International Journal of Computer Engineering and Technology (IJCET)
Volume 15, Issue 3, May-June 2024, pp. 92-110, Article ID: IJCET_15_03_009
Available online at https://iaeme.com/Home/issue/IJCET?Volume=15&Issue=3
ISSN Print: 0976-6367 and ISSN Online: 0976-6375
Impact Factor (2024): 18.59 (Based on Google Scholar Citation)

OPEN ACCESS

IMPLICATIONS OF AI ON JOB OPPORTUNITIES FOR ENTRY-LEVEL SOFTWARE DEVELOPERS

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ABSTRACT

Artificial Intelligence (AI) is a growing technology in the software industry that can mimic human intelligence. Prior research has shown a direct relationship between AI and job displacement in the software industry as the technology spreads in the industry. However, it has only explored AI's effects on current employees, which reveals a gap concerning AI's effect on the employment of new developers. To evaluate this issue, the study used standardized qualitative interviews with software employers. The data concluded that AI is too primitive to cause job displacement risk, but rather automation programs have been a leading cause of job loss. Future research can explore the specific effects of AI on software companies and the causes of their rapid growth in the industry.

Keywords: Artificial Intelligence (AI), Software Development, Automated Digital Technologies (ADTs)

Cite this Article: Harshith Thatikonda, Implications of AI on Job Opportunities for Entry-Level Software Developers, *International Journal of Computer Engineering and Technology (IJCET)*, 15(3), 2024, pp. 92-110.
https://iaeme.com/MasterAdmin/Journal_uploads/IJCET/VOLUME_15_ISSUE_3/IJCET_15_03_009.pdf

INTRODUCTION

Artificial Intelligence (AI) is a rapidly growing technology in the software industry that is being developed to mimic human intelligence with its adaptive capabilities in problem-solving skills (Chalmers, 2021). AI is considered the product of multiple concepts and technologies such as computer statistics and machine learning due to its ability to not only adapt to changing problems but also analyze big data (Agrawal et al., 2019). “AI and its related techniques” (p. 2) have become a prime focus for many software corporations to increase their company output by delegating it to an increasing number of complex tasks (Manyika, 2022). As the software industry gets more complex with the increasing amount of data that needs to be analyzed, it becomes prevalent that AI's computational power is required to analyze the information efficiently and effectively (Kobbacy et al., 2007).

The existing research exemplifies information on how AI is quickly changing the climate of the software sector which can bring drastic changes to the industry's workforce such as low-level software developers (Goodman, 1996). Although agencies are attempting to regulate the development of AI through governance programs to control AI's growth, many of them have been inadequate due to their inefficiency and the sheer power of AI (Dafoe & Journal of International Affairs, 2018). In addition, companies are questioning whether they need these low-level software developers in the company as AI can be a more viable solution to increase company output while being cost-effective (Chilton et al., 2005). All in all, the increasing presence of AI and its rate of development has been giving software companies more and more reason to shy away from using a human workforce, and rather, delegate their tasks to an AI that may be able to do those tasks more effectively, all while cutting down costs.

GAP IN THE RESEARCH

The existing research connects AI to the job displacement of the developers currently in the software industry as the technology endangers their role in the company. However, this existing research does not indicate the effects that AI will have on recruits to the company and their employment situation in the software industry. Since AI's influence has already been drastic on the industry itself, it may impact the employment process as well. So, the purpose of my study is to determine if employment patterns are changing due to the increasing presence of AI in the software industry. To understand the correlation between AI and employment patterns in the software industry, it becomes prevalent to ask the question: To what extent, if at all, does AI in the software industry affect job opportunities for entry-level software developers?

LITERATURE REVIEW

AI's rapidly expanding presence in society has affected the software industry as developers became the center of this crisis due to the high replaceability of their work in their company (Johnson, 2023). While core research has been done on AI, it is majorly focused on its effects on the current workplace and its rapid advancements in the software industry. This revealed a gap in the topic concerning the applications of new employees to the software sector as AI could be a better alternative than hiring human developers.

SHORTCOMINGS OF AI

Although the enhancements of AI have progressed the technology, many aspects of the concept still need to be tested and corroborated to assess its viability to society. In the software sector, AI was seen as a revolutionary technology that can be more efficient even though the technology was not well tested. According to Belton (2021), even AI made errors in its programming, creating widespread distrust in its usage for large projects in software corporations that can have a larger negative impact than errors in consumer-grade applications. Moreover, the errors were extremely subtle, making them hard to debug, which negatively affected the functioning while remaining hidden. With the presence of these shortcomings, it can be understood that AI is not flawless. Nonetheless, it was perceived to be perfect, which has led to an increased reliance on the technology. Furthermore, the shortcomings of AI are expressed by Costa & Aparicio (2023), who explained how the technology can only function by inputting massive amounts of data on the AI development end. A technology that is supposed to help society become the most efficient has been rejected by many companies due to the access that AI requires to compute simple tasks such as spreadsheets or organizing meetings. Combining the intrusions of privacy and the ability of AI to make subtle mistakes allowed the technology to be distrusted for certain occupations that deal with humanitarian relations even though it could dramatically alter society.

AI REGULATION

Due to the ever-increasing speed of AI advancement, multiple attempts have been made and analyzed to govern AI so it does not cause many societal problems. A key problem that could occur is ethical controversies that tread on personal security and privacy. James Manyika (2022) stated that “AI and its related techniques have been used as tools to advance” (p. 2) technology that can process complex tasks with relatively little instruction or information, allowing it to be more advanced than any employee. However, to achieve this power, it needed to access massive amounts of data, which can lead to breaches in privacy and actions that the AI may think are right but might be inhumane even to concur (Agrawal et al., 2019). Dafoe & Journal of International Affairs (2018) attempted to solve this problem by asserting that a governance structure is required to regulate AI, but this will require extreme control over the technology. As of now, controlling AI has only been partially successful but has ultimately failed due to AI’s prominent role in society. Moreover, AI’s advancements have been rapid in sectors that are not directly part of the software field, which could show how a governance structure, such as regulatory practices of ChatGPT, may not be able to properly manage the technology's usage. Overall, both Dafoe and Manyika point out that AI requires serious thought about its impacts on the software industry before any more advancements.

THE RISE OF JOB DISPLACEMENT RISK

During this rapid growth of AI, the trajectory of job displacement is faster than the creation of new jobs. Chen et al. (2022) expressed this new risk by forming an equation based on empirical models that utilized variables of employee skill, AI performance, categories of displacement, and the time it could take for this change to occur. They explained this equation in detail concerning how at first wages could be affected but has been furthered with the complete removal of human developers as their presence will no longer be required. Still, slowly job offers will be retracted as AI will become a more economically viable option for companies. Corinne Cath (2018) explains how our society has been “increasingly delegating complex, risk-intensive processes to AI systems” (p. 2) that can harm the world with consequences that cannot be fathomed right now. Yet, AI is allowed to continue advancing which correlates with job displacement risks to express a growing sentiment that AI will not only destroy many occupations but will also require too much knowledge for entry-level jobs. However, Cath does not express what this means for new employees personally but rather only explains the effects on society as a whole. This broad perspective can be useful in comprehending the field of AI in the workplace but not its specific aspects. Brunello et al. (2023) attempted to fill this gap by concluding that employees will “need to re-skill or up-skill to adapt to the re-organization of tasks and [the] emergence of new tasks” (p. 1) as time goes on and AI performs better. However, they failed to include the fact that AI will find methods of solving problems that even employers do not understand, but do not care about, as they produce desirable results, further expanding on the idea of job displacement.

SUMMARY

Current research articles have all described the contemporary status of AI and how society is reacting to its rapid advancements. AI is being treated as a revolutionary technology that affects many different sectors made it become an integral part of society even though its in its infancy. Although this technology is being reflected as a benefit to society, it is important to note that AI majorly impacted the labor market where developers are stripped of their jobs and lifestyles due to AI’s efficiency and power. However, many of these articles failed to consider how applications for these programming occupations will be affected which leads to my research question concerning the employment situation for the software industry.

METHODS

The goal of this study is to explore if entry-level developers will face problems in their employment process due to AI and the determining factors that software employers have to decide upon for the benefit of their company. This is important as it reflects the trajectory the software industry will take as AI becomes a more dominant factor in the workforce.

STUDY DESIGN

This qualitative study was designed to represent information that quantitative statistics cannot portray as guided discussions will allow participants to justify their reasoning for the employment criteria. This design shifted away from the contemporary perspective and views toward the future trajectory of AI in software. As Handel (2022) researched job displacement risks of AI, he utilized the "U.S. Bureau of Labor Statistics (BLS) projections and recent employment trends" to grasp the problems that AI can cause, but he also voiced how there are "potential problems with representativeness" (p. 1) with this type of study design as these statistics might not give proper results due to their quantitative nature. Although quantitative statistics provide precise data points to make accurate models of representation, the field of AI requires extensive information concerning opinions of different perspectives to provide information that can be thoroughly analyzed.

Moreover, the qualitative interviews were done with experts in the field since the topic required multiple perspectives to properly understand the nature of the situation, and the data needed to be able to analyze and discover trends that can predict future trajectories of AI (Dafoe & Journal of International Affairs, 2018). The interviews were designed so that the questions would relate to the company that the interviewee represents, allowing for different data points to be compared with the established research and draw conclusions to understand the trajectory of AI.

VARIABLES

The independent variable was the interviews that shifted across different companies to provide varying perspectives which helped provide a complex dataset that was free from the bias of leaning towards a specific corporation. Then the dependent variable was the different perspectives that led to varying answers concerning AI in the participant's company which were measured as an effect of the company's nature.

PARTICIPANTS

The participants partaking in this study were employers of software developers since they have an evident role in the employment process and the ability to influence the criteria that are followed when employing new software employees (Brunello et al., 2023). All employers were volunteers and selected from software companies that have utilized automation technologies or AI in the state of Texas. The participants were reached out by email or phone call about the interview and given a brief explanation of the study and their role. This information was acquired by requesting contact details from software employers I know personally and asking them for other employers' information, which was utilized to connect with other software developers.

RESEARCH INSTRUMENTS

The qualitative interview comprised an initial set of standardized questions that directed the rest of the interview. The questions were on a semi-structured basis to drive the interview in the right direction and get the interviewee to give information concerning their company's stance on the presence of AI when employing human developers. These initial questions asked about the general usage of AI in the company and what tasks they take on. Then the interview dove into the AI's relationship with human employees and how they are impacted with many of their tasks being performed by an algorithmic intelligence rather than human ingenuity. Chilton et al. (2005) utilized field studies of "software developers [to] suggest that performance decreases and stress increases" (pp. 1-2) when correlating between cognitive styles, a measurement of the cognitive abilities of an individual that explains the extent what environment they perform the best in. This measurement was utilized to design my interview questions to ask about what the company's environment is like and their implementations of AI in the workplace Although the strategy of associating two different variables to guide the questioning process is an effective method to get comprehensive answers, Chilton et al. (2005) utilized field research to construct trends between the variables but my design consists of an interview process that can't be implemented in the same format. However, the core idea of the strategy was executed by associating human employment rates with the presence of AI in the company. With this method in mind, employers discussed their company's relationship with AI and human developers and how the workplace may change accordingly. This helped to determine if the company is leaning more towards favoring AI tasks rather than human developers or if they value human involvement in their software company. Overall, this method helped me curate interview questions that truly gauge the company's interests concerning AI.

PROCEDURES

Once the interviewee list was compiled with software employers who were willing to be voluntarily interviewed, they were asked to sign a consent waiver to provide permission for my usage of any information they stated. Then the procedure of the interview process diverged as some interviews were taken virtually and some were done in person.

The interviews that were conducted virtually were done through Zoom, a video conference application. This allowed both the participant and me to communicate without worrying about an application being closed off for certain parties. After audio recording the Zoom interview, a transcription was made to analyze the information. This transcription needed to be included in the consent waiver and make sure the participant is aware that their statements will possibly be referenced in my research paper.

The other portion of the interviews occurred in person with the location being determined at a later date between me and the participant. For the interviews to be documented, a voice recorder was used to register information that the participant stated and the discussion that occurred between us which were proven useful when referencing back to their key statements about their company.

FINDINGS

This study consisted of qualitative interviews with software employers who were interested in the development of AI for data collection to assess different companies' perspectives on the usage of AI.

GENERAL AI

A crucial question asked during the interview was, "What is your interpretation of artificial intelligence (AI) and what is your current opinion of its growing presence?" The responses have been organized as seen below.

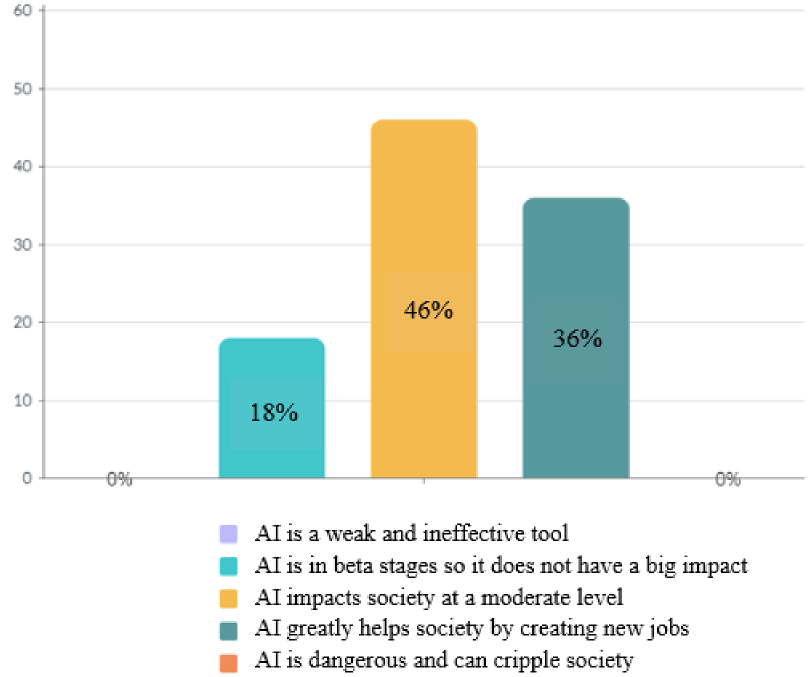

Figure 1: Software Employers' Perspectives on AI

The majority of the participants viewed AI with technological fascination and distrust in its validity as the technology is only in its early stages but promises exceptional growth. Proving this perspective, as shown in Figure 1, 46% of respondents believed that AI will only moderately impact society rather than make any drastic alterations. This attitude is a trend amongst employers as they view AI's infancy as a huge obstacle for the technology to grow beyond a basic tool for society that can increase automation. However, 36% of the interviewed employers express that AI will be able to grow into a tool for society that can construct jobs and alter the structure of the work environment. Regardless, both of these groups see that AI can become a benefit or a hindrance in the software industry, but many are primed to develop the technology and enter a new era. This optimism is expressed by many of the software companies that lead the market in AI development such as IBM and General Motors. Nonetheless, the distrustful perspective of AI persists in some corporations as 18% of participants see the technology as not able to impact society in a meaningful way for the technology to be even considered revolutionary. Moreover, they believe that AI cannot evolve to perform roles that humans currently occupy as they deal with interpersonal relationships, a process that a program cannot act on. Furthermore, no participants asserted any extreme opinion such as that AI is weak and inefficient or that AI could be dangerous to society. This aids in the understanding that the majority of software companies are conservative and moderate in their attitude towards AI and desire to be able to utilize it to its maximum extent.

AI IN COMPANIES

Once the participants' perspectives of AI were understood, the following question was asked: "Has your company/department been impacted by the current increasing presence of artificial intelligence (AI)?"

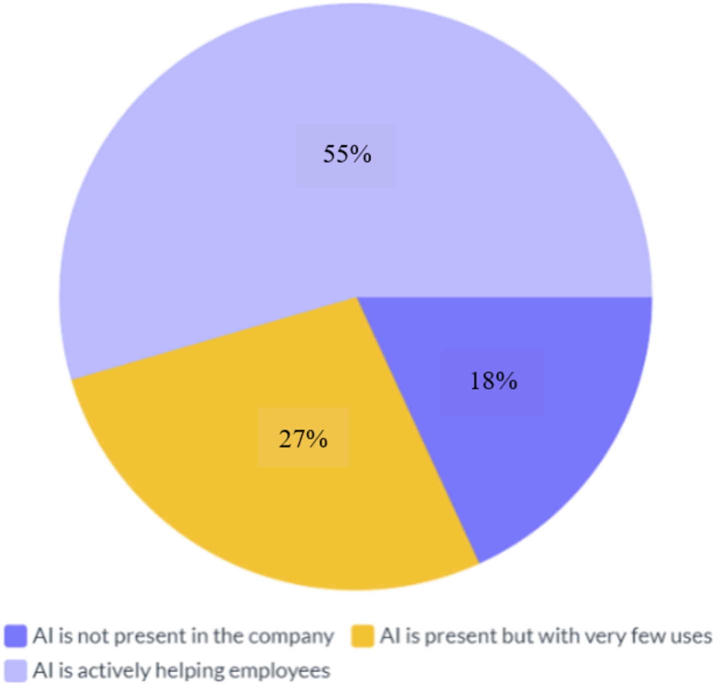

Figure 2: AI in Software Companies

The responses to this question widely differ due to the varying nature of each software company based on their purpose and products. These products include applications such as graphical user interfaces (GUIs) and programs that help with administrative organization such as spreadsheets. The majority of software companies are utilizing programs to create methods to automate their production processes to increase efficiency among their employees. As represented in Figure 2, 55% of the participants explained that AI is being used to help their employees increase productivity as it automates these programs to a degree in which human oversight is not required. This emphasis on AI development is a key trend among software companies, but other companies view AI as incapable enough to aid in their applications or job roles. 27% of the participants described AI as not being applicable in their company due to the nature of their work being more with people relations. However, they are still exploring the technology with lower-level tasks for any possible executions. Participant D expresses this view by explaining how companies such as ExxonMobil are utilizing more "automation tools to simplify [the] data" and are just beginning to implement AI algorithms. Although there is optimism in these two groups, the last group of employers see their employees' tasks as being too niche for the current stage of AI to comprehend and execute effectively as the human equivalent. Overall, the data shows that AI is present in software development. Still, its presence is not causing a job displacement risk within the industry due to its limited usage for low-level tasks that cannot affect the employment of software developers.

ANALYSIS

Through the organization of the qualitative findings concerning AI and software employment, the results can be correlated to established research. More specifically, the correlation between my findings and the established research supports that the trajectory of AI does not have an impact on the job displacement risk in the software industry.

INITIAL UNDERSTANDINGS

When researching the studies that preexisted my findings in this field, it became apparent that AI was seen as a dangerous technology that could dramatically alter the software industry. According to Corinne Cath (2018), software companies have been "delegating complex, risk-intensive processes to AI systems" (p. 2) which has caused fear in the public over the usage of the technology. According to Participant C, while AI is not powerful enough to start "replacing occupations," it is capable of "helping the company and employees grow" in their respective fields. This unexpected insight changed my initial view of AI's reach in society and the software industry, as the technology has not expanded to a level where it can influence massive corporations and take over complete job roles. Overall, my initial comprehension of the subject was characterized by AI's rapidly growing intelligence and its unique ability to mimic human intelligence, but this hypothesis was challenged as it was uncovered that the software industry is maintaining AI as a tool and not a replacement for the human developer.

CAUSE OF JOB DISPLACEMENT

Since AI cannot take over entire job roles in the software industry, it comes to question what the root causes of job displacement risk are when considering software occupations. Chet et al. (2022) express that AI algorithms are one of the dominant causes of job displacement in the software industry with the technology's ability to mimic human intelligence in data computation. However, my findings contrast with this sentiment as I discovered that AI is not the root cause of job displacement, but rather, the automation algorithms being widely distributed in the software industry are causing low-level software job occupations to become obsolete. Participant D expressed this sentiment by explaining how automation technologies are far more entrenched in the software industry than AI programs. This steep contrast in the usage of AI shows software companies' primary attitude towards AI as a tool to increase company output and not to replace the human workforce.

As previously mentioned, AI technology is not the prevalent cause of job displacement, but rather automation programs are causing many software occupations to become obsolete. Even though AI is being utilized in many software companies, it can be comprehended that the technology is not influential enough in corporate methods to make significant alterations in the workforce as it is not able to replace human developers. Participant H makes an excellent point about how AI still requires a "basic level of maintenance" by a "human overseer" who will guide the AI's training, so the technology cannot remove human presence from the industry. The majority of the interviewees have shared similar opinions about AI not being a technology that can replace human presence since it still requires human development for it to grow. This raises the question of what is the cause of mass job displacement in the industry, and the answer can be traced back to the development of automation technologies. Brunello et al. (2023) explain how the development of advanced digital technologies (ADTs) has caused many software developers "to re-skill or up-skill to adapt" to the changing workplace as there are less opportunities for older tasks that can be done using ADTs (p. 1). This gives a clear explanation of the root cause of job displacement in the software industry being automation rather than the increasing presence of AI since automation programs have been more prevalent in the industry with a high level of development.

Participant J expresses this sentiment as well by explaining how automation technologies in the industry, such as General Motors, have been influencing job displacement for software engineers more than AI has due to its high development and reach in the software industry. This correlation between established research and my current findings represents the trend of job displacement having a direct relationship to the usage of ADTs, as AI has not been able to make a significant impact concerning this relationship. Overall, this trend represents how automation programs are a higher factor in the cause of job displacement rather than AI due to AI's infancy and ADT's broad reach and power in the industry.

IMPLICATIONS

Although AI's role in the software industry is not characterized by replacing the human workforce, due to its current stage in experimentation, AI is viewed as untrusted technology. As corroborated by my findings, AI can transform the software industry with new levels of automation, but it can also be used for negative functions that destabilize the software corporation. As Participant A expresses it, AI can be characterized as a "double-edged sword" with its ability to either positively or negatively affect a software company's "tasks that [are done] on a day to day" basis since the technology is still in its infancy. This sentiment is shared by the majority of the interviewed participants as they are all carefully utilizing the technology in their department to ensure that AI will only positively impact their company. Although there are companies that are far more optimistic about the progress of AI development than the previously mentioned majority, they collectively share a cautious stance against AI due to its ability to become a hindrance, or a major catastrophe, very quickly as the technology is currently in its development stages and requires a large amount of data to function. Since there are no precedents about the technology, it really can be developed in any direction, and this unknown factor is what halts the increased usage of AI in the industry due to the high possibility of unexpected outcomes. Overall, this implies that AI's presence will increase in the software industry, but at a slower rate since the technology is still being developed and many companies are cautious in their usage of AI by allowing it to access large amounts of data.

CONCLUSION

Following the analysis of established research with the data collected through qualitative interviews, it can be concluded that AI is not a significant factor in job displacement in the software industry, but rather automation programs have been the primary cause behind the crisis. This is because AI technology is still in its infancy and has not been properly developed to make a significant impact on the industry. Still, automation programs have had more time to become entrenched in the industry and impact employment and workplace procedures. This realization signified that future software developers attempting to enter the industry will face harsher competition, not only with other developers, but also with AI and automation technologies such as ADTs. Software companies and their employees need to understand how this can change the employment process in the future as my research expresses that at its current stage, AI may be not much of a threat, but later on, AI and ADTs can cause changes to the employment process. Overall, my research expresses that as of now, AI is not a threat to the employment of software developers, but in the future, this can very easily change due to the rapid growth of AI.

LIMITATIONS

My research process was mostly hindered in the data-gathering process as multiple factors led to the concession of certain study goals. One such constraint was the amount of time given to complete the data collection, as it was not sufficient to get a large enough sample of different companies that I initially hypothesized. As mentioned before, I interviewed software employers from different companies in Texas to provide various perspectives concerning AI in my dataset. However, this meant I needed to coordinate with these employers and their schedules which, combined with the limited time, I was unable to acquire the desired number of interviewees for my dataset. Although my data was still able to be analyzed, it could have been more diverse by including companies from areas other than Houston and Dallas to be more inclusive in my analysis concerning the region as a whole when discussing the effects of AI on software corporations.

Another key limitation that hindered my research process was the feasibility of getting in contact with software employers that fit my research criteria for the data collection process. Since my model was made never to repeat an interviewee from one company, I had to broaden my scope of possible participants to get these various perspectives. However, many of the software employers that were easy to contact were all associated with large corporations such as IBM. This limited certain software employers as I already interviewed someone from the company. To overcome this obstacle, I attempted to get in contact with smaller software companies, around 9 start-ups, to be able to increase my pool of participants as their experiences concerning AI programs in the software industry may differ from larger corporations. However, getting in contact with these employers was much more difficult than the other software employers as I could not secure a time to call or meet in person with them due to their tight and inflexible schedules. Overall, the inclusion of their perspectives on AI would have opened up a new level of analysis and given me a better understanding of the situation in the industry.

REFLECTIONS

Throughout this research process, my mindset and perspective considering AI has changed frequently. I initially thought AI would be a dominant force in the software industry, but I was proven wrong by the lack of its involvement in major projects in the software industry. This development has made me realize that during research, it is important to keep an open mind about new perspectives and directions that the process may take and to not be too fixated on one approach.

FUTURE DIRECTIONS

The limitations that have been previously mentioned are pathways to future studies in this field. The selected participants can be more diversified by including small-scale software companies to attain a better understanding of the AI situation on all levels. Moreover, the scope can further be diversified by expanding the geographical focus of the study to areas beyond Texas to understand a national or an international perspective on AI in the software industry. All these methods help increase variety within the data to create a more accurate and cohesive dataset of the perspectives of software companies on the usage of AI in the workplace.

Future researchers can also branch off my study by solving my limitations and assessing possible futures for the field of AI. The ideal future for this field would be to have AI coexisting with software developers to make programs with efficient methods while keeping their employment criteria unchanged. However, there are many possible futures in which AI can drive society which requires increased focus. One such direction would be with a study that builds off of my research to analyze the various methods to create the AI models being used in the software industry.

The AI models and programs being used within each company are unique to the company's needs and can be analyzed in how they are being used within the company to increase productivity in certain job roles. Another direction that future researchers can take this topic would be to study the effect that AI in the software industry has on the education to become a software engineer as AI could drastically alter the job's required skillset, thus the needed education to enter the industry may change to accommodate for AI. This can lead to a study through a completely different lens of the topic by explaining the educational aspect of AI's presence in the software industry.

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APPENDICES

Appendix A: Interview Questions for Participating Interviewees

Disclaimer: This is a set of pre-selected questions that will be asked of every participant, the interviewee, by the primary researcher. This is only an initial set of questions and each participant will be asked further questions depending on their answers.

1. What are your position and credentials in your company/department?
2. What occupations do you primarily employ for your company/department?
3. For each of these occupations, what are their primary responsibilities and tasks?
4. For each of these occupations, how much of the job requires knowledge of data computation or other online tasks that tackle data analysis?
5. What is your interpretation of artificial intelligence (AI) and what is your current opinion of its growing presence?
6. Do you believe that AI can ever truly take over one's occupation and lifestyle?
7. Has your company/department been impacted by the current increasing presence of artificial intelligence (AI)?
8. Can the online tasks done by the occupations mentioned above be performed by AI? If yes, then to what extent? If not, why?

From this point, each interviewee will be asked different questions that will be determined by their answers to the previous questions. The questions will consist of company policy towards AI and the relationship between human employees and AI.

Appendix B: ***Consent Form***

You are being invited to participate in a research study titled:

"Qualitative Interview Concerning the Trajectory of Software Employment Due to AI"

- This study is being done by ___________ from O.D. Tompkins High School as a requirement of the College Board Capstone – AP Research class.
- You were selected to participate in this study because you are an employer for a software company/software division for a company whose business has been impacted by the presence of artificial intelligence (AI). Due to your expertise in the criteria for hiring new employees, you are chosen to be interviewed as your job may be impacted by the presence of AI and the employment of new employees.

PURPOSE OF STUDY

- You are invited to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information.

- The purpose of this study is to understand how the presence of AI has affected the employment of new human developers and the methods to balance AI and human employee activity in the workplace. Also, this study will represent the impact of AI on future human developers and how their employment will be affected due to AI's takeover of their jobs. The findings of this study will be focused on the culmination of a model that will represent the trajectory of AI usage in the software industry and show how it will affect employment.

STUDY PROCEDURES

The purpose of this research study is to examine the presence of artificial intelligence (AI) in the software workplace and its effects on the employment of human developers. Through the findings of this research study, it will be possible to examine the trajectory of AI usage in the software industry and analyze how it impacts human employment correlating with the presence of AI.

- If you agree to take part in this study, you will be asked to participate in a qualitative interview by answering questions about the criteria of employment for human developers and how those criteria have evolved over time. The questions will also pertain to how the employment process has changed due to AI and if any future changes will be planned to accommodate the growing presence of AI.
- This qualitative interview will ask about the employment criteria that are used to employ human employees and how these criteria have altered over time. The questions will also ask about the effects of AI on the employment process and if has had any significant impacts that have altered the process.
- The process will take you approximately 20 minutes to complete.
- With your permission, this interview will be audio/video-taped in order to ensure that all quotes and comments are not misrepresented in any way.

RISKS

- There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life.

BENEFITS

- There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study may help your profession or company understand the impacts of artificial intelligence (AI) in the workplace and how it could affect human employees.

CONFIDENTIALITY

- For the purposes of this research study, your comments will not be anonymous. Every effort will be made by the researcher to preserve your confidentiality including the following:
  - Assigning code names/numbers for participants that will be used on all research notes and documents
  - Summarizing and anonymizing notes, interview transcriptions, and any other identifying participant information in an electronic digest
  - Securing all confidential data/documents, including audio tapes and their transcriptions, in a password-protected folder

- Destroying all confidential data/documents, including audio tapes and their transcriptions, at the culmination of this project
- Participant data will be kept confidential except in cases where the researcher is legally obligated to report specific incidents. These incidents include, but may not be limited to, incidents of abuse and suicide risk.

COMPENSATION

- No compensation will be given for participation in this study.

CONTACT INFORMATION

- If you have questions at any time about the study or the procedures, you may contact my AP Research teacher, Dr. John Gresham via email at JohnDGresham@KatyISD.org.
- If you feel you have not been treated according to the descriptions in this form, or that your rights as a participant in research have not been honored during the course of this project, or you have any questions, concerns, or complaints that you wish to address to someone other than the investigator, you may contact the Tompkins Campus IRB, Attn: Mr. Scott Shanks, at 4400 Falcon Landing Blvd, Katy, TX 77494

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature ______________________________________ Date __________

Investigator's signature _____________________________________ Date __________

Appendix C: *Participant A Transcript*

Interviewer: So what is your name and position and credentials in what company that you represent?

Participant A: Hey Interviewer my name is _______ and I work as associate director with Kyndryl, it's one of the consultant company that handles with multiple embassies within the United States, India, and Portford class well

Interviewer: And for this position, what occupations do you primarily employ?

Participant A: Most of my teammates handle client data, it is related to their client critical data with production data. So we work 90% of the time handling the client data refreshing databases as well as streamlining the databases designing the database is so our data network is related to data only.

Interviewer: So for can you give me a specific occupation that you do employ for?

Participant A: For example, we employ database administrators database engineers. So database administrators what they do is they take they handle client to databases like taking backups restoring from one environment to the other environment along with if there are any critical outages that you're making sure that the database is not impacted or data is not corrupted.

Interviewer: OK that's good and so for each of these occupations that you just listed the data administrators and data engineers. How much of the job requires knowledge of data computation or online tasks but because you said these are administrative jobs?

Participant A: Correct correct. So, computation is nothing but arranging the data in a presentable format so knowledge of where the data how the data fits in different scenarios depending on the client's requirement is where it could go so I would say 90% of the time we need to know In and out of the data where it is coming from where it is going how it is orchestrated how it is being presented to the client etc.

Interviewer: So, with this thorough analysis of data, you probably understand that there's a presence of AI in the field right?

Participant A: To some extent.

Interviewer: Okay. So, what is your interpretation of artificial intelligence or AI and what is your current opinion of its growing presence just in general not only in this industry?

Participant A: Any new technology is a double-edged sword initially so it depends on how we use it. You know some people use it for good some people use it for bad but yes definitely it puts some kind of ease to some of the tasks that we do on a day to day depends how each individual take AI and how they're planning to use it.

Interviewer: Right so with this understanding now of your perspective of AI do you believe that AI can never truly take over an occupation or a lifestyle that someone has right now?

Participant A: I have heard this question every time and there is a new technology or something new that comes into the picture so I don't think AI will completely take over. I would say maybe 30-40% of the tasks can be done through AI or robotics.

Interviewer: Okay once I go through the other questions I want to come back to that. So has your company or department been impacted by the current increasing presence of artificial intelligence or AI?

Participant A: No, at this moment none of my team members are affected or there are no significant job loss in our company because of AI.

Interviewer: Why do you think this is the case like so what tasks that you've mentioned before data analysis do you think that AI is unable to do right now?

Participant A: Processing the data, AI can do efficiently compared to the human but understanding the nature of the data is still the human responsibility I mean to make AI understand what kind of data it's handling is still humans human responsibility who handles the AI. So, always there is a human intervention required to make sure that AI understand okay whether this is a critical client data or whether this is a critical data related to individuals or personal information. So it couldn't segregate itself yet

Interviewer: So you believe a human component in this data analysis is still necessary?

Participant A: Yes.

Interviewer: How about the online tasks and the organizational tasks done by these data administrators do you think those could be performed by AI or at least AI could help these data administrators do their job better?

Participant A: There are some tasks which we can automate I wouldn't call it AI but there are some automation tools that we use for example to execute the backups, but when that fails it still requires human intervention verifying those logs and see where exactly it went wrong And fix that so we won't face that issue again.

Interviewer: Ok, so, I wanna go back to that how AI can talk about taking if you can take over one's lifestyle or occupation. Wouldn't you consider AI as a new technology that not only helps because previous inventions they have helped the human do their job better but this one is actually aimed at almost mimicking a human a no human no other inventions in the past would actually mimic human intelligence, right?

Participant A: Right now I haven't seen any significant proof that AI can do a human job with 100% accuracy I would say there are still 30-40% maybe. In the future I don't know about even to train an AI we still need data models and human interaction is still required

Interviewer: But you would think that AI could right now only do unskilled labor not skilled labor

Participant A: Correct

Interviewer: Ok thank you _____

Appendix D: *Participant C Transcript*

Interviewer: Right, this interview is about software and AI alright _______?

Participant C: Yup

Interviewer: Okay so what company are you representing and what is your position in that company?

Participant C: I work in Honeywell as a principal architect.

Interviewer: Right what credentials do you have for this position?

Participant C: I work in a software architecture for multiple platforms including SAP, SAP Commerce Cloud, and SAP ECC.

Interviewer: Alright and what occupations do you primarily recruit for your department or company?

Participant C: I'll try to hire most of them are architects and tech leads who are professional in the platforms where they try to learn and then how to develop the programs as well as how to architect any designs that need to be done.

Interviewer: And for each of these professions that you are recruiting, what are their primary tasks or responsibilities to do in the company?

Participant C: So it depends on the requirement to requirement so a business brings some requirements and then we try to develop software solutions for them. So, 2 ways it goes, one is it could be out-of-the-box functionality which a platform is. Simple example like it is a commerce one there is a commerce solution we try to implement. If there's nothing in-house, we try to develop them a custom solution.

Interviewer: Alright and so for these professions, these architects, that you recruit right how much of that job actually requires a knowledge of data computation or any online tasks that's about data analysis?

Participant C: Pretty much everything we do is around data analytics it could the data can be varied in different ways. One is what is the volume of data which implies whether our application or any development that is being done can be scalable or not. And the second piece is who are the consumers of the data and who are the users of the application. The sales people could be customers that it would be anyway. So we tried to do it under text-based on who is the user, how they use it, and then what is the volume that you use it.

Interviewer: So the amount of data varies a lot?

Participant C: Yes, it varies a lot.

Interviewer: Okay, so aside from your company, you know of AI right? What is your interpretation or current opinion of its growing presence?

Participant C: So AI comes in varied forms so I am into generative AI, it can be a text based or it can be a computational one. So a generative AI that we I use personally for my growth is anything in terms of business language predictions and then also any AI which is a consumer analytics production. This could be somewhere like how a user behaves or anything like that.

Interviewer: What do you think about you know AI's general effects on society now?

Participant C: Effects could be 2 ways. One is some occupations can be replaced like a text writing or any technical writers and those could be replaced. However, it also enhances a certain individual's operations too. Spending hours and hours to do programming, you could use AI to help them up programming to move it forward.

Interviewer: But let's just talk about any AI right now. Do you think it could actually take over someone's job? You said it could take over someone's occupation right? Do you think that could like be almost a reality for the majority or just some occupations?

Participant C: It would be way too less in terms of replacing an occupation wise but a helping them grow in the current occupation, yes much more I believe.

Interviewer: Ok, so at Honeywell or at least in your department, has it been impacted by this increasing AI, and in what ways?

Participant C: Yes, it did impact but it impacted in 2 ways where consumers are expecting much more real estate and then real-time data the way that they're browsing history and the way they want to look at the data. So we try to implement new AI stuff to help the customer to get to their information way faster and way easier and less management to it so yeah so its helping out.

Interviewer: Any of those data analysis tasks you talk to about your architects doing, can they can any of those tasks be performed by AI or some AI model?

Participant C: We are evaluating certain kinds of situations where some of the directives can be done by AI. One I was talking about browser analytics where we try to monitor consumer-based browsing history and the way that they browse products within our system. So and purchase history that we try to like what they purchase and everything. So we will try to use AI tools to get the analytics way faster.

Interviewer: And you said that this data analysis can be somewhat performed by an AI right? So would you think it could cut down on staff?

Participant C: No I don't think it's cutting down the task it may speed up the task process but I wouldn't feel it as a guy cutting down anything.

Interviewer: Ok so but do you think you would like to limit employment to that position because now not you you will rather need an overseer, not an actual data analyst, right? You need someone who can understand it like check the AI what it's doing.

Participant C: Yeah, if you put it in such a way yes you could think in ways where you're trying to transform the way that people perform their jobs would do the job less like the data analytics, yes they would do less time in terms of doing the data analysis and then spend their time in terms of the results rather than performing the analysis. I could think that yes it would reduce there, but I also think in such a way that it would transform the data analytics into a second forward where earlier getting the analytics or executing the analytics is time-consuming, but right now the job transforms from doing the analytics to writing the AI programs to get multiple metrics. So, I feel it is more of a shift rather than actually cutting down anything. We try to shift, generational shift, which will happen most of the AI ways so I feel like it's more of a shift rather than cutting down anything

Interviewer: OK that's it for the interview. Thanks _____.

Participant C: No problem.

Appendix E: *Participant D Transcript*

Interviewer: Okay, this interview is for between software employment and AI. Okay, ______.

Participant D: Yes.

Interviewer: Okay. So question one, what are your position and credentials in your company or department? And what company are you representing?

Participant D: So I'm working as a senior engineer. My job role basically is managing labs in my company, versus an oil and gas major Company in Houston. So I majorly monitor the quality of lab testings, and also network, various labs that belongs to our company. So that's my primary responsibility.

Interviewer: Okay, that's good. So what occupations Do you primarily employ for this lab company, and also, what's the name of the company?

Participant D: So, I work for ExxonMobil. So in ExxonMobil, they're primarily on oil and gas. So, whereas the domain where I'm working is chemicals, so chemicals is part of all the oil and gas, petrochemical companies is a co-product that comes out, and we do make varieties of products from that co-products coming out of the refineries, you know. So coming to the people that we recruit, in my job role, I often see, we need a lot of people who are skilled in testing. Sometimes they are beginners or experienced hires, but they should have a strong background on analytical science, testing products, and data analysis, we do have certain things that we have to maintain the quality of testing and quality of reporting, that's where the data of all the tests that we do has to be managed, in order to deliver quality results to the, to the customers.

Interviewer: So their primary responsibility is like, analysis of lab tests?

Participant D: Yes. It's lab testing, as well, as, you know, the results part, you know, like, if you test something, you have to have results, and you have to communicate those results. As per the standard route, you know, for example, if you get data from a result, or from an experiment as 5.776, something like, like, you have significant figures of decimal numbers after the decimal point, right? So the technicians or the operators, whoever is doing the test should know, what is the right way to report the results to the customers.

Interviewer: Okay, so this data analysis is, how much of it is actually online? Or like, not hands, not paper, but more like on the computer? How much?

Participant D: Yeah, so almost every data that we generate in the labs, it's directly going into the server. So we have to maintain data integrity, and traceability, right, for both these purposes, if we maintain paper copies, it's extra work for the operators to maintain that record. And, you know, XR is like 50 plus years of record is there, right, they cannot keep all paper copies, you know, in the past, it used to, but now, we do maintain all the backups in the server. And whenever we need to retrieve some data for addressing any issues with the current customers or to re-review the tests that we have already done on a particular product, you know, we can always bring back the data from the server and see that so almost 99% of the data goes into the, into the server or like, what do you call online?

Interviewer: Yeah. Okay. So company aside, what is your interpretation of AI? Like, what is your view current opinion of its presence? Because it's growing?

Participant D: Yeah., so, I being not in the IT industry or not having much knowledge on software. So, the word you know, I may not be able to judge exactly what AI can do, but in our area, where we are working, we do take advantage of AI, in other words, automation of the data, right? So that is very important for our job roles, we have to use some automation tools in order to simplify our data. So starting from a simple Excel sheet, you know, we do sorting and also apply some functions so that once we create a template, any new data can be fed into that template and the final results can be easily extracted, right? You know, we don't need to every time to go through the whole process. So that's a very beginner form of automation, like Data Automation. So you feel like 10,000 data points in the Excel sheet, and you get what you need, at the end within the same template, right? So that's what I see as a very beginner or first stage of audit automation or using those tools to simplify our data. But I do know, like, in big companies like Exxon, we generate a lot of data, because some of our plants, they are running 24 by seven. So every plant has a set of testings that has to be done before they sell the product out of the gate. So Exxon gives top priority to data integrity and the quality of the product. So both these things can be achieved by properly testing each and every part of the product that we test that we release to the customers. So that means we are doing so much rigorous testing on all the products that we sell in the market. And it's happening, like I would say, every minute we can get at least, well, it's difficult to quantize. But in a minute, we get maybe hundreds and hundreds of data points across the globe, we have these plants in all the continents, and like we have in Asia, and the Pacific, few plants, the plants in Europe and few few in North America. So imagine, every data point that we generated belongs to Exxon. And we have to make sure that all this data is properly processed. And use it to maintain, the ultimate goal is to maintain the quality and integrity of our product in the market. Right. Yeah. So those things can be achieved only if we maintain this data properly, modify it manage that, and get the right results to the customers. So that much data is generated and that much storage and automation is happening behind the scenes.

Interviewer: Yeah, that's good. So do you think that this data analysis, right, it can only be done mostly by humans, right? For in your company? Because it needs that human element. Do you think AI could help them? Maybe like, do it a little bit faster?

Participant D: Yeah, sure. I think as the market is evolving, or the industry is evolving, in parallel AI is also bringing new tools to the board. It takes some time for us to adopt because, for a smaller, shorter startup, it might be a very quick switch because they have less amount of data to manage and less amount of hassles to go through less steps to convert or implement something new into the organization. But for us, it's we have to be very careful, we cannot lose anything from our data, the valuable data by doing this conversion. So it's it's a multi-step process, it's going a little slow because we want to be very careful. But definitely, AI is making a revolutionary change. And we actually if we have more tools like that, the resources that we spend in managing the data, bringing back the data from the server doing all these calculations can be significantly reduced. Not only that, we can avoid all kinds of manual or human errors in the system. So that's the main thing. Any error caused by humans will cost us sometimes millions of dollars, right? Yeah. So to just give an example. So a million dollars is a big money, but a small person to make an error, right? So that's why we try to use all automated tools from the beginning ever since I joined Exxon, they always encouraged improving efficiency, automation, and automating the process so that we can reduce human errors.

Interviewer: All right, yeah. Thank you. That's it.

Appendix F: *Participant H Transcript*

Interviewer: So this interview is about AI and software employment. Do you understand about that?

Participant H: Yes, I do.

Interviewer: Okay, so the first question is, what are your position and credentials in your company? And what company are you representing?

Participant H: Okay, so I work for JPMorgan Chase. It's a commercial bank and investment banking company. And my position is that of a Production Support Engineer, and my designation is that of Vice President, which generally means someone in a senior role, it doesn't represent any leadership role. I'm a senior Production Manager and management engineer.

Interviewer: Okay, and what occupations do you primarily recruit for JP Morgan?

Participant H: Okay. So, as I mentioned, it's a banking, commercial banking, and investment banking organization. So in the organization that I work for, inside of JP Morgan and Chase, we recruit someone who is a software developer, production management engineer, data analyst, testing engineer, or business analyst, because we create the required software and required web applications for the internet banking or investment banking part of JPMorgan and Chase.

Interviewer: And these different jobs, right? What are their primary job responsibilities within the company?

Participant H: Okay, so our primary responsibility is to support the investment banking applications that are used in JP Morgan. So for example, there is an application that takes care of creating IPO, which is, you know, what is IPO? Right? IPO is where it's like a company is putting itself out for sale, for shares, things like that. So in that case, we have an application that cares, that takes care of the entire process. So we need people who can create the application. And once it's created, we need people. And the creation process involves software development. It could be in any language like Java, dotnet, or whatever. And after that, we need someone who can test that application, whether or not it's doing the job correctly. And who gives us the validation of whether the job is created correctly and is working properly? It’s the business person who actually gathers the information and gathers requirements from actual stakeholders. So that's their final. That's their role.

Interviewer: Okay, and this development, software development, and testing, right? Does it require any understanding of data analysis or any online understanding of how to manage data?

Participant H: They require it day in and day out of their job?

Interviewer: Okay. So they're very involved in this data understanding of how it works. Okay. shifting away from your company, or talking about it. What is just your general interpretation of AI? What's your opinion on its growing presence?

Participant H: I would say, AI is definitely playing a huge part in the banking industry. Because, as I mentioned, each one of us we need to know how to do data analysis, and interpret data. And I think AI is a very good tool that can automate a lot of these tasks for us, it may not eliminate human presence completely, but it can help us in a large way to automate these processes by probably running bots, and by collecting a lot of information automatically instead of us having to do it manually.

Interviewer: So, you said how human presence will always be required even if AI becomes big, but do you think that even for some jobs, do you think AI can just completely replace that job?

Participant H: So, any application right, be it AI-driven or not? It requires a basic level of not just basic, but it requires maintenance. Say I have created an application that actually uses AI in the backend to do the work. But it still needs me to make sure it is doing the right thing to make sure it is. It is also taking into account the newer changes that I wanted to take care of. It doesn't know unless or until it's told what to do. I know AI is growing, and sometimes they are self-learning, even then, to make it to get to that point, it needs a human to train it. So I would say it won't ever take away human presence completely.

Interviewer: Okay. And has your department at JPMorgan been impacted by this increasing AI, presence?

Participant H: Impact, I wouldn't say the impact is negative, I would say. I mean, there is some negative impact to like if there is somebody trying to hack into our websites, by using AI bots. Of course, that's bad. So we need AI, again, to take care of those problems. But other than that, it has also been very helpful, because it helps us eliminate a lot of repetitive tasks that we do manually and repetitively. Which is probably not a very good use of time for us. So AI also helps us in automating a lot of things. So the impact is positive too, and negative in the sense of people who use it in a bad way.

Interviewer: Okay, and you talked about how previously how these occupations do a lot of software development. Do you think an AI could perform that software development, or at least help them help the software developers make these programs?

Participant H: Definitely help. Because so for example, let's take ChatGPT into account. So say, for example, I am writing a program, and I'm trying to figure out the best way to write it. Probably I could just ask ChatGPT to spit out the code for me. I may not use it, 100% of it, but it can give me a good idea of what I'm missing. So that way it can help me. But I don't think it would think of all the edge-case scenarios that a human can think of.

Interviewer: Okay, so you think a human overseer will still need to, you know, manage the AI. But AI can, like AI do some tasks, but you still need a human who actually has expertise in that area to check it because it's still prone to error.

Participant H: Yes, definitely.

Interviewer: Yeah. Okay, thank you.

Appendix G: *Participant J Transcript*

Interviewer: So this is an interview about AI and software employment. Do you understand that?

Participant J: Yes.

Interviewer: All right. So first question, what are your position and credentials in your company and what company are you representing?

Participant J: So I'm working for General Motors as a sap test engineering manager.

Interviewer: Alright, and for General Motors, what occupations Do you primarily recruit for the company? It's for recruitment. Yes. What do you bring? What job titles do you recruit to the company?

Participant J: SAP test engineers, SAP data analysts, and SAP functional consultants.

Interviewer: Okay, and for each of these occupations, what are their primary responsibilities for General Motors?

Participant J: So, the functional analysts are the SAP testers, they need to understand the business process and what is happening in the manufacturing area and the supply chain area, and then they have to design a solution in the SAP system so that it meets the business process requirements. The testers have to make sure that that process works without any defects or if they find any defects in the development they have to log defects and follow up until the resolution.

Interviewer: Okay, and for each of these engineers, software engineers, how much of the job requires a knowledge of data computation or any tasks about data analysis?

Participant J: Oh, they need they need a full thorough understanding of the data that is there in the system. Because they have to use the data like from the production system to simulate scenarios in the test environment to make sure the system is designed as expected.

Interviewer: All right, and just in general, not just from General Motors. What is your interpretation of artificial intelligence? And what is your current opinion of its growing presence? Like its effects on society?

Participant J: Yeah, artificial intelligence in one way is going to help the companies to make some critical decisions for the company by analyzing the historical data. And looking at the trends like going into the market, like open online internet, understanding the trends and the historical data, analyzing those things, and giving some critical inputs to the senior management to make decisions for the company.

Interviewer: All right, and do you believe that AI can actually take over one's complete occupation? Like just like say, “Hey, AI, took over your job? Sorry.” Is it ever gonna be like that?

Participant J: In some areas where the things are, things are like pretty repetitive. So those guys those kinds of jobs, are going to take over, and it's already happening. But AI is going to create a lot of new jobs in the new technologies, the new occupation can say.

Interviewer: Okay has your company or department in General Motors been impacted by the current increasing presence of AI?

Participant J: Impacted in a positive way you can say, did not impact the occupations like taking over somebody's job, but we are using the AI to improve the quality of the vehicles that we are building, improve the user experience, and improve the support that the company is providing to the to the vehicle owners like in the when they're driving if they're stuck somewhere something so the AI we are taking the help of AI for the customer satisfaction.

Interviewer: Okay, and, you know, the other online tasks that you discussed about the SAP engineers, right? How much of that job can be done by an AI?

Participant J: This job? At the moment not very much replaced by AI because it doesn't have a lot of interaction with the business users to understand the business processes. Looking at the existing system and providing a new solution and testing. So probably in the testing area. It might back something but not in the actual solution provided to the business users.

Interviewer: Do you think that the job has any repetitive tasks that AI could help with? Like, so the software engineers have more time for other stuff?

Participant J: Some of the things we are already doing, not exactly by AI, I can say like it's by automation kind of thing. So those are some of the lots of manual efforts we are replacing with automation, especially in the testing area. Okay. And also in the release management, the pipelines, and all that stuff. Yeah.

Interviewer: And in these testing phases, right, automation is already present?

Participant J: Yes.

Interviewer: And with this automation can it be expanded to an even greater extent, or do you think it's already at its limit?

Participant J: It can be extended to its greater limit, not just in the SAP area, but we have lots of other cloud, Azure-based applications, and AWS-based applications. So in that area, we are mostly trying to do the complete automation like we have something called automation first strategy, which means like, straightaway, the testing will be done with automation. So kind of eliminating the manual testing.

Interviewer: And when you said that, General Motors is in for these job applications, they're making the design experience for these vehicles. Do you think AI could help with that as well?

Participant J: Oh, yes, definitely is going to help. We already started a couple of projects on AI like making use of AI to improve our products and the customer experience of our vehicles.

Interviewer: All right, thank you. That's it.