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EXPLORING THE IMPACT OF TECHNOLOGICAL ADVANCEMENT ON THE VALUE OF HUMAN CAPITAL TO THE OUTPUT OF MANUFACTURING COMPANIES

MA THESIS

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Approval

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Declaration

I hereby declare that all information, documents, analysis, and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of the Institute of Graduate Studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

Gardeh Nyepudolo Garteh

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Exploring the Impact of Technological Advancement on the Value of Human Capital to the Output of Manufacturing Companies

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Abstract

This study investigates the role of technological advancements on human capital within manufacturing companies. It was hypothesized that technological changes have a positive significant impact on human capital. Through a comprehensive questionnaire survey involving a significant number of participants, various aspects of this relationship were explored.

It was revealed that there was a robust and positive link between technological advancement and human capital. Technological advancement was found to be a key determinant in driving changes in human capital, thereby confirming the hypothesis.

In terms of individual perceptions, employees reported a high level of skill and capacity to perform their duties effectively and efficiently. They also affirmed that their skills have increased with work experience and that their contributions to the company have been well recognized.

Consequently, the study concludes that technological advancements in manufacturing companies play a crucial role in boosting human capital. The findings shed light on the need for manufacturing firms to strategically invest in technological advancements and align their employee training efforts accordingly for achieving the maximum returns on human capital.

Keywords*: Technology, Human Capital, Productivity, Performance, Employees, Manufacturing*

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Özet

Bu çalışma, imalat şirketlerinde teknolojik ilerlemelerin insan sermayesi üzerindeki rolünü araştırmaktadır. Teknolojik değişikliklerin insan sermayesi üzerinde pozitif ve önemli bir etkisi olduğu varsayılmıştır. Oldukça sayıda katılımcının dahil olduğu kapsamlı bir anket araştırması ile bu ilişkinin çeşitli yönleri incelenmiştir.

Sonuçlar, teknolojik ilerleme ve insan sermayesi arasında güçlü ve pozitif bir bağlantı ortaya koymaktadır. Teknolojik ilerlemenin, insan sermayesindeki değişiklikleri sürükleyen anahtar bir belirleyici olduğu bulunmuştur, böylece hipotezi doğrulamıştır.

Bireysel algılar açısından, çalışanlar yüksek düzeyde beceri ve görevlerini etkili ve verimli bir şekilde yerine getirme kapasitesi bildirmiştir. Ayrıca, becerilerinin iş deneyimi ile arttığını ve şirkete katkılarının iyi tanındığını da teyit etmişlerdir.

Sonuç olarak, çalışma, imalat şirketlerindeki teknolojik ilerlemelerin insan sermayesini artırmada önemli bir rol oynadığı sonucuna varır. Bulgular, imalat firmalarının stratejik olarak teknolojik ilerlemelere yatırım yapma ve insan sermayesinden en yüksek getiriyi elde etmek için çalışan eğitim çabalarını buna göre ayarlama ihtiyacına ışık tutar.

Anahtar Kelimeler: Tecknoloji, İnsan Sermayesi, Verimlilik, Çalışan Performansı, Üretim

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List of Abbreviations

AI – Artificial Intelligence

OECD – Organization for Economic Co-operation and Development

CHAPTER I

INTRODUCTION

Background of the Study

The Organization for Economic Cooperation and Development (OECD), has bemoaned the future of work and the prospects of human contribution to the new digital and technological wave hitting the world.

In its 2022, Future of work report, the OECD concluded that with 32% of factory operations becoming automated, young people with low skill sets are at a higher risk of leaving the workforce or not joining it at all. The report also suggested that even more experienced workers with higher skillset are at risk of losing their jobs.

COVID 19 with a little push from the internet has made very popular the concept of working from home. It has also led managers to rethink whether a crowded office is still important in the twenty-first century.

Given these prevailing circumstances, this research would be undertaken first of all to ascertain the current condition of technological advancement in Liberia's manufacturing companies. Also, it will seek to understand if the companies have improved their operational practices over the past ten years and also investigate how employees are coping with such changes. Finally, the research seeks to understand any marginal change or shift in labor demands as a result of technological advancements in the companies.

The impact of technology or the discussion around its use is significantly important because technology in driving economic growth, improving living standards, and addressing societal challenges. Technological analysis is crucial in understanding the dynamics of technological change, identifying emerging technologies, and assessing their potential impacts.

Statement of the Problem

Since the beginning of the twenty-first century, technology has rapidly changed the way we live. In just few years, something as portable as the cell phone has taken over many tasks and automated our everyday lives. This change is no less confined to our daily lives but also our work place. With the OECD reporting that even high skilled jobs are at a higher risk of being

replaced by technology, the goal of this study will be an inquiry into the effect of technology on the value of human capital to companies in the manufacturing industry.

Assumptions

It is assumed that the descriptive results derived from this research would help newer firms to hire staffers with skills that would have long-term value, and also prepare existing companies to invest in the advancement of skills of current employees as well as relevant technologies.

Significance of the Study

The discussion to justify this research would be divided into different parts. Firstly, it would cover the skills gaps to be unfilled due to technological advancement. Additionally, other parts of this Justification would focus on projecting jobs to be outrightly lost due to Artificial Intelligence and related technologies. Research of this sort would be incomplete without sampling the views of industry players concerning the various impacts technological change would have on the value of human capital. To sum up this justification, there would be a discussion of the employment opportunities and further research areas that could be covered as a result of conducting this study.

To begin with, a study conducted by The Manufacturing Institute and Deloitte on the skills gap presented by technological change in the United States indicates that the advancement of new technologies would in the long run lead to more jobs being created than the ones that would be lost. However, their study points out that the new jobs to be created would require skillsets that current workers lack. A field or job type that stands a greater risk of suffering the backhand of the wave of technological change that's engulfing us is the manufacturing industry. The report further noted that the skill gap will lead to 2.4 million unfilled positions with a succeeding financial and economic effect of 2.5 trillion dollars. (Deloitte & The Manufacturing Institute, 2018) Although this research was conducted in the United States, it still has practical reverberations for countries around the world due to the penetrating effects of technology. Hence, it is essential that individual countries conduct similar studies to access their skills gaps.

On the jobs to be lost from the Internet of Things (IoT), and Artificial Intelligence, the World Economic Forum did a survey that concluded that by the year 2025, Artificial Intelligence will replace 85 million jobs related to the assembly line and repetitive tasks. Assembly line jobs

are expected to cover a significant portion of this hit. This research was conducted on companies with established systems to absorb this job loss and capacity to bring employees up to speed with advancements in technologies. However, this thesis will be examining the strength of businesses in an emerging economy to deal or cope with this rapid change. (World Economic Forum 2020).

To compound the threats posed by Artificial Intelligence, Elon Musk, the CEO of Tesla, the largest and most valuable electric car manufacturer in the world has raised an alarm. Mr. Musk has been concerned about what he believes is the growing intelligence of machines. He believes that at the rate of their growth, machines have the propensity to lead to massive unemployment among the global workforce. Given his seat at the top of a giant car manufacturer, we cannot ignore this dark revelation from him. That is why this thesis seeks to understand how technology will impact the manufacturing industry which can be used as a tool of advisement to employers to devise a mechanism to replace them based on employees' perspectives.

In conclusion, this research will examine the current state of human capital's value to the manufacturing industry in Liberia. It will also explore the threats posed by Artificial Intelligence and make efforts through employees' responses to proffer suggestions on how managers and top executives of manufacturing companies could continue to enjoy the value of human capital as a function of intellectual capital in the long run.

Limitations

Like any research, this research faced stumbling blocks along the way. Some of the limitations of this research was funding. As a student, the researcher faced difficulty in raising adequate funding to connect with the participants. This slowed down the flow of the data collection process. Another limitation of the research was the geographical location of the researcher. As a student based in Cyprus, it required a much greater effort to gather research data from participants in Monrovia.

Research Questions

- How does technological advancement influence the productivity of human capital in manufacturing companies?
- What is the relationship between the degree of technological advancement in manufacturing companies and the development of employee skills, competencies, and

knowledge?

- Does the incorporation of technological advancements in manufacturing companies lead to an increase in human capital value, as reflected in skill acquisition and productivity enhancement?

Key Words/Terms

- Technology: Technology is defined as "a manner of accomplishing a task especially using technical processes, methods, or knowledge." Merriam-Webster (n.d)
- Human Capital: Frank & Bemanke (2007) defined Human Capital as "an amalgam of factors such as education, experience, training, intelligence, energy, work habits, trustworthiness, and initiative that affect the value of a worker's marginal product"
- Productivity: Productivity is defined as the ratio of output to input for a specific production situation. Roger (1998)
- Employee Performance: This is defined as the total performance in meeting the anticipated worth and achievement of tasks under the procedure and time requirements of the organization. Inuwa, M. (2016).
- Manufacturing: This is defined as "the process of making wares by hand or by machinery especially when carried on systematically with division of labor." Merriam-Webster. (n.d.).

CHAPTER II

Literature Review

Related Literature

Definition of Technology

There are many definitions of technology. However, this review will begin with a definition from Carroll, L. (2017) which proposes a new definition of technology that takes into account its impact on human behavior and culture. Carroll argues that technology is not just tool or a machine, but a system of artifacts, skills, and practices that are used by humans to adapt to their environment and achieve their goals. From an ethological perspective, technology is seen as a form of behavior that is subject to the same evolutionary principles as other forms of behavior.

The author starts by defining Technology as the scientific study of animal behavior, including human behavior. From this perspective, technology is seen as a form of behavior that is subject to the same evolutionary principles as other forms of behavior. Carroll argues that technology is a system of artifacts, skills, and practices that are used by humans to adapt to their environment and achieve their goals. This definition emphasizes the holistic nature of technology and the fact that it is not simply a tool or a machine, but a complex system that involves a range of different factors.

The author then breaks down the different components of technology, including its cognitive, affective, and behavioral aspects. The cognitive aspects of technology refer to the mental processes that are involved in its creation and use. This includes things like problem-solving, decision-making, and creativity. The affective aspects of technology refer to the emotional and psychological experiences that are associated with its use. This includes things like pleasure, satisfaction, and frustration. Finally, the behavioral aspects of technology refer to the physical actions that are involved in its use. This includes things like manipulating objects, using tools, and interacting with other people.

Carroll also discusses the ethical and moral implications of technology and its impact on society. From an ethological perspective, technology is seen as a form of behavior that can have both positive and negative effects on society.

On the one hand, technology can be used to solve problems, improve living standards, and promote social and cultural change. On the other hand, technology can also be used to create new problems, exacerbate existing ones, and perpetuate social and cultural inequalities.

The author suggests that a more comprehensive and holistic definition of technology is needed to fully understand its impact on human behavior and culture. This definition should take into account the complex and multifaceted nature of technology, as well as its social, cultural, and ethical implications. Carroll argues that a more comprehensive definition of technology can help us better understand the ways in which technology interacts with and shapes society, as well as the ways in which we can use technology to promote positive social and cultural change.

Overall, Carroll's article provides a compelling argument for a more comprehensive and holistic definition of technology that takes into account its impact on human behavior and culture. By emphasizing the holistic nature of technology and its impact on society, the author provides a new framework for understanding the role of technology in our lives. This framework can help us better understand the complex and multifaceted nature of technology, as well as its potential to promote positive social and cultural change. Carroll, L. (2017)

In their research on an operative definition of Technology, Ellis, J. et. al (2020) The article "Toward a productive definition of technology in science and STEM education" discusses the need for a more productive definition of technology in science and STEM education. The authors argue that the current definitions of technology are too limited, focusing only on technological artifacts and ignoring the broader societal and cultural implications of technology.

The authors propose a new definition of technology that emphasizes its dynamic and iterative nature. According to this definition, technology is a system of human activities, tools, and resources that are used to solve problems and achieve goals. This definition emphasizes the iterative and collaborative nature of technological development and highlights the importance of considering the social, cultural, and ethical implications of technology.

The authors argue that this definition provides a more productive framework for understanding technology in science and STEM education. They suggest that this framework can help educators engage students in authentic, inquiry-based learning experiences that reflect the dynamic and iterative nature of technological development. By focusing on the process of

technological development rather than just the technological artifacts themselves, educators can help students develop a deeper understanding of the complex and multifaceted nature of technology.

The authors provide several examples of how this definition can be applied in science and STEM education. For instance, they describe a classroom activity in which students are asked to design and build a device that can transport a ping-pong ball from one end of a room to another. This activity requires students to collaborate, iterate, and problem-solve as they work to design and build an effective device. By focusing on the process of technological development, rather than just the device itself, students are able to develop a deeper understanding of the role of technology in solving real-world problems.

Overall, the article provides a compelling argument for a more productive definition of technology in science and STEM education. By focusing on the process of technological development, rather than just the technological artifacts themselves, educators can help students develop a deeper understanding of the complex and multifaceted nature of technology. This, in turn, can help students develop the skills and knowledge they need to navigate the ever-changing technological landscape of the 21st century. Ellis, J. et. al (2020)

The Concept of Technology

Halicka, K. (2017) provides an overview of the main concepts and approaches used in technology analysis. The article is a comprehensive review of the literature on the subject and covers a range of topics related to technology analysis.

Overall, Halicka's article provides a comprehensive overview of the main concepts and approaches used in technology analysis. The article is well-written, organized, and easy to follow. It is a valuable resource for anyone interested in understanding the dynamics of technological change and the role of technology analysis in shaping the future. Halicka, K. (2017)

Another concept of technology is adaptive technology. Adaptive façade has gained very significant strides by highlighting the increasing contemporary architecture. The role of facades in energy efficiency, occupant comfort, and overall building performance cannot be overstated. Adaptive facades have the potential to respond to changing environmental conditions and user

needs, thereby optimizing energy consumption and enhancing indoor comfort. Attia, S. et. al. (2020)

To understand in a much deeper form the concept of technology, we will review research on this topic. In the article "Sources of technological innovation: Radical and incremental innovation problem-driven to support competitive advantage of firms" by Mario Coccia, the author examines the different sources of technological innovation and how they can be used by firms to gain a competitive advantage. Coccia argues that firms can pursue two types of innovation: radical and incremental, and that each type can be problem-driven to support the competitive advantage of the firm. Coccia, M (2016)

The article "Building automation systems: Concepts and Technology" provides an overview of the concept and technology behind building automation systems. The authors argue that building automation systems (BAS) are becoming increasingly important in the modern world due to their ability to improve energy efficiency, enhance comfort and safety, and reduce operating costs. The article provides a detailed overview of the key components of a BAS and the technologies that are used to create them. Domingues, et. al (2016)

Overall, the article provides a comprehensive overview of the concept and technology behind building automation systems. The authors provide a detailed explanation of the key components of a BAS and the technologies that are used to create them. They also discuss the benefits of a BAS and the challenges that lie ahead. The article is well-researched and provides valuable insights for anyone interested in building automation systems, from building owners and managers to engineers and technicians. Domingues, et. al. (2016)

The article titled "Conceptual Origins, Technological Advancements, and Impacts of Using Virtual Reality Technology in Education" by M. Raja and G.G. Lakshmi Priya provides a comprehensive overview of the conceptual foundations, technological advancements, and impacts of virtual reality (VR) technology in the field of education. Raja & Priya (2021)

In conclusion, the article provides a comprehensive summary of the conceptual origins, technological advancements, and impacts of using VR technology in education. It emphasizes the potential of VR to create immersive and interactive learning experiences, enhance student engagement and knowledge retention, and foster collaboration among learners. The article also

acknowledges the challenges and limitations that need to be addressed to fully realize the benefits of VR in educational settings. Overall, the article serves as a valuable resource for educators, researchers, and policymakers interested in understanding the applications and implications of VR technology in education. Raja & Priya (2021)

The History of Technology

In the article "History of Technology" by Noah Arceneaux, the author provides a comprehensive overview of the history of technology, from prehistoric times to the modern era. The article covers the major technological innovations and advancements throughout history, from the invention of the wheel to the rise of the internet and beyond. The author also explores the social and cultural factors that have influenced the development of technology over time. Arceneaux, N (2016)

The article then moves on to discuss the technological advancements of the ancient world, including the development of writing, the invention of the printing press, and the construction of massive public works projects such as the Great Wall of China and the Roman aqueducts. The author also explores the role of religion and philosophy in shaping technological development during this time. It goes on to discuss the technological innovations of the Industrial Revolution, including the invention of the steam engine, the rise of mass production, and the development of new transportation systems such as railroads and steamships. The author explains how these innovations transformed the world and paved the way for modern industry and commerce. Arceneaux, N (2016)

"Machines as the Measure of Men" by Michael Adas is another thought-provoking and meticulously researched article that explores the intricate relationship between science, technology, and Western dominance. Adas's nuanced analysis, supported by extensive historical evidence, reveals the ways in which scientific advancements have been used as instruments of control and domination. By incorporating non-Western perspectives and questioning prevailing ideologies, Adas stimulates critical thinking about the ethical dimensions of Western progress. While the academic writing style may pose a challenge for some readers, this article remains a valuable resource for scholars and individuals interested in the dynamics of power, technology, and cultural imperialism. Adas, M. (2015)

Social And Cultural Shifts in Technology

Twenge et al. investigate the trend of decreasing psychological well-being among American adolescents since 2012, coinciding with the rise in smartphone technology. The authors utilize large-scale national surveys and statistical analysis to establish a correlation between increased screen time and adverse mental health outcomes, such as depressive symptoms and suicidal ideation. They argue that the excessive use of digital devices and social media platforms has contributed to a decline in psychological well-being, exacerbating feelings of loneliness, anxiety, and low self-esteem among adolescents.

In their comprehensive article "What the digitalization of music tells us about capitalism, culture, and the power of the information technology sector," David Hesmondhalgh and Leslie M. Meier present an insightful analysis of the complex interplay between these forces in the contemporary world. The authors use the digitalization of music as a lens through which to explore the broader implications of capitalism and the IT sector's influence on culture. In this review, I will discuss the key themes and arguments presented in the article, highlighting the authors' well-researched, thought-provoking, and engaging narrative.

"What the digitalization of music tells us about capitalism, culture and the power of the information technology sector" is a must-read for anyone interested in understanding the complex relationships between music, capitalism, and the IT sector. David Hesmondhalgh and Leslie M. Meier have crafted a well-reasoned, insightful, and thought-provoking analysis that invites readers to reflect on the implications of digitalization and consider the broader cultural consequences of our increasingly technologically. Hesmondhalgh & Meier (2018)

Bibri & Krogstie (2017) provide empirical evidence of the social shaping dimensions at play in real-world contexts. They also offer practical recommendations for policymakers and urban planners, emphasizing the importance of participatory design processes, transparent decision-making, and addressing the digital divide.

One of the key contributions of the article is its innovative theoretical framework, which effectively bridges the gap between the SST and SCOT perspectives. By combining these two approaches, Bibri & Krogstie (2017) offer a more nuanced understanding of the relationship between technology and society, highlighting the mutual influence and co-construction of each other in the context of smart sustainable cities.

Lastly, the article offers practical recommendations for those involved in the planning, design, and implementation of smart sustainable cities. The authors' emphasis on participatory design, transparent decision-making, and addressing the digital divide is especially valuable, as it highlights the importance of incorporating the social shaping dimensions into urban. Bibri & Krogstie (2017)

In their comprehensive article "Pandemic politics, pedagogies, and practices: digital technologies and distance education during the coronavirus emergency," Ben Williamson, Rebecca Eynon, and John Potter explore the multifaceted implications of the rapid shift to online learning as a result of the COVID-19 pandemic. They analyze the political, pedagogical, and practical aspects of this sudden transition and examine the role of digital technologies in facilitating distance education. The authors also consider the challenges and opportunities that arose during this period and the potential long-term effects on the future of education.

The article concludes by reflecting on the future of education post-pandemic, suggesting that digital technologies and distance education are likely to play an increasingly prominent role in teaching and learning. Hybrid models of education, combining face-to-face and online learning, may become more common, leading to a reevaluation of traditional educational practices. The authors call for further research to better. Williamson, et.al (2020)

Advancements in Technology

In the article "Machine learning in manufacturing: advantages, challenges, and applications," authors Thorsten Wuest, Daniel Weimer, Christopher Irgens, and Klaus-Dieter Thoben provide a comprehensive analysis of the role of machine learning in modern manufacturing. They discuss the potential benefits, drawbacks, and practical applications of machine learning in manufacturing settings, emphasizing the transformative nature of this technology. This literature review will present an overview of the authors' arguments and situate their work within the broader context of existing research on machine learning and manufacturing.

Machine learning, a subfield of artificial intelligence (AI), has experienced rapid development in recent years, driven by the growing availability of data, increased computing power, and advancements in algorithms. These factors have facilitated the application of machine learning across a wide range of industries, including manufacturing. Wuest et al.'s

article contributes to the growing body of literature that explores the potential of machine learning to revolutionize manufacturing processes and improve productivity, quality, and efficiency.

Also, the authors discuss the challenges associated with integrating machine learning algorithms into existing manufacturing processes and systems. This may involve adapting current workflows, upgrading or modifying equipment, and addressing any organizational resistance to change. Wuest et.al (2016)

In their work, "Growing Opportunities in the Internet of Things," authors provide a comprehensive overview of the potential applications, market growth, and challenges of the Internet of Things (IoT). They discuss various aspects of IoT, including the role of data analytics, emerging business models, and potential barriers to adoption. This academic review will evaluate the authors' work, examining the scope, methodology, contribution to the field, and potential areas for further research. Dahlqvist, F. et.al (2019)

The authors offer a broad and informative exploration of the IoT landscape, covering a wide range of topics, from the technological foundations of IoT to the potential impact on various industries and sectors. The scope of the work is comprehensive, making it a valuable resource for readers interested in understanding the growth potential, opportunities, and challenges associated with IoT.

Impact of Technology

The article by Brynjolfsson and McAfee (2017) provides insights into the potential and limitations of artificial intelligence (AI) for businesses. The authors discuss the evolution of AI, its implications for different industries, and the challenges organizations face in adopting AI technologies. This literature review highlights the key points and findings of their article and connects it to related research in the field.

Brynjolfsson and McAfee (2017) trace the development of AI from its early beginnings to the current era of deep learning and neural networks. They argue that advancements in machine learning, particularly deep learning, have significantly improved the performance of AI systems. This emphasizes the role of deep learning in driving AI breakthroughs and enabling a wide range of applications.

The authors identify several areas where AI has the potential to transform businesses, such as natural language processing, image and speech recognition, and data analysis. They suggest that AI can help companies make better decisions, optimize processes, and create new products and services. This view is echoed by Bughin, et.al. (2019), who discuss AI's potential to drive productivity and generate new business opportunities.

Brynjolfsson and McAfee (2017) also highlight the limitations of AI, emphasizing that it cannot replace human creativity, strategic thinking, and emotional intelligence. They argue that AI systems are still far from achieving human-level general intelligence. This limitation is supported by Marcus (2018), who contends that deep learning struggles with tasks requiring abstract reasoning and common sense.

The authors discuss the challenges organizations face in adopting AI, such as the need for high-quality data, the scarcity of AI talent, and concerns about transparency, fairness, and ethical considerations. Davenport and Ronanki (2018) also highlight these challenges, emphasizing the importance of developing a data-driven culture, reskilling the workforce, and addressing ethical concerns in AI deployment.

Brynjolfsson and McAfee (2017) briefly touch upon the impact of AI on the job market. They assert that while AI might lead to job displacement in some areas, it can also create new opportunities. Arntz, Gregory, and Zierahn (2016) provide a more comprehensive analysis of the potential job market effects, concluding that the risk of job automation varies significantly across countries and industries.

The article by Arntz, Gregory, and Zierahn (2016) investigates the risk of job automation in OECD countries through a comparative analysis. The authors provide a nuanced perspective on the potential impact of automation on employment, focusing on the tasks performed within occupations rather than whole occupations. This literature review highlights the key points and findings of their article and connects it to related research in the field.

The authors use data from the Program for the International Assessment of Adult Competencies (PIAAC) to estimate the risk of automation for jobs in 21 OECD countries. They find that on average, 9% of jobs are at high risk of automation, a lower figure compared to previous studies. Their results are in line with Nedelkoska and Quintini (2018), who also find lower job automation risk when considering task heterogeneity within occupations.

In summary, the article by Arntz, et al. (2016) offers a valuable contribution to the literature on job automation risk by proposing a task-based approach and providing a comparative analysis of OECD countries. Their findings challenge previous estimates of job automation risk and emphasize the importance of considering the heterogeneity of tasks within occupations. The article connects well with other research in the field, highlighting the ongoing debate on the impact of automation on employment and the role of policy interventions in fostering workforce adaptability. Arntz et al. (2016)

The article by West and Allen (2018) explores the ways in which artificial intelligence (AI) is transforming various aspects of the world, from economy and employment to national security and ethics. The authors provide a broad overview of the current state of AI, its potential impacts, and the challenges it presents. This comprehensive review highlights the key points and findings of their article and connects it to related research in the field.

In summary, the article by West and Allen (2018) offers a comprehensive overview of the ways in which AI is transforming the world and the challenges it presents. The authors provide valuable insights into the potential applications and impacts of AI across various sectors, the economic and employment consequences, and the ethical and policy considerations. The article connects well with other research in the field, highlighting the ongoing debate on the opportunities and challenges associated with AI and the importance of addressing them through responsible policy and collaboration.

Human Capital

A plethora of Authors have defined Human Capital from various perspectives and with countless of dimensions. This section of the review will take all of these into consideration and discuss the various definitions in detail.

Mubarik, et.al (2018) defines Human Capital from the angle of an index called the Human Capital index. Their research which was quantitative in nature tears the concept of Human capital apart and gives up to nine different determinants. The Authors found that Human capital cannot in and of itself be defined by just the use of the words but by the effect of many other factors that affect human capital. They concluded that with understanding these factors, A definition of Human Capital can be derived. The major determinants mentioned are experience, skills, education, abilities and training. Additionally, they concluded that a major sub-dimension

are work-related experience and organizational tenure.

Therefore, Human Capital took on the combination of these definitions in the context explained and was concluded to be human beings who have benefited from the accumulation of tacit and explicit knowledge and possess the ability to apply such to add value to the production process of any aspect of a work operation.

In a paper published by Eriksson, et.al (2022), the term Human Capital is again defined in relations to other factors that may affect Human Capital. Somme of these factors include economic growth and innovation.

They examined the theory of economic growth from the traditional sense of increment in the total production of goods and services in the economy. However, they had to give a detailed explanation of the factors that affect such production and the contribution of human capital to these factors and how these concepts contribute to the development of the definition of this concept.

In terms of innovation, they saw it as an important aspect in the development of their theory linking the three. For them, innovation encompassed everything that makes work and life better. They classified fringe benefits, tax incentives, new forms of training, etc. as part of innovative efforts. For them, such efforts are linked to higher productivity and greater output. Eriksson, et.al (2022)

Therefore, Human Capital was defined as the sector of the economy with skills, knowledge and training that are motivated by the right number of incentives to improve economic output and increase growth. Eriksson, et.al (2022)

According to a 2018 World Bank report, Human capital can be defined in terms of knowledge and skills as well as their appertaining benefit to moving a society forward. The report concludes that human capital is a collection of knowledge, skills, ability, and capacity of a people within an economy. World Bank (2018)

Investing in human capital is particularly important in developing countries where access to education, health care, and other basic services is limited. The World Bank has launched a Human Capital Index to measure the amount of human capital that a child born today can expect to attain by age 18, based on the level of education, health, and other factors in their country.

World Bank (2018)

In closing, the World Bank might have brought a slightly different view to the discussion by measuring human capital even from a stage where certain members of the population cannot be involved in the production process of the economy. However, they found a metric to measure how constant development of the capacity of such individuals could make them valuable assets to the economy.

History And Evolution of Human Capital

This section of the review is intended to follow the development of human capital from ancient times to our current dispensation. Accordingly, this part of the review will discuss in-depth the formation of human capital by contextualizing the term and explaining how developed and developing economies pull together and build their human resources to foster economic growth.

Also, the concept of human capital will be discussed in more detail and a study of how human capital was conceived in ancient times would be carried out. Afterwards, there will be a discussion of the contribution of human resources to the industrial revolution, as well as how the revolution impacted human capital. Next, there will be a review of how the world of work especially human capital was reformed after the two major world wars, and that would lead to a discussion of the impact of women on the workforce.

The last parts of this section will focus primarily on the impact of technology on work. Firstly, it will examine the impact of the "dot com boom" on human capital, as well as the new frontiers that have been opened as a result of the information age.

Finally, the section will close with a thorough examination of the knowledge economy and the impact it has on the labor force.

Formation of Human capital

Kousar, et.al (2023) discussed the concept of Human Capital from the perspective of government's intervention in development of skills and the impact from the health sector. By outlining these, the Researchers aimed to examine the roots from which Human capital starts in our modern society. Though it was research conducted with a case study of Pakistan, it is also

useful in an underdeveloped country like Liberia where priorities are so pressing that they compete equally for government's funding.

In order for Human capital to be developed, Governments have to be front and center of the process. They must invest in expansionary fiscal policies that would not just be intended to build more schools, but also more health facilities. These schools have to be intentional in fostering innovative drive of students. If government's funding towards health and education are sustained over time, it is a recipe for the promotion of valuable human capital. Kousar, et.al (2023)

The formation of Human capital does not only involve the building up of skills in the schools but also the setting up of mechanisms to promote competence in the work environment. It is such competence that led to growth in economic productivity. The Digital economy which has pretty much made work different and keeps revolutionizing the way we conduct business has also brought about new ways for human capital to be formed. Kuznetsova, I.G. et.al (2019)

The formation of human capital can therefore be approached from variety of spectrums. Psychologists, Sociologists, and Tech enthusiasts have looked at it from the glance of their respective fields. However, it is safe to say that human capital formation, regardless of approaches only serve the purpose of pulling the knowledge of humans to contribute to development efforts and productivity wherever it is use.

Human Capital During the Industrial Revolution

With an understanding of how Human capital is formed, it is important to know how it has been conceived inn different times and under different circumstances. Therefore, human capital as it was in the industrial revolution is very important to set the basis of this research. Particularly, the first industrial revolution will be looked at with great emphasis. The first industrial is important to examine because this is when production in a large economy like the United Kingdom was heavily subsidized by machine.

The industrial revolution which took place between 1850 to 1900 was able to create new opportunities for in several aspects of the economy. In places like England, it contributed to widening the economic space and creating new frontiers for jobs, education, and training. One very important innovation that marked this period was the invention of the steam engine. Zhao, Z. (2019)

Moreover, the cotton gin was also one major technological advancement. These technological interventions were cardinal to creating new types of jobs. These jobs require skillsets that were specialized and also got rid of many other manual jobs. As a result, individuals and firms invested in education and training to meet the growing demand for skilled workers.

everyone, but this was not the case as it led to the growth of big industrialists, and many younger children and women did not benefit from such change. Zhao, Z. (2019)

What is very inarguable is the first industrial revolution led to generations of technological advancement.

Human Capital and the Dot Com Boom

The late 1990s and early 2000s dot-com boom saw the IT sector see unprecedented expansion and innovation. The introduction of new businesses and the quick expansion of old ones during this time period resulted in a rise in the demand for skilled laborers in industries like software engineering, web development, and digital marketing. Using peer-reviewed studies that were released during the last five years as a source, I will analyze how the dot-com boom affected human capital in this review. Tang & Bayus (2019)

With the promise of high pay and stock options, the tech industry attracted a lot of individuals who later found themselves unemployed when the bubble broke. As a result, many workers were compelled to accept lower-paying positions or quit the business completely, which caused the value of human capital in the tech sector to significantly fall. Tang & Bayus (2019)

The dot-com boom significantly improved the human capital of employees in the IT sector, resulting in higher productivity and more innovation. They point out that the increase in the need for skilled laborers during this time helped draw bright people to the sector and prompted the creation of new training and educational initiatives to aid employees in acquiring the skills they required to thrive. Soytas & Atesagaoglu (2018)

Human capital has been significantly affected by the dot-com boom, particularly in the IT sector. Because of the boom, there was an apparent increase in the need for highly qualified personnel, which spurred pay increases and a move toward more educated individuals. The collapse that came following the boom, however, had a conflicting effect on women's human

capital in the sector, displaying the difficulties that may occur during periods of fast technological change. Hu & Lu (2018)

Industry 4.0

It is important to discuss how the fourth industrial revolution has affected the current labor force. It is significant because after reviewing on detail the development of Human Capital and its changes over time, it's current position must be examined.

Consequently, The Fourth Industrial Revolution, or Industry 4.0, is the moniker that describes the assimilation of cutting-edge technologies like AI, the Internet of Things (IoT), robots, and data analytics to alter manufacturing and other industries.

With a summary of these concepts, it is important to state that this period is marking major changes around the world. The Internet of Things, computers, big data, additive manufacturing, autonomous robotics, cybersecurity, augmented reality, and simulation technologies are all components of Industry 4.0. These are the primary drivers of automation and digitalization. Meanwhile, the implementation of these technologies has resulted in the transformation of a dynamic production environment, lowering costs while enhancing operational efficiency, quality, customization, and productivity. Its design principles, on the other hand, are as follows: visualization, decentralization, interoperability, real-time capabilities, service orientation, and modularity. In the transition to Industry 4.0, these design concepts serve as a foundation for systematic understanding of "how to do" phenomena. Hajoary, P. (2023)

The incorporation of Industry 4.0 technologies (I 4.0 T) and the resulting digitalization raises the need for technology adaptation in manufacturing plants, which has strong territorial effects due to technological constraints associated with the adaptation process itself and which often results in relocating jobs back to Western countries. Bilbao-Ubillos et.al (2023)

With the integration of digital technology in the way firms make, enhance, and distribute their goods, Industry 4.0 (I4.0) is altering the world's industrial ecosystem. However, most industrial businesses frequently struggle to incorporate these technologies into their organizational units owing to a lack of Industry 4.0 readiness, and evaluation of current systems, processes, and practices. On the other hand, using Industry 4.0 readiness measurements, it is feasible to analyze the existing state of the organization in order to integrate and assist them in migrating to an Industry 4.0 fully prepared company. Hajoary, P. (2023)

Disruptive Innovation has the potential to have a significant impact on the job market. It is critical to recognize that the changes brought by the industrial revolution are having a major impact on employment and labor productivity, thus affecting the overall development of society. It also can potentially put less qualified individuals at risk, but they may also bring new job qualification requirements. Those who wish to excel in society will need to retrain and increase their education. Vrchota, et.al. (2020)

The Knowledge Economy

A knowledge economy, as defined by the Organization for Economic Cooperation and Development (OECD), is "an economy that recognizes that knowledge and information constitute key drivers of growth, productivity, and competitiveness in every sector." (OECD, 2017)

The concept of human capital has developed over many centuries, but it wasn't until the 1960s that it became a well-established theory in the Western world. Human capital theory has made significant contributions to both economics and culture, and it emerged from studies on human behavior and economic development in the Western world.

Before the emergence of human capital theory, physical resources were considered the primary determinant of economic development in Western nations. However, with the establishment of the school of human relations, the focus shifted to the importance of human capital. This shift in emphasis drew increasing attention from both theoretical and industrial viewpoints. As a result, human capital conceptualization and theorization have gained popularity and become a triumphant topic in Western nations. There has also been an increase in research output on human capital and related topics. Overall, the evolution of human capital concepts has played a crucial role in shaping our understanding of economics and the importance of investing in human development. Human capital categorization and theorization have been pushed and triumphed in Western nations, and the research outputs of human capital and associated theories have made significant contributions to social, economic, and corporate growth. Zhao, S. (2008)

With the advent of endogenous growth theory in the 1990s, knowledge has come to be seen as the primary economic asset of industrialized nations. This new method of defining the link between knowledge and the economy is reflected in global policy rhetoric and national

growth strategies. On the one hand, education investment is increasingly considered as critical to future competitiveness in a globalized and computerized world. On the other hand, the imperatives of obtaining global market share indicate that education policy must move to an emphasis on skills that provide the most 'value for money'--for both individual students and society. Yarrow, D. (2022)

Latest research has indicated that economies that tap into knowledge skills tend to enjoy more development in their economies, as evidenced in the quality of their goods, output, and innovation results. This is consistent with Solow's finding and Romer's statement that knowledge capital may be used to accelerate economic growth and development. Oluwatobi, et.al. (2020)

To conclude, the knowledge economy has gained considerable traction over the past years. This traction has spread from the West to the Global South. With more investments in education and rewards for innovation, it will take a while to understand the true impact of the knowledge economy in Africa.

Trends In Human Capital Development

Human capital development refers to the process of investing in and improving the knowledge, skills, abilities, and talents of individuals to increase their productivity, effectiveness, and overall contribution to an organization or society. OECD (2018)

The integration of digital technology into almost every industry and workplace, commonly referred to as "digitalization," has significantly transformed the American economy and the nature of work in recent years. This widespread adoption of digital technology has provided tremendous opportunities for individuals, businesses, and society as a whole, while also exposing a range of complex challenges and inequalities. These issues include disparities in wages across different demographic groups and variations in urban economic growth and development. Therefore, while the digitalization of everything has expanded the potential of the economy, it has also brought about unintended consequences and imbalances that require attention and solutions. Carnevale & Smith (2017)

Today's industry highly values workers who possess advanced digital skills to develop and exchange ideas and information. The current state of global competition, ubiquitous technology, and the internet suggests that the 21st-century economy will present novel

challenges to the workforce. The rapid pace of digital transformation means that almost all professions require some level of digital proficiency, as well as engagement in society. Due to the widespread availability of ICT in organizations, digital skills expected of workers surpass basic practical ICT abilities. In the 21st century, knowledge creation plays a pivotal role, and as a result, employers increasingly seek highly skilled knowledge workers who generate and disseminate information and ideas, rather than producing goods or services. van Laar, E. (2019)

The change of manufacturing operations is being shaped by new digital technology. This transformation is characterized by increasing digitalization, interconnectivity, and automation. However, the transmission of new technology is highly unequal, and enterprises exhibit varying adoption behaviors. It is difficult to separate the talents that drive innovation from those that are required as a result of the change brought about by innovation. It is still conceivable to question whether skill sets are better suited for the adoption of new digital technologies as part of firm-specific plans. Firms must anticipate skill requirements in order to prepare for specific technology choices, and their technology options are constrained by path-dependent human capital endowments. Firms that choose to digitize all or part of their business may analyze their position in the supply chain and discover an opportunity for productivity increases. Cirillo, et. al (2023)

To conclude, Digital skills are very highly needed in today's employment market. It has surely become the most important set of skills needed to produce on a large or small scale.

Lifelong learning is the continuous process of acquiring information and skills throughout one's life, frequently beyond traditional schooling or formal education. It can encompass both official and informal learning activities and can take place in a range of settings, such as the workplace, community groups, and personal hobbies. The purpose of lifelong learning is to continue to develop and better oneself, both personally and professionally. Field, J. (2017)

Throughout their lives, humans and animals may constantly learn, fine-tune, and impart information and talents. This capacity, known as lifelong learning, is mediated by a diverse set of brain systems that work together to build and specialize our sensorimotor abilities, as well as to consolidate and retrieve long-term memory. As a result, skills for lifetime learning are critical for computational learning systems and autonomous agents interacting in the real world and

processing continuous streams of information. However, lifetime learning has long been a problem for machine learning and neural network models since the continuous acquisition of gradually accessible information from non-stationary data distributions usually results in catastrophic forgetting or interference. Parisi, G. et.al (2019)

Human behavior underpinning learning and work is increasingly mediated by technology as businesses and educational environments continue to digitalize. Lifelong learning is a critical component of active citizenship and social inclusion. The evolution of artificial intelligence (AI) and its incorporation into daily technology affects how humans interact, learn, and make decisions. Poquet & de Laat (2021)

Other countries like Singapore have made great strides to implement policies that foster lifelong learning. Singapore has been recognized by the OECD as a poster child for life-long education. Many countries' policies on lifelong learning have come and gone during the previous few decades. Much of the policy experience in lifetime learning has been unsuccessful or has slipped in and out of policy conversations undetected. Adult education and workforce development policies have a long history in Singapore. Workforce training has arguably always been an important aspect of Singapore's nation-building and economic growth plan. Sung & Freebody (2017)

The COVID-19 epidemic has pushed many people to work from home, and the extent of the move to remote work is astounding. Prior to the epidemic, around 15% of US employees worked from home at least part of the time. During the first part of April, half of all employees in the United States worked entirely from home. This fast transition has brought to light difficulties with remote work that may have gone unnoticed when the practice was more limited in scope. Sull, et. al (2020)

Working from home (WFH) has become the new method of working for millions of employees in the EU and throughout the world as a result of the COVID-19 pandemic. Because of the epidemic, many workers and companies were forced to transition to remote work for the first time, without any preparedness. According to early Eurofound estimates, about 50% of Europeans worked from home (at least partially) owing to the pandemic, up from 12% previous to the disaster. These figures are currently around the same, with many employees and businesses probably choosing for WFH even after the epidemic. To slow the spread of the virus,

Italy promptly implemented home confinement regulations, which were repeated for many months in the spring of 2020 and are still in effect as of this writing. Galanti, T. (2021)

In order for organizations to be more effective in managing remote workers, they must master remote management skills. Some of what is needed to do this are to maintain a transparent, frequent, and consistent communication environment, provide support for physical and mental health, help employees stay productive and engaged, and don't lose track of strategic priorities. Sull, et. al (2020)

To combat these obstacles and become more competitive, companies attempt to develop innovative methods to become more flexible, rentable, and financially viable. Technology has been identified as a critical facilitator for huge virtual cooperation, which has showed promise for both advancing sciences and changing the disadvantages of virtually into strategic benefits while also enabling rigorous scientific findings. As a result, corporations have begun to look for new paradigms and solutions, such as remote work (RW), which allows them to be geographically free. Globalization, industry informatization, and government legislative assistance have all contributed to RW acceptance. Furthermore, in the current setting of the COVID-19 epidemic, practically every company must rely on remote teams. Ferreira, R. et. al (2021)

To conclude, working remotely demands a unique skill set that differs from that required in a traditional office setting. Remote employment requires effective communication, time management, self-motivation, technological competency, and the capacity to be adaptive and flexible. Employers should prioritize these abilities when hiring remote workers, and individuals should aim to acquire them so that they can succeed in a remote work environment.

Teamwork, a notion commonly seen on motivational posters and workplace walls, is easy to detect but difficult to describe and even more difficult to foster. Teamwork is defined as the joint efforts of team members to achieve task objectives. It includes acts that translate individual contributions into collective results, such as team effectiveness and satisfaction. Driskell, J. et. al (2018)

Pelinescu, E (2015) examines the crucial relationship between human capital and economic growth. Her article investigates the multifaceted ways in which investments in human

capital, including education, skills development, and health, contribute to economic growth and overall prosperity.

The study emphasizes the importance of policy interventions to foster human capital development and promote economic growth. Pelinescu suggests that governments should prioritize investments in education, skills development programs, and healthcare infrastructure. Policies aimed at improving access to quality education, lifelong learning opportunities, and healthcare services can enhance human capital, boost productivity, and stimulate economic growth. Pelinescu, E. (2015)

The Modern Trends of Human Capital

Green energy has been the go-to solution for the current climate challenges plaguing the world. However, it is only imperative to examine pieces of research that put this in context and provide a prediction of the future of green energy and how climate change will impact this future. The most vicious impact of the change in climate patterns is felt through rising temperatures or heatwaves called global warming. Ahmed, (2020) It cannot be overstated the impact that such shift in climate patterns will have on the workforce and the appertaining effects on technologists to craft a way around this menace and continue productivity. Dietz et al, (2020)

Climate change has sparked significant concern throughout the world. According to research conducted by Lu et al., (2019), Global warming has captivated the interest of most people around the globe due to the casualty it has cause us directly, and indirectly. Importantly, it has also had an impact on the social and economic growth of a great number of nations, and it has done so in the most audacious manner conceivable. The researchers used a trans-log production function model to carry out their study. The conclusion drew attention to the fact that the adverse effects of climate change on the economy as well as the absolute value of the production elasticity of the border were eliminated as a result of increased rainfall and a decrease in temperature. (Lu et al, 2019)

One of the ways climate change fits into the conversation surrounding electric cars is the impact of smoke caused by natural gas on the environment. The production of these electric vehicles has led to the development of mega-factories with updated technologies. The technology used are groundbreaking and more efficient than previous technologies. A study done

by Wood & Roelich, (2019) concluded that the benefits of intensive energy use and production (mostly, fossil fuels derived energy) can have negative impacts on well-being attainment globally. The endgame of greenhouse gases (GHGs) from the overuse of fossil fuel-derived energy, the current changes in the climate will have and also continue to have climate massive and substantial, converse global well-being effects. Wood & Roelich, (2019)

Other studies have corroborated the previous studies by speaking more directly about the impact of electricity on the future and the present. Environmentally friendly production sites, especially have been used or made in recent years to aid in dealing with the ever-growing concerning environmental woes in China. Qiao et al., (2019).

Relationship Between Technology and Human Capital

The article by Brynjolfsson, et.al. (2018) addresses the productivity paradox in the context of artificial intelligence (AI), highlighting the discrepancy between the expectations surrounding AI's potential and the observable productivity statistics. The authors propose four potential explanations for this paradox and provide insights into future productivity growth. This literature review outlines the key points of their work and connects it to related research in the field.

The authors discuss the productivity paradox, which refers to the apparent contradiction between the rapid advancements in AI and other digital technologies and the relatively slow growth of productivity observed in macroeconomic data. They note that this phenomenon has historical precedents, such as the slow productivity growth during the early years of the computer revolution. This perspective is supported by Solow (1987), who famously stated, "You can see the computer age everywhere but in the productivity statistics."

Brynjolfsson, et. al. (2018) suggests that resolving the productivity paradox will require addressing these four explanations. They argue that as measurement techniques improve, implementation lags are reduced, redistribution effects are mitigated, and complementary innovations are developed, the productivity growth from AI and digital technologies may accelerate. This perspective is supported by Mokyr et al. (2015), who discuss the potential for technology-driven productivity growth in the long run.

In summary, the article by Brynjolfsson, et. al. (2018) offers a comprehensive analysis of the productivity paradox in the context of AI, providing valuable insights into the possible explanations for the observed discrepancy between expectations and productivity statistics. The authors' framework for understanding the productivity paradox connects well with other research in the field, shedding light on the challenges and opportunities associated with the ongoing AI revolution and the potential for future productivity growth.

"The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis" by Antz, M. et.al (2016) is a pioneering paper that delves into the profound impact of automation on jobs in OECD countries. The authors undertake a comparative analysis, combining existing studies and employing a meticulous methodology to present a comprehensive overview of the potential risks and implications of automation.

The paper begins by acknowledging the growing concern regarding the displacement of human labor due to rapid technological advancements. It acknowledges the need for empirical evidence to evaluate the actual scale and nature of this risk, thereby providing policymakers and researchers with a solid foundation for informed decision-making.

Arntz, Gregory, and Zierahn expertly gather data from a wide range of sources, including national labor force surveys and occupational classification systems. They utilize a novel approach, namely the task-based framework, which enables a granular assessment of occupations based on their susceptibility to automation. This methodological innovation sets their study apart, providing a more nuanced understanding of the potential impacts.

The authors effectively present their findings by outlining the potential risk of job automation at the aggregate level, dissecting the data for various OECD countries, and categorizing occupations based on their vulnerability. They highlight that a considerable proportion of jobs face a high risk of automation, particularly those involving routine and manual tasks. This nuanced analysis helps dispel common misconceptions and reveals that the risk is not uniform across all occupations or countries.

Furthermore, the paper addresses important implications for workers and policymakers. It emphasizes that the automation risk may vary across different skill levels, thereby underlining the need for targeted policies to support those at higher risk of job

displacement. The authors also discuss the potential for skill substitution and argue that adapting to technological change is crucial for individuals to remain employable in the future.

One commendable aspect of this paper is its comprehensive scope, which covers a wide range of OECD countries. By providing an international perspective, the authors effectively highlight the varying levels of automation risk across different regions, shedding light on the factors that contribute to these disparities.

While the paper is an invaluable contribution to the literature, it is important to note that it was published in 2016, and technological advancements have since continued to evolve rapidly. Therefore, it would be beneficial to consider more recent studies that can provide insights into the current state of automation risk and its implications.

In conclusion, "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis" by Arntz, Gregory, and Zierahn is an exceptional piece of research. The authors successfully navigate the complexities of automation and its potential impact on jobs, presenting a comprehensive analysis that considers the varying risks across occupations and countries. This paper serves as an essential resource for policymakers, researchers, and anyone interested in understanding the implications of automation on the labor market. Arntz, M. et.al (2016)

In the article "Where Machines Could Replace Humans—and Where They Can't (Yet)," published in McKinsey Quarterly in 2016, authors Michael Chui, James Manyika, and Mehdi Miremadi explore the potential impact of automation on various occupations and industries. The authors aim to provide insights on the future of work and the role of technology in shaping the labor market. Chui, M., et.al (2016)

The study is based on a detailed analysis of more than 2,000 work activities across 800 occupations in the United States. Using a framework that assesses the technical feasibility of automating these activities, the authors highlight the potential for automation to transform the workforce. They find that approximately 45% of work activities could be automated using current technologies, with an additional 13% potentially automatable as technology advances.

One of the key contributions of the article is its focus on work activities rather than entire occupations. This approach allows for a more nuanced understanding of the impact of

automation, as it highlights that most jobs will see a mix of tasks being automated rather than entire roles being replaced. The authors argue that this perspective is crucial for policymakers and business leaders to make informed decisions about workforce development and investments in technology.

The authors also provide a sector-wise analysis of the potential for automation. They find that automation is likely to have the most significant impact on manufacturing, accommodation and food services, and retail trade. However, they also note that the potential for automation varies significantly within each industry, depending on the nature of the tasks performed.

Furthermore, the article emphasizes that the potential for automation does not necessarily translate to immediate job losses, as other factors such as labor costs, regulatory environment, and social acceptance may influence the actual implementation of automation technologies. The authors also discuss the need for retraining and reskilling the workforce to adapt to the changing labor market.

"Where Machines Could Replace Humans—and Where They Can't (Yet)" is a thought-provoking and insightful article that provides valuable information for understanding the potential impact of automation on employment. The authors' focus on work activities rather than entire occupations, as well as their consideration of various factors influencing the implementation of automation technologies, makes this article a must-read for policymakers, business leaders, and researchers interested in the future of work and the role of technology in shaping the labor market. Chui, M., et.al. (2016)

"The Future of Jobs Report 2018," published by the World Economic Forum (WEF), is a comprehensive examination of the emerging contours of the global labor market in the context of the Fourth Industrial Revolution. This report, drawing on the insights from a variety of industries and geographies, presents a far-reaching look at the future employment landscape, with an emphasis on how technology, and specifically automation and artificial intelligence, will transform work and workplaces.

One key finding is the dual narrative of job displacement due to automation and job creation because of innovation. The WEF estimates that by 2025, about 75 million jobs may

be displaced due to the shift in the division of labor between humans and machines, while 133 million new roles may emerge. This underlines the report's central theme that the net effect of automation may be positive, but the transition could be challenging.

The report also underscores the urgent need for large-scale upskilling and reskilling, as more than half of all employees will require significant re- and upskilling by 2022. The onus of this challenge, the report suggests, is on multiple stakeholders, including governments, companies, and individuals themselves.

The "Future of Jobs Report 2020" also sheds light on persistent gender disparities in the workplace and the risk of women missing out on opportunities in emerging roles. It advocates for proactive measures to ensure gender parity in the future of work.

The report stands out in its rigor, breadth, and depth. It is an invaluable resource for policymakers, educators, business leaders, and workers. Its insights, while at times disquieting, offer a roadmap for navigating the changing landscape of work. The report underscores the importance of proactive and collaborative efforts by all stakeholders to manage the transition and ensure an inclusive and resilient labor market. WEF (2020)

Laddha et al. (2023) utilizes a rigorous methodological approach, employing both panel and cross-sectional data analyses. This dual approach enables a more comprehensive understanding of the influence of ICT on labor productivity, as it captures the temporal and spatial effects. The authors sourced data from the World Bank and International Telecommunication Union, enhancing the credibility and reliability of the study. These databases provide a comprehensive global perspective on ICT adoption and labor productivity, enabling an inclusive and diversified investigation.

In summary, Laddha et al. (2023) provides a comprehensive analysis of the impact of ICT on labor productivity. Their robust methodology, insightful findings, and important policy implications make a significant contribution to the literature. Their work extends the understanding of the digital divide and highlights areas for future research. The study is a valuable resource for policymakers and researchers interested in the intersection of ICT and labor productivity.

Acemoglu, D (2023) propose a "tasks framework" that distinguishes between two types of technologies: automation technology, which replaces labor in tasks it was performing, and task-creating technology, which introduces new tasks in which labor has a comparative advantage. This framework is a distinct departure from the standard labor- economics view that focuses on the skill-biased technical change (SBTC), which posits that technology tends to favor skilled over unskilled labor.

Their approach resonates with the earlier works of Autor, Levy, and Murnane (2003), who conceptualized work as a bundle of tasks and showed how computers substitute for workers in routine tasks while complementing them in non-routine ones. Acemoglu, however, move beyond this dichotomy to consider the introduction of entirely new tasks.

The authors argue that the primary impact of automation on labor markets is displacement, but this can be offset by the creation of new tasks. They assert that recent slowdowns in labor demand across advanced economies can be traced to an imbalance between automation and new task creation.

In line with Brynjolfsson and McAfee's (2014) work on the "great decoupling" - the divergence of productivity and employment - Acemoglu and Restrepo propose that the current wave of automation has been less beneficial in creating new tasks, leading to labor displacement and stagnating wages.

Acemoglu and Restrepo's work carries significant policy and societal implications. If the authors' assertion about the imbalance between automation and new task creation holds, policymakers and businesses should consider fostering environments conducive to the development and adoption of task-creating technologies.

Acemoglu (2023) offers a novel perspective on the impact of technology on labor markets. By introducing the "tasks framework," they advance our understanding of how the interplay between automation and task creation affects labor demand. While their work is a significant contribution to the literature, it opens up new avenues for research into the nature of new tasks and how best to facilitate their creation. As such, their paper serves as a critical resource for scholars, policymakers, and businesses navigating the dynamics of automation in the labor market.

Shahnazi, R. (2023) paper "Do information and communications technology spillovers affect labor productivity?" explores the relationship between Information and Communication Technology (ICT) spillovers and labor productivity. This paper is a crucial contribution to the ongoing discourse on the impacts of ICT on labor markets, with a unique focus on the concept of ICT spillovers. This review will delve into the research's methodology, main findings, implications, and its place within the broader literature on ICT and labor productivity.

Shahnazi (2023) finds that ICT spillovers do indeed have a significant positive effect on labor productivity. This effect is particularly pronounced in sectors that are already heavily digitalized. However, the benefits are not uniformly distributed across different countries and sectors, suggesting a potential digital divide.

The findings of Shahnazi carry substantial policy implications. To maximize the benefits of ICT spillovers, policymakers should promote ICT adoption across all sectors and support the diffusion of ICT usage from digitally advanced sectors to less digitalized ones.

In summary, Shahnazi's (2023) paper, "Do information and communications technology spillovers affect labor productivity?" makes a significant contribution to the literature on ICT and labor productivity. The paper's methodological rigor, innovative focus on ICT spillovers, and insightful findings make it a valuable resource for researchers and policymakers interested in ICT's impacts on the labor market. Despite leaving some questions unanswered, the paper significantly enhances our understanding of ICT spillovers and their role in shaping labor productivity.

The review of the literature highlighted several factors. The first of these factors is that many researchers agree that technology has been very pervasive in the past year. Technological advancement has entered the world of work and led to many changes in the way we work.

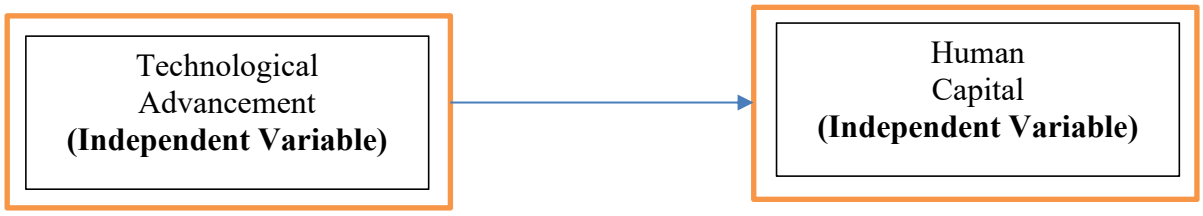
Theoretical Framework:

After a careful review of the different literature that have set the foundation for this work. A model was designed and drawn. The conclusion is that there are two variables controlling this research. The independent variable and a dependent variable. The independent variable is technological change while the dependent variable is human capital. One study that further justifies the design of this model is Maqbool & Shafique (2014) where they linked technological

advancements to human capital performance. In their research, even when variables like motivation and training were held as dependent variables, it was still observed that technological advancement impacted the two and where there was an improvement in technology, there was willingness of the employees to work better and even learn more. Abass et. Al (2014) corroborates this conclusion by going further to indicate that investment in new technology leads to a competitive company which is a product of high employee productivity.

Additionally, other studies including Maqbool & Shafique (2014) agrees that technological advancement affects training. They also stated further that even when technology advanced, training was seen to be needed. Finally, Elnaga and Imran (2013) agreed that the paramount objective of any training section is to add value to the performance of employees. Training of employees was seen to be a continuous endeavor.

Hence, these studies have informed the decision to create a model below where Technological advancement is the independent variable and Human capital is the dependent.



Hypothesis:

The hypothesis of this research is given below: The main Hypothesis:

"The advancement in technology will have a positive significant impact on Human Capital."

CHAPTER III
METHODS/METHODOLOGY

Design

This study was purposedly carried out to understand how valuable human capital still is to manufacturing companies. With technology taking over the world of work and dictating the way in which we conduct business, it is important to know how such advancement has affected manufacturing firms. This is particularly important because when the evasive effects of technology are discussed, it is not very often that manufacturing work are considered. Given that we still depend on the manufacturing sector around the world for the production of valuable goods and also for the employment of many workers, it was very important that stakeholders like government, business leaders, ordinary workers and Academics understand how new technological advancements are affecting the manufacturing sectors.

This study was carried out using a correlative research method, the study used descriptive data like frequency tables to present and analyze the demographic variables. For the research questions, it was discussed based on the findings from the analysis of the mean values and standard deviation of questions on the scale that measured them. For the hypothesis, a linear regression analysis was used to analyze it. Savovi & Babic (2021) The sample in the study came from employees of the following companies: The Liberia Cement Corporation (CEMENCO), Jetty Steel, Inc, Sethi Brothers, Inc., Atlantic Foods, Inc., and National Toiletries Inc. These companies constitute the major manufacturing companies in Liberia.

Sampling and Sampling Size

In terms of the study population, they consisted of employees who worked at The Liberia Cement Corporation (CEMENCO), Jetty Steel, Inc, Sethi Brothers, Inc., Atlantic Foods, Inc., and National Toiletries Inc. who carry out their functions at these companies' plants in Monrovia. The reason these companies were selected was because they made up the major manufacturing companies in Liberia. They have been in existence for over five years and employ many Liberians. Liberia being a country in the Global South where data about companies' finances and employee number can be a hard thing to come by, the researcher had to contact Human Resources Personnels in each of these companies to get the data on their employees.

After this tedious fact-finding process which took place between the 3rd of January to the 14th February, 2023, it was the conclusion of the researcher that these companies collectively employed 713 employees. Since this was the conclusion on the Population of the Study, the sample size was 250 with a confidence level of 95%, a margin of error of 5%, and a population proportion of 50%. Savovi & Babic (2021) The Participants of the study were chosen through a convenience sampling method.

Data Collection Procedures

In order to collect the data of the study, the participants of the study were chosen through a convenience sampling method. Due to the fact that the Researcher is in the Turkish Republic of Northern Cyprus and the study participants were in the Republic of Liberia, the Researcher had to ask for permission from Human Resources Personnels to allow the premises of their Headquarters to be used for the data collection process of this Research. After they have agreed, a Researcher based in Liberia was trained between the 3rd and 17th of April about the research questions. The researcher was trained on the confidentiality involved in the collection of the data. Additionally, the researcher was trained as to the structure of the questions and to answer questions that may arise as a result of the questionnaire. The Questionnaire was answered on the spot as it was distributed and nobody was pressured into participating in the study. This process of the distribution of questionnaire for participants to answer the questions began on the 22nd of May and was completed on the 5th of June. At the completion of the process of data collection, the questionnaires were received and the process of analysis started.

Materials

The material used for this research was a questionnaire. The Questionnaire consisted of three different parts. The first part included the demographic variable. These questions began by asking the participants for their age range. This category included age that ranged from 18 to over 60 years old. The next set of question sought to know the Gender of the respondents and the two questions following this was intended to know the experience level of the Participants. These two questions asked for the Participant's experience in terms of the particular company they worked for and also their experience in the industry with which they currently work.

The next part of the questionnaire was intended to measure the independent variable (Technological Change) and the Dependent Variable (Human Capital). In these parts, two scales were used. The first part that measure the Independent Variable was referred to as the

"Technology Use" scale. This scale was adapted from Karsh (2018). It consisted of seven questions. These questions were carefully crafted to understand how effective is the use of technology in these companies. The first of these seven questions stated, "New Technology are contributing to making products better", the second stated, "The use of technology reduces production time and increases production outputs", for the third, it asked, "the company has been successful in regularly altering or modifying the design of its products", the fourth question asked, "The Improvement in technology has led to the diminishing of certain huma-conducted tasks" and for the fifth and sixth questions, they stated "The Improvement in technology within or outside the company increased the need for hiring employees with skill-sets not sort after i10 years ago", "Further technological advancement in the company will lead to redundancy of certain employees" respectively. Finally, the last question stated, "Changes in information technology made work easier and allowed me to perform tasks better than usual". These questions were able to understand from these employees how their work has changed as new forms of technological innovation were applied.

For the second Scale called "Human Capital" scale which was about measuring the dependent variable, four questions were asked. These questions were adapted from Al-tit, et.al (2022). The questions on this scale were meant to understand how human capital is impacted within the organization. These questions began with "I have the skills and capacity to perform my duties at work efficiently and effectively". The second question was "with every marginal increase in my work experience, I have increased my skills". The third question was "In every capacity I served in this organization, I have made valuable suggestion that has improved the company". Lastly, the final question was "My Supervisors/Superiors have appreciated my contributions to the company".

For the scales that measured the Independent Variable and the Dependent Variable, all of the questions were measured on a five-point Likert scale. On this Scale, 1 was equal to Strongly dis-agree while 5 was equal to strongly agree. For the others, two was equal to disagree and 4 was equal to agree. Lastly, three was regarded as neutral.

Data Analysis Procedures

In the analysis of the data, the principal tool used was the statistical packages for social science (SPSS). The SPSS software was used to analyze all of the data that was collected.

The first step of this process included imputing the data that was collected into the Statistical Packages for Social Sciences (SPSS) software. The first section of the questionnaire was the demographic variable that asked about the age, gender, and experience of the Respondents. This section of the work was analyzed using the results from the frequency tables. This process included analyzing the number of respondents from each of the various age groups. Afterwards, the same frequency analysis was done for the experience levels of the various respondents.

The second part of the questionnaire was coded as "T_U" for technology use on the SPSS software. The last part of the questionnaire was coded in the software as "H_C". This section measured how Human capital is impacted by factors like technology. This section consisted of four questions.

In order to draw a comprehensive analysis of these two variables, several tests were done and these tests would be discussed in the order in which they were done.

The first set of analysis carried out was the descriptive analysis. The descriptive analysis was done on the two scales; that is the "technology use" scale and the "human capital" scale separately. This tables generated that were used to analyze the variables contained the mean of each question or item in the scale while also including their standard deviation. This section of the questionnaire consisted of seven questions.

The both scales together had eleven questions. The Technology Use scale had seven questions, while the Human Capital scale four questions. They were firstly analyzed by ascertaining their Cronbach Alpha scores. The Cronbach Alpha test was carried out purposedly for the sake of assessing the reliability of the scale. When it was determined the score of the Cronbach Alpha was acceptable for this scale, meaning it was reliable. The next process started.

This next process involved the implementation of the Pearson Correlation Test. This test was done to understand the correlation of the two scales. The intent was to know if the both scales measured the same constructs properly. This test was carried out with the scale that measured the independent variable and the Dependent variable. The result proved that the two variables were perfectly correlated.

After the Cronbach Alpha and Pearson Correlation tests were conducted, the analysis

progressed to the stage where the Hypothesis Test was carried out. The main Hypothesis in this study was that "Technological Advancement has Significant Impact on Human Capital". In order to test the hypothesis of the study, a linear regression analysis was done. This analysis resulted in the presentation of three tables, namely; the model summary table that showed a summary of the fit of the model. This included the R value which showed the strength of the relationship between the two variables. Other major elements of the table were the R-square and the Adjusted R-square. These were important in understanding the proportion of the variance in the dependent variable that can be predicted by the independent variable. On the other hand, the adjusted R-square looks specifically at the number of variables that can be predicted by the independent variable. The next table presented at the end of this analysis was the ANOVA table. This is short for Analysis of Variance table. This table was particularly important in the test of the Hypothesis because it tested the significance level of the model. Its main element was the significance(sig). Finally, the last table in the process of testing the hypothesis was the Coefficients table. This table was important because it provided the necessary details needed to understand how each predictor in the model worked.

Finally, it was as a result of these analysis that the research questions were answered and the discussion of the study was done. Fox et.al. (2009)

Ethical Considerations

First of all, this research was meant only for educational purposes. In order to protect the identity of the participants, the research Questionnaires were labelled with numbers to identify each of the questionnaire that was used for the study. So, the Researcher did not collect the names of any of the Participants in the Study. Additionally, the researcher made sure that no unauthorized person had any access to the data that was collected.

The subjects of the research were approached individually and nobody was compelled against his/her will. Moreover, the researcher had intended to use the data as received and did not use any false or fabricated data.

CHAPTER IV

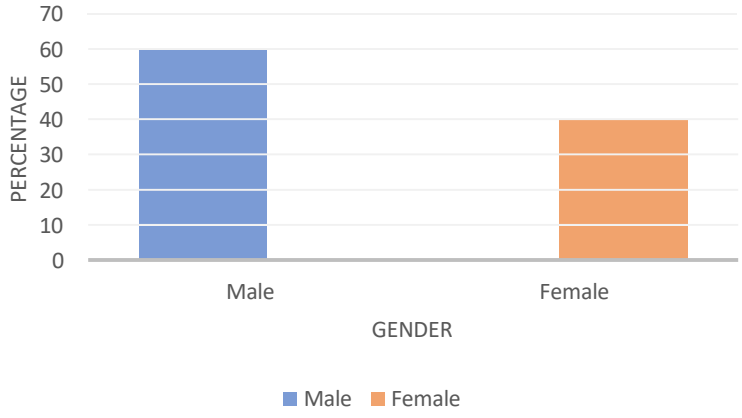
FINDINGS

The research was carried out by distributing a total of 260 Questionnaires. However, of these 260 Questionnaires sent out, 248 were returned constituting a response rate of 95.38%. These Questionnaires were distributed among some employees of Liberia Cement Corporation (CEMENCO), Jetty Steel, Inc, Sethi Brothers, Inc., Atlantic Foods, Inc., and National Toiletries Inc. As Figure 1 indicates, in terms of the demographics of the respondents, 153 persons, or 61.7 percent of them were male while the other 95 persons constituting 38.5 percent of the Respondents were females as indicated in Figure 1.

To study and conclude this research, a questionnaire was adapted. This questionnaire consisted of three parts. The first part which was the demographic variable is the current theme of this result. The questionnaires were subsequently sent out to employees of the Liberia Cement Corporation (CEMENCO), Jetty Steel, Inc, Sethi Brothers, Inc., Atlantic Foods, Inc., and National Toiletries Inc. Of the 260 Questionnaires that were sent out, 248 were received in completed. This means the research questionnaires had a response rate of 95.38%.

Figure 1

Gender of Participants



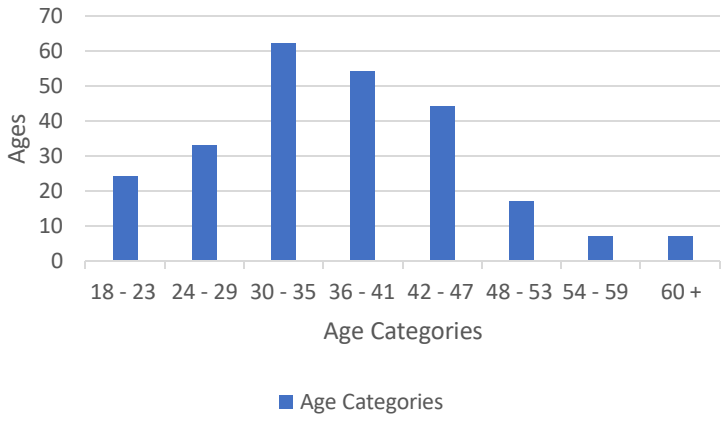
Note: Number of Males = 153, Number of Females = 95, total N= 248

The ages of the respondents were grouped on an ordinal scale that included eight categories. The first category included ages 18 – 23 years while the last category included ages 60 and above. In Figure 2, the results of the descriptive analysis showed that the participants of the study cut across all 8 age group categories of the study population. The range of 7 proves that the study has a high age diversity. With this result, the generalizability of the study is enhanced across different age cohorts. This generalizability is proof that the study's participants come from different generations that have experienced technology's advancements in their respective fields over different period of time. For instance, responses of people who might have worked before the 2000's and those who started working in the 2010's gave insight into how technology has impacted the world work across multiple generations.

To conclude, the standard deviation was equal to 1.654. This goes on once more to reinforce the point of the generalizability of the participants of the study. With such a broad distribution of the ages among the study participants, there is a considerably wide range for the analysis and also a reinforcement of the point that the study participants are very diverse in terms of age.

Figure 2

Ages of the Respondents



In addition to the age of the participants, the Questionnaire also asked for the number of years of experience in their industry as indicated in Table 1 and the number of years of experience in their respective companies as is also indicated in Table 2. The significance of this particular question was principally for understanding how experienced the participants were in their field. Since the study was intended to understand the impact of new technology, a dataset

that included responses from people who have worked in their fields over several years was very important. It added valuable substance to the research because of the diversity of knowledge that the different participants brought to the study. When responding to the number of years in the company, the minimum number of years reported was 1 while the maximum was 18 years. This again is an indication of the diverse experience the respondents of the study have in the various companies they work in. With a mean length of service of 8.6 years, the study's participants have an average experience of almost a decade. On the other hand, the standard deviation is equal to 3.6 years. With such an indication of high variability in age, it is not uncommon that the participants of the study will have an age that deviates from the average or mean age by 3.6 years. This is also an indication of that these participants have witnessed significant changes in their jobs over a period a time.

When it came to the experience in the industry, the respondents were asked to respond as they did with the previous question. This question is particularly important because it indicates that those who participated in the study are very aware of the change technology have been having on their sector. They came from diverse age groups and were able to relate whether they have experienced change as a result of technology or not. Consequently, when the analysis was run, the results of the measure of experience in the industry showed a vast richness of the dataset in this study. The lowest year of experience was 1 year while the highest was 35 years of experience. The participants on average had 10.27 years of experience in the industry.

With the result given above, it can be noted without a doubt that the study involved participants from a very vast pool of experience. They cut across at least two different generations and have worked on diverse products under different conditions and times. With this stated, it must also be noted that the standard deviation was 6.06 years which is again is a resounding demonstration of the very significant diversity in terms of the experience of the participants. Therefore, this goes without saying that this research sample was very heterogeneous in terms of age, experience and also gender.

Table 1

Respondent's Experience in their Industry

Number of Years	Frequency	Percentage (%)
1	16	6.5
2	19	7.7
3	5	2.0
5	7	2.8
6	23	9.3
7	6	2.4
8	8	3.2
9	2	0.8
10	43	17.3
11	24	9.7
12	37	14.9
13	7	2.8
14	8	3.2
15	14	5.6
16	5	2.0
17	4	1.6
18	3	1.2
19	2	0.8
20	5	2.0
21	1	0.4
25	1	0.4
30	7	2.8
35	1	0.4
Total		100%

Table 2

Respondent's Experience in their Respective Companies

Number of Years	Frequency	Percent
1.00	6	2.4
2.00	19	7.6
3.00	5	2.0
4.00	4	1.6
5.00	16	6.4
6.00	25	10.0
7.00	7	2.8
8.00	16	6.4
9.00	4	1.6
10.00	82	32.9
11.00	9	3.6
12.00	32	12.9
13.00	7	2.8
14.00	3	1.2
15.00	10	4.0
16.00	1	.4
17.00	1	.4

18.00	1	.4
Total	248	99.6

The following information would discuss in great depth the results of the data collected through the Questionnaires.

Reliability

As was stated in the Research methodology, the analysis of the data also involved a reliability test. The reliability test was conducted on the two scales separately. This test was the Cronbach Alpha test. The Cronbach alpha test is intended to test how internally reliable the items of the scales are.

The research Questionnaire consisted of the "Technology Used Scale" and the "Human Capital Scale". Since the Technology Use Scale was intended to measure the independent variable, it was the first scale that was measured. It consisted of seven questions or items and the respondents were 248. The test reported an alpha value of 0.724, as Table 3 indicates. With such an alpha value, it is an indication of an acceptable level of internal consistency within the scale. The reason the analysis could be conclude that such an alpha value was acceptable is because the generally acceptable range for this test is $0.7 \leq \alpha < 0.8$. Taber, K.S (2018)

With this scale having seven items and such a value for α, the result indicates a correlation underlining the scale's reliability to measure the Impact of Technology. To be even more exact, it must be noted that the alpha value based on standardized items was reported as 0.722. This is another result that gives a very important verdict on the reliability of this scale and puts into proper perspective the aloha value that was reached. This is a testament that the reliability of the scale was still strong even as the items in the scale were standardized (>0.722).

With the conclusion being made above, it is safe to say that the results generated from the conduct of these tests validate the use of this scale in measuring the "Impact of Technology" because the reliability has been proven to not be heavily reliant upon the specific measurement unit of the item.

Table 3
Reliability Test Results for the Impact of Technology Scale

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.724	.722	7

The next Cronbach Alpha test that was implemented was the test on the "Human Capital Scale". When this test was conducted, the Cronbach Alpha, or the resulting α value was 0.780 for the four items on the scale. As was with the Technology Use Scale, this was another indication of the reliability of the scale. As indicated in Table 4, α=0.780 met the generally accepted threshold for the measurement of internal consistency. This is very important because it details how reliable the items on the scale are.

However, the Cronbach Alpha based on standardized items was found to be 0.779. As have been stated, such a score is acceptable because it was above 0.7. A Cronbach Alpha result of such is considered acceptable for Exploratory Research.

On the Cronbach Alpha result for the "Human Capital Scale", it is important to conclude that this scale is a demonstration of an acceptable level of reliability for standardized items (α=0.779).

Table 4

Reliability Test for the Human Capital Scale

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.780	.779	4

Lastly for the Cronbach Alpha test, it was carried out on the two scales that consist of the entire questionnaire. This test was carried out on all of the 11 items of the scale. The reason for this test was to verify the degree to which the set of items in the questionnaire consistently measure the concept they are intended to gauge.

As the data in Table 5 shows, the Cronbach's alpha score amounted to .858. Statistically, this score was very significant. Generally, a Cronbach's alpha of .7 or above is considered acceptable in social science research, thus a score of .858 is an indication of strong reliability. This means that there is high internal consistency among the items in the questionnaire, indicating that they are well-correlated and together, they measure the intended variables

effectively.

Furthermore, when the alpha score was standardized; a process which takes into account any possible variations in the length of the measurement scales, the alpha score remains resounding at .857.

This is an indication that the questionnaire is a reliable measurement tool for the variables in this study. Therefore, it can be confidently agreed upon that the results derived from the questionnaire are both reliable and valid, given the high level of internal consistency reflected by the Cronbach's alpha score.

Table 5

Reliability Test for the Questionnaire

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.858	.857	11

Descriptive Statistics

In this part of the work, the descriptive statistics of each of the questions asked from the scale that measure the independent variable (Technology Use scale) and the scale that measured the dependent variable which was the Human Capital scale. The essence of carrying out this analysis was to measure and understand the central tendency of the responses to the different questions, where 1 represented Strongly Disagree and 2 represented Disagree. The number four represented Agree, while five represented Strongly Agree. Number three was for neutral.

Overall, the total number of respondents to the questions in this section were 248. To begin the presentation and interpretation of the data, the questions would be analyzed individually.

The rest of the analysis of the mean and standard deviation of the individual items on the Technology Use scale is based on the data in Table 6. The first question asked, "New Technologies are contributing to making the products better". When the data collected for this question was analyzed, it was notices that it had a low variability as indicated in table 5. The table shows that most of the responses were closed to the means which was 4.6129. this is also an indication that on the average, those who answered the question rated it very highly. It also

meant that most of the participants in the study were in agreement on this question. As for the measure of the dispersion, that is the standard deviation, the result was 0.48807. This is also an indication of the low variability of the responses to this question. In summary, the views of the respondents to this question were consistent with the value of the question.

When the second question was analyzed, the results also included gems that were very pivotal to the overall substance of this work. The second question was "The use of new technology reduces production outputs". This question was vitally important to understanding how incremental increase in technological change can help the company get better. Getting employees responses on this query was significant because from their perspective the study was informed about how the firm could benefit or not benefit from increase technology change.

The respondents who attempted this question were 248. These 248 respondents to the question agree to a low extent. This can be concluded as an agreement to a certain extent because the average or mean of the respondents were slightly lower at 4.5484. However, this low average might not have affected the standard deviation to a large extent as it was slightly higher at 0.51464. This is an indication that the spread of the responses in this question was slightly higher than question one. In question one, most of the respondents agree on it to a very large extent. However, in this question, the variability of the responses was high with a minimum of three and a maximum of five. Due to the nature of this question, some respondents might have been in agreement or disagreement based on their portfolio or experience. However, this is an indication of the effect of the rich diversity of the experience of the respondents.

When the third question was analyzed, it also gave interesting facts to ponder over. The third question asked, "The Company has been successful in regularly altering and modifying the design of its products. This question was important in giving thee study a perspective of how innovation is leading the way in many companies. In was also important to know if product transformation which is regular in the West is also a thing that is affected by technology in a place like Liberia. Marketers also recommend this process because consumers are more often than not attracted by new products.

The result of the third question had a surprisingly low mean of 0.5119. This is an indication that many respondents give a low score to this question. With a minimum score of 2, the respondents did not all have agreement that their products are updated or altered regularly.

The score of 2 is also an indication that some disagree with this statement. However, the standard deviation was 4.3266. This meant that the spread of the responses to this question was much than it was to the other questions analyzed before. Many of the respondents to the questionnaire had a mixed reaction to this question as shown in the fact that the respondents answer widely scattered from the mean. In summary, since the respondents came from across different companies, their responses might be peculiar to the entity they represent.

The fourth question was intended to understand if as technology improved labor force had less work to do. With the advent of for example of the desktop computer and Microsoft office, many people stopped using typewriter and the use of the computer made typing easier and faster. So, this question was "The improvement in technology has led to the diminishing of certain human led tasks". Its intent was to know whether technology use in the factory has made employees to either be reassigned or even sacked.

The mean score of the responses in this question was 4.5040. This is a clear indication of very high rating of this question by the respondents to it. However, the dispersion of the answer was 0.50099. This dispersion was moderate. To a certain extent, this is an indication that the respondents had a level of agreement on this question. This gives insight into how technology is changing the workplace and even displacing human labor.

The fifth question, was to a certain extent an opposite of the fourth question. While the fourth question was meant to know if technology has led to job loss, the fifth question was meant to understand if technology has led to job gains. It was written as follows: "The improvement in technology within or outside the company increased the need for hiring employees with skill-set not sort after 10 years ago". This question deliberately sought to know whether as technology changes the paradigm of work, it also led to new work. This question is very important in directing more effort into understanding the kinds of jobs that might be affected by technology and the skills that could be needed as technology becomes more evasive.

In the analysis of this question, the mean score was lower than the other scores for the previous questions. With a mean score of 4.5040, it can be indicated that the respondents answer this question fairly. This fair response showed that they were less positive in their responses to this question. With a minimum of 2, some of the respondents even believe or are of the perception that technology change does not bring along with it, a change in skills demand.

However, there were a handsome number who had an opinion that was positive. A standard deviation of 0.55956 was seen. This high standard deviation is a prove of the high variability of the respondents rating of this answer. This is an indication of the respondents' diverse views on this question.

In the sixth question, the overarching aim was to know if employees believed that technological change was evasive. This is to say that technological change might be the reason for mass layouts. The question was written as follows: "Further Technological advancement in the company will lead to the redundancy of certain employees".

For this question, the mean score was 4.3581. This mean score meant that many of the respondents give a low rating to this question. This is an indication that they do not believe that technology is going to be a reason for people to lose their jobs at their various workplaces. Furthermore, the standard deviation was 0.47395. This is an indication of a moderate variability in the responses of the participants.

For this question, it gives a clear indication that the mean and the standard deviation is low. This low mean and a low standard deviation is an indication that most of the respondents disagree on this premise. Again, as indicated earlier, they have the perception that technology has an effect on their work but they do not believe that this impact could extend to making them lose their jobs or experience mass layoffs.

The last question for the "Technology Use" scale was very important. This question sought to understand how much changes in Information Technology has impacted employee's performance. It intended to know the level of impact it might have had and also comprehend whether such impact was negative or positive. The question was "changes in information technology had made work easier and allowed me to perform tasks better than usual".

When this question was analyzed, the minimum response was 2, while the maximum was five. On the overall, the mean score of the respondents was 4.4758 and the standard deviation was 0.52413. The means score indicated that the respondents rated the question very high. This could be an indication that for most of the respondents to this survey, technological tools are more like partners to better their work than enemies that want to take them away. For the standard deviation, it is an indication of moderate spread of the data across or around the mean. This meant that some of the respondents' answers varied widely from others. However, most of

them were close to the mean.

To conclude on the analysis of the descriptive statistics of the Technology Use Table, it is important to note that the results gave a very clear picture of how the respondents answer these questions.

Table 6

Descriptive Statistics for the Technology Use Scale

	N	Minimum	Maximum	Mean	Std. Deviation
Q1	248	4.00	5.00	4.6129	.48807
Q2	248	3.00	5.00	4.5484	.51464
Q3	248	2.00	5.00	4.3266	.51119
Q4	248	4.00	5.00	4.5040	.50099
Q5	248	2.00	5.00	4.3629	.55956
Q6	248	2.00	5.00	4.2581	.47395
Q7	248	2.00	5.00	4.4758	.52413
TOTAL	248				

The next set of analysis to follow would be the descriptive analysis of the "Human Capital" scale. This scale was meant to understand how human capital is impacted by technological factors. It consisted of four questions as indicated in Table 7 A meticulous analysis of these four questions would be given below.

The first question was styled "I have the skills and capacity to perform my duties at work effectively and efficiently". This question was important to this research because it was intended to understand how confident the respondents were about their skills they have. It was particularly important because it allowed the respondents to give out information about the skills they had and how they have applied these skills.

For this question, the mean was 4.3266. This mean gives out and indication that on the average, the respondents agree with the statement and that they feel confident that they are well equipped to carry on the functions of their various jobs. This is also an indication that in terms of work-related skills and capacity, the respondents feel highly positive. The standard deviation which for this research has been used to measure how much the responses differ from the mean, was 0.51119. Such a low score for the standard deviation is an indication that the responses were close to the mean. In simple terms, it can be stated that the responses were consistent across the different respondents.

The second question for this scale was styled “With every marginal increase in my work experience, I have increased my skills”. This question was intended to know how skilled workers get as they age on the job. This is an important measure because it gave an insight as to how the very skilled the participants of the study are. It also allowed the study to have more information on the kind of workers that are been impacted or not impacted by technology. It allowed the research to be informed by the skills growth of participants over the years. This investigation gauged the views of respondents about whether they felt that they were improving their skills, which is very cardinal to human capital development.

For this question, the mean score was 4.5040. Additionally, the standard deviation of the question was 0.50099. the mean score was an indication that the respondents to a very large extent agree with the statements. These participants agree that they are growing in skill as they age in terms of experience. This could also mean that skills as a major part of human capital is a commodity that grows with increased years of experience. With a low standard deviation for this question, there is a clear indication that the responses were clustered closely around the mean. When this happens, it means that the responses were fairly consistent across different respondents. In a simpler term, this is an indication that the agreement of the respondents on this question was overwhelming.

The third question was styled “In every capacity I have served in this organization, I have made valuable suggestion that has improved the company”. This question was intended to allow the respondents to carry out a self-reflection or introspection of their roles in the organization they were serving. It also allowed them to give the study an understanding of how they have worked in the organization and the impact they have had across the different departments they served in. It also allowed them to give an honest assessment of their believe in their ability to be positive influences in their organizations. The important elements of human capital which are knowledge, skills, and abilities to contribute to organizational success were measured here.

The result of the mean for this question was 4.3629 and the standard deviation was 0.55956. The mean score is an indication that the respondents generally agree that they have been making valuable contributions to their organizations in all the roles they were given to serve in. These respondents are of the perception that they are making a valuable impact and helping to improve the organizations. A standard deviation score of 0.55956 is an indication that the variability of the respondents’ responses to this question is quite moderate. Even though the

mean suggests that majority of the respondents agree with this statement, the standard deviation indicated that there is a good number of employes who might have an opinion that is negative and the answers have a certain degree of variability. Such an increase variability to this particular question could be due to the experience levels of the employees. Younger employees with less experience might not get to start being listened to earlier on.

For the last question, it was styled, “My supervisors/Superiors have appreciated my contributions to the company” This question landed inn two folds. The first was targeted at the Supervisors. It intended to understand the level of cordiality between the supervisors and the workers they supervise. Additionally, it was also intended to harness the relationship between top management and lower management and shed a light on how top management value the efforts of those they supervise. Motivation, which can also be a part of forming a good human capital comes in the form of appreciation to employees. Such intrinsic acts help to make them perform better. The next fold happened to do with feedback. Feedback is a very important management principle. When people are aware of their shortcomings and try to work on a fix for it, it makes the company better. As a result, appreciation which is a form of feedback is very important as it reinforces positive behaviors.

In the analysis of the data for this particular question, the result for the mean was 4.2581. Also, the result obtained for the standard deviation was 0.47395. The mean scale was a suggestion that the respondents to the question were in general agreement about the statement. Such a score showed that positive feedback is something that happens at the companies with which most of the respondents’ work. This can be a contributing factor to some human capital elements like employee motivation, employee engagement, and even improvement in performance. The standard deviation was low in relation to other questions that were answered. This implied that the responses were closed to the mean. This implication meant that the disagreement of the respondents on this statement is very low. Most of those who answered this question were of the perception that they work in an environment where positive feedback is a norm.

Table 7

Descriptive Statistics of the Human Capital Scale

N	Minimum	Maximum	Mean	Standard Deviation

Q8	248	2.00	5.00	4.3266	.51119
Q9	248	4.00	5.00	4.5040	.50099
Q10	248	2.00	5.00	4.3629	.55956
Q11	248	2.00	5.00	4.2581	.47395

Correlation

The next process in this work was to study the correlation. In the study of the correlation, a Pearson correlation test was done. The essence of this test was to study the degree of the relationship between the two variables; independent and dependent. While the Cronbach Alpha test studies the relationship while testing for reliability, that was for internal consistency. However, this test was able to give a perspective as to how the two variables in the study interact.

The Pearson correlation coefficients were calculated, while the significance of the correlation was assessed. As indicated in Table 8**,** the analysis revealed that the Pearson Correlation for the "Technology Used" scale was 1 (r=1.0). This indicates a perfect linear relationship between the items on the scale. This relationship also further informed the study that as one of the items on the independent variable increases there is proportional increase in the dependent variable. This was also an indication that the predictor which is the independent variable predicts the dependent variable perfectly. The correlation coefficient of 1 informed the research that as changes in technology occurred, there was a corresponding positive impact or effect on human capital. This result is often the standard when the variable is compared to itself which indicates that the scale predicts itself perfectly. Ly, A, et.al. (2018)

When the second scale, the "Human Capital" Scale was measured, a strong positive linear relationship between the two variable was established. The Pearson correlation coefficient was .823 when compared to the "Technology Used" scale. As indicated in Table 8, as the "Human capital" scale increases, so does the "Technology Used" scale. The relationship is also very strong. Since the coefficient here is less than one, it showed a less than perfect relationship. There were some variabilities. However, the results gave us information that as changes in technology increased, so did human capital. As indicated above, this relationship was not perfect, but the pattern was consistent.

It was very important as the study progressed to find an understanding of the relationship between the independent and dependent variable. When the significance was assessed for the

correlation, a p-value of .000 was found. Since this value is below the common threshold of .05 to 0.1, the correlation was found to be statically significant. Ly, A, et.al. (2018) This further indicated that as the independent variable increased, so did the dependent variable. Therefore, this validates the reliability results from the Cronbach alpha and also the positive correlation found through the Pearson Test.

Table 8

The Correlation Table

		Impact of Technology Scale	**Human Capital Scale**
Impact of Technology Scale	Pearson Correlation	1	.823
	Sig. (2-tailed)		.000
	N	248	248
Human Capital Scale	Pearson Correlation	.823	1
	Sig. (2-tailed)	.000	
	N	248	248

Hypothesis

The hypothesis of the research was: "An advancement in technology will have a significant impact on human capital."

For any research, this is a very major component. In this study, it was used to provide structured method for making inferences from the data that was collected. It provided the study with evidence to inform the discussion on the results. Moreover, since this study was based on an assumption that needed to be tested, a hypothesis test was very necessary. Also, it can enable other researchers to follow the steps followed in this research and replicate the test due to its standardization. Lastly, the tests that were done give and dictated the direction of the study.

The hypothesis was tested using a Linear regression analysis. The linear regression analysis was very important to be used because it allowed for the investigation of the relationship between the independent variable and the dependent variable. With the implementation of this analysis, the nature of the relationship was investigated as well as how a unit change in the independent variable may also affect change in the dependent variable. Furthermore, the analysis, by examining individual items in the scale give a clue of the impact of the independent variable on the dependent variable in the future. Also, when the study needed to quantify the effects, the linear regression came in handy as it was able to quantify the effect of the independent variable

on the dependent variable. That is how the coefficient in the regression analysis came to be very important. Lastly, this method of analysis allowed the study to test the hypothesis of the relationship. This test produced a significantly positive result as would be presented later.

When the analysis was done, three important tables were generated. These three tables were the Model summary table, the ANOVA table and the Coefficient Table. The model summary table as given in Table 9 was very vital in providing key statistics. One of the major statistics presented in the model summary table was the R-squared value. This value gives out key detail regarding what proportion of the variance in the dependent variable that can be explained by the independent variable. When the R-squared is adjusted, it enhances the R-squared result to account for the number predictors in the model. The table also included elements like the standard error.

The next table was the ANOVA table. ANOVA is a short form of Analysis of variance. This table was able to provide the research with important detail on the F-statistics and its related P-value. Lastly, Coefficient table was also used to understand the data that was analyzed. This was important as it provided the probable coefficient for the intercept and every independent variable, along with their standard errors, t-values, and related p-values. This was an indication of predicted change in the independent variable when all other factors were held constant.

When the statistical analysis was carried out, it allowed the research to have an access to a very convincing pieces of evidence on the research. To be more precise, the evidence provided also came in the form of providing a proof that the main hypothesis is favored in the result. The data suggested that technological advancement significantly influences human capital within manufacturing companies. This conclusion was supported by the regression model that was used in the study. The model summary that was generated at the end of the regression analysis found that there was a high significance in the relationship between the two variables as is indicated in Table 7.

As for the F-statistic, it gave the research evidence that the regression model predicts human capital significantly better than using the mean alone. On the other hand, the extremely low p-value is an indication that it is almost impossible to get a result of such if a relationship did not exist between technological and human capital.

The power of the model to explain itself was the over-riding reason for using the linear

regression analysis. It accounted for around 67.7% of the variation in human capital (R-squared = .677). To put this in a better context, it showed that about two-thirds of the differences observed in human capital can be explained by differences in technological advancement. Before proceeding to analyzing other elements of the models, an important point to note is that the variance might be attributed to other factors not included in the model.

The model also presented result of the standard error of the estimate (SE). This particular item is very important as it was able to measure the accuracy of predictions made with a regression line. It was also able to indicate the standard deviation of the regression of the residuals or prediction errors.

For the standard error, the model gives a result of SE = .22640. This value is a clearer estimate of the number of This value provides an estimate of how much would be expected of the predictions of human capital from the model to deviate from the actual values, on average. Since, the lower the standard error, the more accurate the predictions, this means the prediction of this study was accurate.

In summary, the details from Table 9 provides that technological change does have a significant impact on human capital. This one provides support for the hypothesis. Additionally, the strong or significant correlation coupled with a relatively high R-squared value was an indication of a substantial linear relationship between technological change and human capital.

However, it must also be noted that there was a 32.3 % variance in the model. This could mean that other factors also account for impact on human capital apart from technological change.

Table 9

Model Summary for Linear Regression Analysis

Model	R	R-Square	Adjusted R-Squared	Standard Error of the Estimate
1	.823[a]	.677	.676	.22640

As have been stated throughout this work, the research was purposedly done to measure the impact of technological change on human capital. The hypothesis stated: "Technological change has a significant impact on human capital". After the regression analysis, a major table that was generated was the ANOVA table of the Analysis of variance table. For this table, one major element that was analyzed was the sum of squares. As indicated in Table 10, the sum of

squares gives out information of just how much variation the human capital could be explained by technological change. To be more exact, the residual sum of squares which was 12.609 was a measure of the amount of variation in human capital that cannot be explained by technological change. Finally, the culmination of the sum of squares (39.089) represented the total variability in human capital that as explained by the regression model.

The next very important element of the ANOVA table was the mean square for the regression analysis. This which is usually calculated by dividing the regression sum of squares by the degrees of freedom for the regression which is usually the number of independent variables. For the mean square it was acquired by dividing the residual sum of square by the degrees of freedom from the residual. The last two measures were the F statistic and the significance. The F statistic was able to measure and compare the variance in the model.

For this study, the F statistic indicated that the explained variance in the model is much provide compelling evidence to back the hypothesis in this study. As reported, the sum of squares, degrees of freedom, mean square, F statistic, and p-value all indicate a very significant and statistically strong relationship between technological change and human capital.

The F-statistic is significantly high, coupling with a p-value that was very low (almost 0), these were all indication that the model was statistically significant. Additionally, they were further implication that some of the variables significantly related to the outcome (human capital). In the case of this research where there was only one independent variable, it meant that technological change significantly predicted human capital. The higher or larger than the unexplained variance. This indicates that the model provides a good fit to the data.

The next and most important item in the ANOVA table was the significance (sig) level. A low p-value usually indicates that there is overwhelming evidence to reject the null hypothesis. With the P-value of this study being .000, it provides strong evidence that technological change has significant impact on human capital. Therefore, the main hypothesis must be accepted.

Table 10

ANOVA Table

1 Model	Sum of the Squares	df	Mean Square	F	Sig
Regression	26.480	1	26.480	516.608	.000[b]
Residual	12.609	246	.051		
Total	39.089	247			

The last table to be analyzed for the Regression analysis would be the Co-efficient table. This table gave so much valuable data that can be used to understand the data as they were analyzed.

The first place to look is at the unstandardized Coefficients. With an unstandardized coefficient for the independent variable being 1.044. According to Fox, J. (2015), it is acceptable and a foundational concept in statistics to have a beta coefficient of the independent variable in a regression analysis to be equal to or greater than 1. This result is another glaring indication that as technological change experience a unit increase in change, so does human capital.

The standard error as indicated in Table 11 for the independent variable values of 0.046. With a small value for the error, this indicates that the coefficient is more precise. In terms of the coefficient beta, the independent variable of 0.823 was an indication that the number of standard deviations that the human capital variable would change as a result of a change in technological advancement. The value is an indication of a strong positive relationship between the two variables.

The last but most important element was the T and significance(p-value). The t-values and their accompanying p-values usually test the null hypothesis. With the significance level of 0.181, this is an indication that constant may very different from zero. Additionally, with the values given for the t-value, it is also clear that the independent variable is significantly different from zero.

To conclude, it is important to note that the unstandardized coefficient value is an indication that as technological advancement increase by just a unit, there is an increase in human capital by 1.044 units. This leads to the conclusion that technological is required for the improvement of human capital. It is important to highlight that the spotting of the negative constant that was reported is an indication of the importance of continual

technological advancement if an institution would want to promote human capital. This is a reinforcement of the claim that that technological advancement substantially affects human capital in manufacturing companies.

Table 11

Coefficients[a] of the Linear Regression

Model	Unstandardized Coefficient		Standardized	t	Sig.
	B	Standard Error	Coefficient Beta		
1 (Constant)	-.275	.205		-1.342	.181
T_U	1.044	.046	.823	22.729	.000

CHAPTER V

DISCUSSION

In concurrence with the work done by Lee, et al. (2022) which emphasizes that the rich diversity of a sample can lead to better output. The sample was rich in age diversity and experience in their various industries and companies. This assured that their input of participation supported the credibility of the research.

Before going any further, it is important that the reliability of the scales used in the study is looked at in more detail. The Cronbach's alpha for the Technology Used scale was .724, this according to Ling, et.al (2021) is an acceptable level of internal consistency. It is also an indication that the scales measure various elements appropriately. When the Human Capital scale was measured, the result of the Cronbach Alpha was .780. This is a clear indication that the scale is reliable and all the items measure human capital collectively. With these results, there is zero doubt that the two technological advancements and human capital were measured accurately and that their implications and findings can be given credence. Manufacturing companies can take this as a call to action. As the data shows that a minimum increase in technology increases human capital, it means that in many aspects of production, there must be concerted effort to employ technological tools to make the work better. The reason for regarding the importance to carry out this meticulous process is because the impact on human capital can also be a result of other factors. Though technology plays a greater role than those factors in manufacturing firms, it is important to identify the areas that require this modification.

To further validate the Cronbach Alpha tests that were run on the independent and dependent variables, a Pearson Correlation test was also done. The results of the Pearson Correlation test were particularly interesting. With a perfect positive correlation ($r = 1$) within the technology used scale, it can be reaffirmed that all the items of the scales consistently measure the same construct of technology use across the surveyed manufacturing companies. This relationship is very significant. The significance as stated earlier is an important part of the upskilling that needs to happen at the manufacturing plants. A significance gives managers a blank check to definitely implement targeted changes in technology.

In addition, there was a strong positive correlation ($r = 0.823$) The strong positive

correlation (r=0.823) between technology use and Human capital suggests that as technology increases, so does the value of human capital. These findings fall in line with those of previous literature, especially (Obilor & Amadi, 2018), where technological increase also meant that there was an increase in the value of human capital. Nonetheless, with such a significant correlation, it would be interesting to also explore the particular technology that might influence this phenomenon.

With these findings, the research gives quantitative backing to the argument that advancing technology enhances employee performance. This may be true because employees are provided with more effective tools for improving workflows and creating new opportunities for innovation. This research goes on to highlight the importance of investing in technological improvements for manufacturing companies looking to enhance productivity and employee performance. This particular claim is backed by the study of Scarrà & Piccaluga (2022).

Research Questions

The Research questions in this study were designed as a means of exploring the different aspects through which technology could impact human capital. In light of this, these are the discussions surrounding the three research questions.

Question One: How does technological advancement influence the productivity of human capital in manufacturing companies?

To comprehensively discuss the research question, we can break it down into a few key areas: the impact of technology on skills and abilities, the effect on work efficiency and output, and the role of training and education. These areas form the basis for a detailed discussion around the implications of the research findings and potential future investigations.

The first area to explore is how technological advancements affect the skills and abilities of employees in manufacturing companies. Based on the findings, technological change has a significant, positive relationship with human capital, suggesting that advancements in technology might enhance the skills and capacities of employees. This is particularly noticeable when looking at the respondent's answers to the questionnaire item: “I have the skills and capacity to perform my duties at work effectively and efficiently”. The mean score for this question was 4.3266 out of 5, indicating that most respondents feel competent and equipped to perform their duties, possibly due

to technology aiding their tasks.

Technological advancements have revolutionized manufacturing processes, leading to increased efficiency and output. Innovations such as automation, machine learning, and AI can take over repetitive tasks, leaving more complex and creative tasks to humans, and increasing overall productivity. For instance, technologies like CAD/CAM (computer-aided design/computer-aided manufacturing) enable more precise, rapid, and efficient production processes. The positive response to the questionnaire item: “With every marginal increase in my work experience, I have increased my skills” could indicate that as employees gain more experience with technology, they become more efficient and productive.

Given the pace of technological advancement, the role of training and education becomes crucial. Employees need to be equipped with the necessary skills to utilize these new technologies effectively. Regular training sessions can ensure that the workforce keeps up-to-date with the latest technologies. In the long run, this contributes to productivity as employees can leverage technological advancements better.

Recognition of contributions, as highlighted by the high mean score on the question “My supervisors/Superiors have appreciated my contributions to the company”, can be enhanced by technology. Digital platforms can track and evaluate employee performance more effectively, providing data-driven insights for managers to recognize their team's contributions.

The research results indicate a significant, positive impact of technological advancements on human capital. As technology improves, the human capital – the skills, knowledge, and experiences of the employees – also tends to improve. This relationship, indicated by an R-value of .823 and a significant p-value, suggests a strong correlation between technological change and human capital in the context of manufacturing companies.

In conclusion, technological advancements significantly influence the productivity of human capital in manufacturing companies. They enhance skills and abilities, improve efficiency and output, and require consistent training and education. As such, it's vital for companies to invest in technological development and employee training to stay competitive. Further research could delve into how different types of technology (digital, AI, automation) individually impact productivity and how companies can strategically invest in technologies that deliver the highest return on human capital

Question Two: What is the relationship between the degree of technological advancement in manufacturing companies and the development of employee skills, competencies, and knowledge??

The research question addresses the interaction between technology and human capital development in a specific sector: manufacturing. This intersection can be explored through various aspects, such as the influence of technology on skills, the implications for training and education, and the relationship reflected in the data.

Technological advancements often necessitate new skills and competencies. For instance, with the advent of digitalization and automation, employees in manufacturing companies may need to learn how to operate and maintain advanced machines and software. According to the research findings, there appears to be a significant, positive correlation between technological advancement and human capital. This suggests that as technology improves, so do the skills, competencies, and knowledge of employees.

The questionnaire item: “I have the skills and capacity to perform my duties at work effectively and efficiently” had a mean score of 4.3266 out of 5, indicating most respondents felt capable in their roles, possibly due to the influence of technology.

As technological advancements progress, continuous training and education become crucial for employees to keep up with the changing landscape. Companies investing in new technologies should also invest in comprehensive training programs to ensure their workforce can effectively use these technologies.

The response to the questionnaire item: “With every marginal increase in my work experience, I have increased my skills” showed a mean score of 4.5040, suggesting that employees felt their skills improved with increased work experience, likely influenced by exposure to, and utilization of, new technologies.

In the research, the Pearson correlation coefficient was found to be .823, suggesting a strong positive relationship between technological change and human capital. This result reinforces the idea that technological advancement in manufacturing companies goes hand in hand with the development of employee skills, competencies, and knowledge.

In the regression analysis, the R-squared value was .677, indicating that about 67.7% of the variance in human capital can be explained by technological advancement. This finding further affirms that technological progress is a key driver of human capital development.

The study's data suggested that as employees' skills and competencies grow, their contributions to the company are recognized. The questionnaire item: “My supervisors/Superiors have appreciated my contributions to the company” scored a mean of 4.2581. This could be indicative of the fact that as technological advancements provide employees with enhanced abilities, their contributions become more visible and appreciated.

In conclusion, technological advancement in manufacturing companies appears to have a strong positive relationship with the development of employee skills, competencies, and knowledge. As companies invest in new technologies, they should concurrently invest in employee training and skill development. Further research could consider investigating specific types of technologies (automation, AI, digital technologies) and their individual impact on employee skills and competencies. Understanding this relationship can help shape training and development programs and inform strategies for technological investment.

Question Three: Does the incorporation of technological advancements in manufacturing companies lead to an increase in human capital value, as reflected in skill acquisition and productivity enhancement??

The research question probes the connection between technological progress, skill development, productivity enhancement, and the consequent value of human capital in the manufacturing industry.

Technological advancements in manufacturing companies have significant implications for employee skill acquisition. As the manufacturing landscape evolves with the introduction of new technologies, such as automation and AI, employees are compelled to acquire new skills and competencies to navigate these changes effectively. The correlation between technological change and human capital in the research was strong (R = .823), suggesting that technological advancements can indeed contribute to the development of employee skills and competencies.

The questionnaire item, “I have the skills and capacity to perform my duties at work effectively and efficiently”, had a mean score of 4.3266 out of 5, indicating that most

respondents felt they possessed the necessary skills to perform their work, likely reflecting the influence of technology on their skill acquisition.

Technological advancements can lead to increased productivity by automating repetitive tasks, reducing errors, and speeding up production processes. Moreover, employees with newly acquired skills due to technological changes can work more efficiently and effectively, contributing to overall productivity.

The survey response to the statement, "With every marginal increase in my work experience, I have increased my skills" had a high mean score of 4.5040, suggesting that as employees gained more experience with technology, they became more productive.

In conclusion, the incorporation of technological advancements in manufacturing companies appears to significantly increase human capital value by fostering skill acquisition and enhancing productivity. Therefore, manufacturing companies should continue investing in technology and in the continuous training and development of their workforce to maximize human capital value. Future research could explore how different types of technological advancements impact human capital value and which technologies yield the most significant returns on investment.

Theoretical Implication of the Study

Given the data from your research, the theoretical implications can be vast and significant in understanding the interplay of technological advancements and human capital in manufacturing companies.

Reconceptualizing Human Capital: With the results of the study overwhelmingly supporting a strong relationship between technological advancements and human capital, it is important to point out that the study indicated that technology is a complementary ingredient of human capital. It can be concluded that technology enhances technology. This is support for the notion that machines and man can work in synergy to produce maximum productivity. This means that technological factors are now tied to human capital and that human capital must have technological competencies and the ability to work with new technology.

Technological Change and Labor Demand: With the results also suggest that technology is a significant driver of labor demands within manufacturing companies. This is an important

contribution to theories concerning the labor market impacts of technological change,

notably the theories around skill-biased technical change which suggests that technological advancements favor skilled over unskilled labor.

Performance Enhancement Theory: The data shows that technology improves performance of employees. It gives empirical reliance that technology isn't just a tool but a catalyst that can lead to greater productivity, job satisfaction, and overall performance in the workplace.

This research is a stepping stone for future theoretical inquiries and can also be a launching pad for more focused studies. An example could be the exact mechanisms through which technology enhances human capital. This could be a subject of future theoretical and empirical exploration. When pursued, it could further enrich our understanding of these phenomena and help academia and industry to come up with effective strategies for managing technological changes.

Practical Implication of the Study

Practically, this study impacts and influences policy-making, managerial actions, and educational strategies for manufacturing companies. With the compelling evidence given in the study, the following are practical recommendations based on the findings of this study:

Workforce Development: Based on the results of this research, it was concluded that investments in upskilling have the potential to yield great returns in lieu of productivity and performance. Therefore, it is important to recommend that manufacturing companies put specific emphasis on technology training programs. This will allow their workforce to keep up-to-date with the latest technological advancements.

Strategic Planning: The results of the data could be a gold mine for business strategists in manufacturing companies. It can inform their decision-making in terms of investments in new technology. Since the findings indicate that technology significantly enhances the value of human capital and also serves as a driver of employee performance, manufacturing companies are advised to prioritize the adoption advanced technology during strategic planning.

Policy-making: With strong evidence that technological advancement is a driver of human capital performance in a major sector of the economy like manufacturing, policy makers

could direct more policy prescriptions that would deliberately target the manufacturing sectors and implement plan that would ease the pain of labor displacement.

Human Resource Management: In the practice of Human resources Management, when managers understand how technology can impact performance, it helps them in recruiting of employees and assigning of tasks. Therefore, HR Managers are advised to pay keen attention to how different technology interact with humans on the workforce and use this to revise recruitment policy, and retention strategies.

Education and Curriculum Development: The results of this study could have an influence on education and how curriculum is developed. These findings are especially useful for vocational and technical education. Therefore, it is recommended that schools inculcate more technology-friendly trainings in their programs for students to allow them to be more useful on the jobs.

To end this recommendations section, this study could be a guide for all those manufacturing companies that may be facing challenges that are accompanying new technologies. It is important that technological changes are managed proactively rather than passively.

CHAPTER VI

Conclusion and Recommendation

Conclusion

The conclusion will be in three parts. The first part will be the theoretical implication of the study, the second part will be conclusion based on the findings of the study.

Conclusion Based on the Findings of the Study

To begin with, it is important to note that with a strong Pearson correlation (r=.823), it is very safe to conclude that Technological change significantly impacts human capital.

Additionally, in terms of the sample of the study, the conclusion can be made that the major manufacturing companies in Liberia are ahead of their competition due to the depth and breadth of experience of their staff. Also, the companies in this study invest well in the training and development of their employees.

Furthermore, the findings also found that the companies in this study have been investing in the improvement of equipment and tools used in the production of their products. Moreover, based on the findings, it is safe to conclude that when companies invest in the training and development of employees, it improves output and inspires innovation. Also, when companies invest in technological improvements, their employees tend to contribute more valuably to the company's output.

Additionally, it is also safe to conclude that when new technology is implemented, companies look out for skilled laborers who can efficiently manage these tools. This thereby leads to demand for skills that may be new to the company or industry.

Finally, the evidence from the study supports the conclusion that when new technology is used, it provides opportunities and challenges in the manufacturing sector. These challenges could be adapting to the new systems and processes and the opportunities could be providing opportunities for Workers to acquire new skills and for the company to hire people with more up-to-date skills.

Recommendation

The two parts of this section would be recommendation based on the findings of the study and recommendation for future research.

Recommendation for Future Research

The first and foremost recommendation for further research on this study is that the tests that were conducted tested for correlation and not causation. Other researchers could consider testing for causation.

The next recommendation is that the study did not check for specific technological tools that may affect human capital. So, when conducted, it is advisable that other research should look into particular technological tools that may affect human capital. Also, this study did not take into particular consideration the specific part of the production processes that could be affected by technological advancement. So future research could consider this aspect.

Finally, for this research, the study focus was on manufacturing companies. Moreover, these companies were into large-scale manufacturing by Liberian standards. Hence, when other research is conducted, they could look into the impact of technology on manufacturing companies that are very much smaller and have less financial potency.

Recommendation according to Findings

Based on the findings of the study, the following recommendations can be made:

It is important that more and more organizations invest in technology. The study suggests that new technologies are important to making manufacturing companies notch better in their dealings and workings. Another recommendation that can be made based on the findings is that organizations are encouraged to invest in change management.

With new technologies replacing previous tasks and making way for different expertise, it is only imperative that investments are made in helping employees to adapt to the new ways of running the organization.

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APENDICES

Appendix 1

Similarity Report

EXPLORING THE IMPACT OF TECHNOLOGICAL ADVANCEMENT ON THE VALUE OF HUMAN CAPITAL TO THE OUTPUT OF MANUFACTURING COMPANIES by Gardeh Garteh

ORIGINALITY REPORT

8%	6%	5%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Pinosh Kumar Hajoary. "Industry 4.0 Maturity and Readiness- A case of a Steel Manufacturing Organization", Procedia Computer Science, 2023 Publication	<1%
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5	repository.unai.edu Internet Source	<1%
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Appendix 3

Questionnaire:

Dear Participant,

You are kindly requested to participate in this survey that seeks to study the relationship between Technological Change and Human Capital. Your participation will help the researcher, a Graduate student at Near East University, better understand how these variables affect each other. By filling out this questionnaire, you have agreed to participate in this study.

Part One:

Bio-data and Demographics

Please Fill out the required information or select the option that suits you the best

Gender	Male ☐ Female ☐
Age	18 – 23 ☐, 24 – 29 ☐, 30 – 35 ☐, 36 – 41 ☐ ,42 - 47☐ , 48 – 53 ☐, 54 – 59 ☐, 60 – 65 ☐
Current Position	
Department	
Years of Experience (Industry)	
Years of Experience (Organization)	

For the Following Questions, the boxes are labelled from 1 to 5 with the corresponding interpretations:

1=Strongly Disagree
2=Disagree
3= Neutral
4=Agree
5=Strongly Agree

Part Two: Impact of Technology

		1	2	3	4	5
1.	New technologies are contributing to making the products better					
2.	The use of new technology reduces production time and increases production outputs					
3.	The company has been successful in regularly altering or modifying the design of its products					
4.	The improvement in technology has led to the diminishing of certain human-conducted tasks					
5.	The improvement in technology within or outside the company increased the need for hiring employees with skill sets not sort after 10 years ago.					

6.	Further technological advancement in the company will lead to the redundancy of certain employees					
7.	Changes in information technology made work easier and allowed me to perform tasks better than usual					

Part Three: Human Capital:

		1	2	3	4	5
8.	I have the skills and capacity to perform my duties at work efficiently and effectively					
9.	With every marginal increase in my work experience, I have increased my skills					
10.	In every capacity I have served in this organization, I have made valuable suggestion that has improved the company.					
11.	My Supervisors/Superior s have appreciated my contributions to the company					