beb0903fa3>.
- [24] C. Wohlin, P. Runeson, M. Höst, M. C. Ohlsson, B. Regnell, and A. Wesslén, *Experimentation in software engineering*. Springer Science & Business Media, 2012.
- [25] A. Fernandez, E. Insfran, and S. Abrahão, “Usability evaluation methods for the web: A systematic mapping study,” *Information and Software Technology*, vol. 53, no. 8, pp. 789–817, 2011.