The path to AI- & data-driven strategy for LinkedIn

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Executive summary

For years, LinkedIn has been at the cutting edge of AI and data, which have become its core differentiating competencies.

Data products of LinkedIn include but are not limited to skill endorsement, news feed, and personalized recommendation. With an explainable AI system, LinkedIn is helping the sales team to trust AI and identify the best solutions.

Bias, stereotypes, and discriminations are deep-rooted problems associated with algorithms. At the same time, LinkedIn seems to care less about the underprivileged groups.

From audio/video integration and the AI Academy, we see the growing opportunities for LinkedIn in the next 5 years.

Data security, fake profiles, political regulations, and malicious contents are common threats for LinkedIn.

We have made two major recommendations for LinkedIn that concerns inclusiveness and tackling bias in AI.

Overview of LinkedIn

LinkedIn, based in Mountain View, California, was launched in 2002 as a social networking platform specifically for the business community.

LinkedIn emphasizes a user's professional contacts, as opposed to other social networks such as Facebook and Twitter, which tend to be mostly recreational. Users can create profile pages with a format like a resume, in which they can summarize their careers, promote their unique skills, and list their schooling and employment history. When a user accepts an invitation from another to join his or her network, a connection is made. LinkedIn enables individuals to advance their careers by searching for opportunities, discovering connections (even third-party connections) at a specific company, and obtaining recommendations from other users. Membership is free, but for a fee, users can access additional profiles in their search results and view the complete profiles of any LinkedIn user.

LinkedIn was developed in 2003 by venture financier Reid Hoffman, product designer Allen Blue, marketing professional Konstantin Guericke, engineer Eric Ly, and engineer Jean-Luc Vaillant. Initial growth was sluggish. In 2005, LinkedIn launched services that enabled firms to publish job postings and search the network for potential candidates. In addition to these professional services, LinkedIn also offers advertising opportunities for businesses. In 2007, LinkedIn finally became profitable. In 2007, LinkedIn had over 15 million members, and by 2011, it had over 100 million members globally. In the same year, the first public offering (IPO) of LinkedIn raised $353 million.

Microsoft made headlines in 2016 when it paid more than US $26 billion to acquire LinkedIn. The purchase was the biggest in the business’s history. In 2019, Microsoft discontinued publishing LinkedIn's operating profitability. LinkedIn was profitable as a single public corporation until 2015, before being acquired by Microsoft. LinkedIn ran at a loss initially inside Microsoft due to long-term costs associated with the acquisition. But it looked to be on a trajectory toward profitability before Microsoft stopped disclosing LinkedIn’s operating profits. (Bishop, 2021)

Strategic leadership capabilities of LinkedIn

- **Dynamic core competencies**

  LinkedIn employs artificial intelligence (AI) and a vast quantity of data to help professionals locate the ideal job and businesses recruit the best candidates faster than in the past, with the ultimate goal of entirely eliminating hiring prejudices in the future. As a social networking site, LinkedIn always makes sure to provide its users with the newest tools and features. Currently, LinkedIn is managed by two of the key differentiating competencies, such as artificial intelligence and big data analytics, which have distinguished this platform for its users.

- **Emphasize human capital**

  As the world's largest career network with a mission to connect professionals around the world to help them achieve higher productivity and greater success, LinkedIn emphasizes human capital as its major asset and is rated as one of the best employers in the United States. LinkedIn is dedicated to supporting the peace of mind for its employees by providing benefits and perks such as remote working, paid parental leave and education reimbursement.

- **Invest in the development of new technologies**

  LinkedIn has been devoted to cutting-edge technologies, especially to the development of Artificial Intelligence in recent years. LinkedIn incorporates AI into a wide range of products and services. For example, since a great deal of its data is simply unstructured natural language text, attaching structure and meaning to this kind of text is essential to LinkedIn's overall mission of connecting its members to opportunity. To provide better solutions, LinkedIn launches many natural language processing (NLP) projects, such as baseNLP, PolyglotMT and Large-Scale Language modeling to features for use throughout the entire company. Deep Learning

technologies such as image recognition (ImageNet), speech recognition, and machine translation are also heavily invested in LinkedIn to build core competencies. (LinkedIn Engineering)

- **Develop and communicate a vision**

  It consistently conveys to its members that LinkedIn has a clear vision. Every member of the global workforce should have access to economic possibilities. As an organization, LinkedIn's primary goal is to promote professional growth.

  The goal of this endeavor is to link everyone around the globe in order to increase productivity and professional success.

Strengths: How AI and Data power everything in LinkedIn

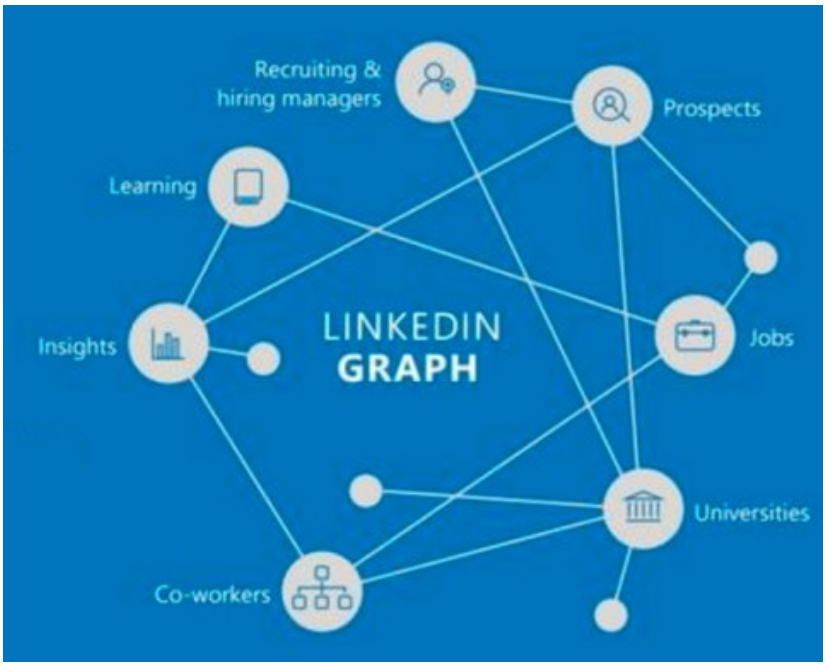
➢ Data & Analytics

Data Products used at LinkedIn:

- **Skill endorsements -** Data collection and analytics are used to identify the most qualified individuals for various skill-based employment jobs.
- **News feed updates** are provided by using relevant data that has been gathered using Hadoop ML algorithms in accordance with the members' areas of interest.
- **People recommendations -** Hadoop batch processing is used to collect online and offline member data to make appropriate recommendations for connections based on similarity in profile and skill sets.
- **Jobs you might be interested in -** This feature uses member data to assist recruiters in finding the best applicants for a certain job type and classification.

LinkedIn Knowledge Graph:

LKG is a large knowledge base that uses entities like members, jobs, titles, skills, companies, locations, schools etc. Data and ML models are used to help with features like ranking search results, ads and updates in news feeds to enhance monetization, business and consumer analytics.



The knowledge graph on LinkedIn is a dynamic graph. Continuously, new relationships are created and new entities are added to the graph. Existing connections can also alter. For instance, when a person gets a new job, the mapping from a member to her present title changes. As member profiles alter and new entities appear, the LinkedIn knowledge graph has to be updated instantly. (He, 2016)

➢ Explainable AI

Explainable Artificial Intelligence (XAI) is a set of tools that allow human users to understand and trust the results and outputs created by machine learning algorithms. It helps to describe the model's accuracy, fairness, transparency and the outcome of AI decisions. Explainable AI is widely used in LinkedIn, and the explainability of AI also helps the company adopt a responsible approach to AI

development. Explainable AI is critical to building trust and confidence in an organization when AI models are entering production phases (Yang et. al, 2022).

LinkedIn builds AI systems to build trust, avoid harmful biases, and respect privacy. The goal is that end users of AI (like LinkedIn employees, customers, and members) can use these insights to understand these systems, suggest improvements, and identify potential problems. By implementing Explainable AI and showing the work of AI engineers such as data scientists, LinkedIn is making transparent the production process for inclusive and equitable products and projects to ensure they empower individuals, regardless of their background or job position.

Predictive machine learning models are widely used in LinkedIn's recommendation systems for different products such as news feed ranking, search, and job recommendations, as well as customer-facing products in sales and marketing. One challenge is to present the model output in an intuitive way to teams that are unfamiliar with AI and machine learning (Basu, 2021). Complex predictive machine learning models often lack transparency, resulting in low trust from non-tech teams despite their high predictive performance.

To address this challenge, LinkedIn has developed CrystalCandle (formerly known as intelligence), a customer-facing model interpreter that creates digestible explanations and insights that reflect the rationale behind model predictions. As of mid-2021, LinkedIn has integrated CrystalCandle with more than eight business forecasting models across five lines of business in LinkedIn, assisting more than 5,000 employees (Basu, 2021). For sales and marketing models, CrystalCandle is able to interpret and translate non-intuitive machine learning model outputs into clear and actionable customer-friendly narratives.

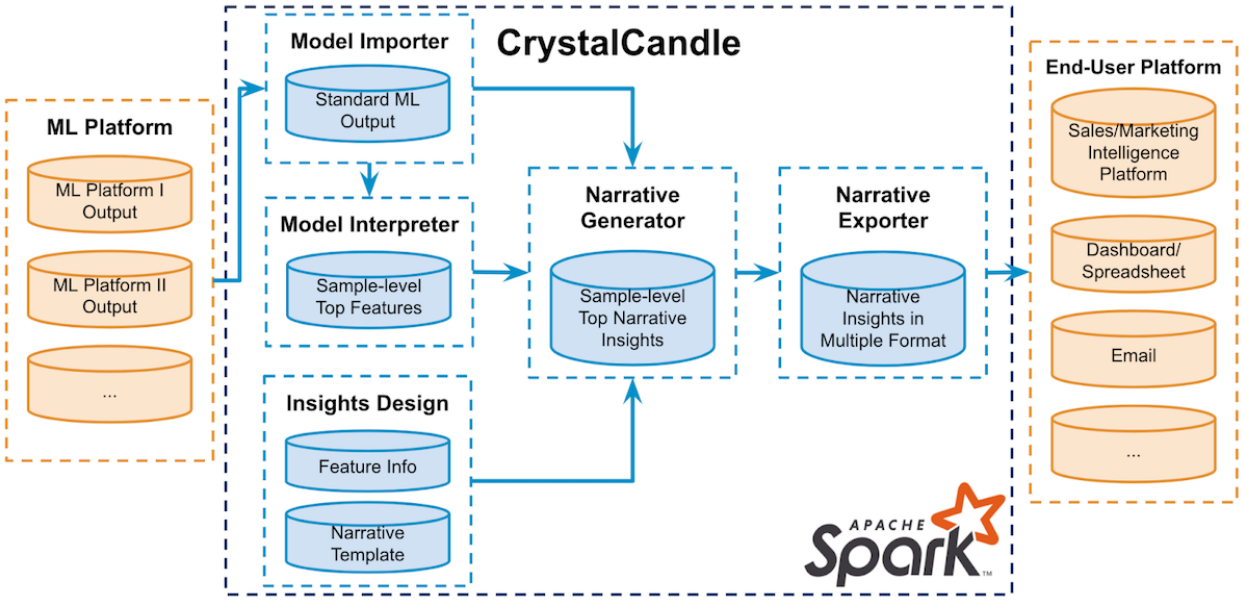
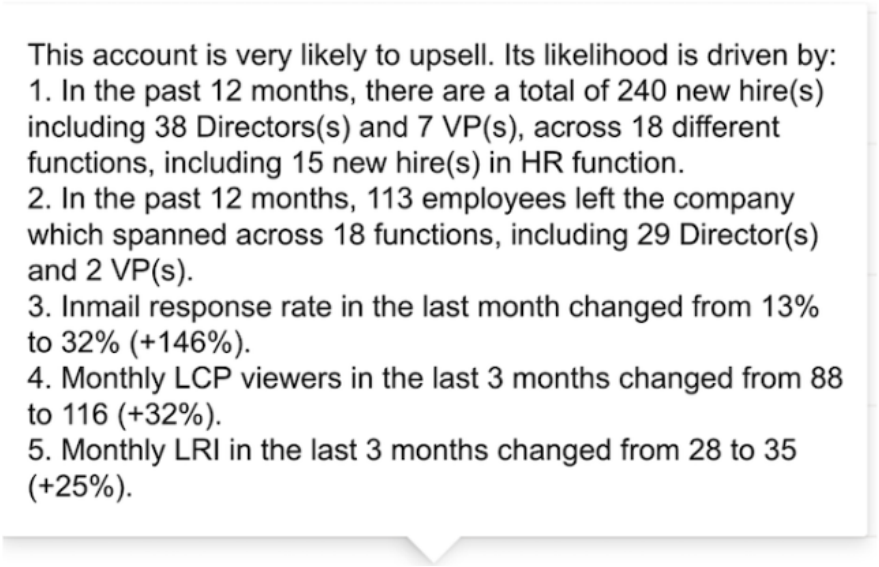


Diagram showing components of the CrystalCandle explainability system at LinkedIn

The figure above shows an end-to-end pipeline from a machine learning platform to an end-user platform in CrystalCandle. It consists of four components: a model importer, a model interpreter, a narrative generator, and a narrative exporter, where the model interpreter and narrative generator generate interfaces for CrystalCandle users to implement model interpretation methods and customized narrative insights respectively. The entire CrystalCandle is built on Apache Spark for high computational efficiency and has been integrated into the ProML pipeline for a single platform solution from model building to narrative services (Basu, 2021).



Mocked top narrative insights generated by CrystalCandle for a specific customer in account level upsell prediction.

CrystalCandle's output is a list of top narrative insights for each customer account, which reflects the rationale behind the machine learning model that calculates scores. These narrative insights here are more user friendly, bring important metrics to the attention of sales representatives, and are clear and concise. These narratives provide more support for the sales team to trust the forecast results and better extract meaningful insights (Yang et. al, 2022).

Weaknesses: what problem does LinkedIn face?

Like many data-driven enterprises, LinkedIn, a model of a platform company, is facing many ethical conundrums that are common in this information age. This paper will analyze two of the most important issues.

➢ **Bias in algorithms**

In an era of mobile internet, algorithmic bias has become a frequently mentioned topic in various academic fields. As is known, algorithmic bias "describes systematic and repeatable errors in a computer system that create 'unfair'

outcomes, such as ‘privileging’ one category over another in ways different from the intended function of the algorithm”.This bias may result from a variety of sources, including the algorithm’s design as well as any unintended uses or decisions made in relation to the coding, collection, selection, or use of data for the algorithm’s training. (Wikipedia)

An example is a mistake that LinkedIn’s recommendation system once made. For a while, LinkedIn developed an algorithm that, when ranking candidates, one of the metrics was to look at how proactive they were in applying for positions and responding to recruiters. In training the model, LinkedIn used a large amount of data from its own users. Technically, LinkedIn removed the gender and age factors to reduce bias. However, bias was still produced in an unexpected way. It turns out that due to gender characteristics, in general, females are not as aggressive or as bold as males in the job-seeking process. When given the same opportunity, women are more likely than men to feel that they are not qualified enough for the job, thus they may choose not to apply, although their ability may be the same as men or even higher than men. This stems from the general differences between the sexes in terms of personality that have developed over the course of evolution. By examining the indicator of proactivity in the algorithm, a female candidate is discriminated against because all other things being equal, she is still ranked behind the man. (Wall,2021)

LinkedIn later became aware of the above problem and quickly made changes to the algorithm. Actually, LinkedIn is very serious about this kind of issue, and it launches a project called “responsible AI”, which follows Microsoft’s Responsible AI Principles, emphasizing eight values that it builds into products: fairness, reliability, safety, privacy, security, inclusiveness, transparency, and accountability. (Logan, 2022)

However, bias cannot easily be eliminated since it is not purely a technical problem. Instead, it reflects our deeply rooted social structure. In the case of Artificial Intelligence applications, AI looks for patterns, statistical data, and trends, which can lead to bias when pervasive societal and cultural inequality impact that data.

For example, below is a graph extracted from an article analyzing the gender gap using LinkedIn advertisement platform data.

Table 1 Descriptive statistics of LinkedIn data by gender and further disaggregated categories. Note: Number of countries includes those after the application of the observation filter with audience counts of fewer than 1000 removed

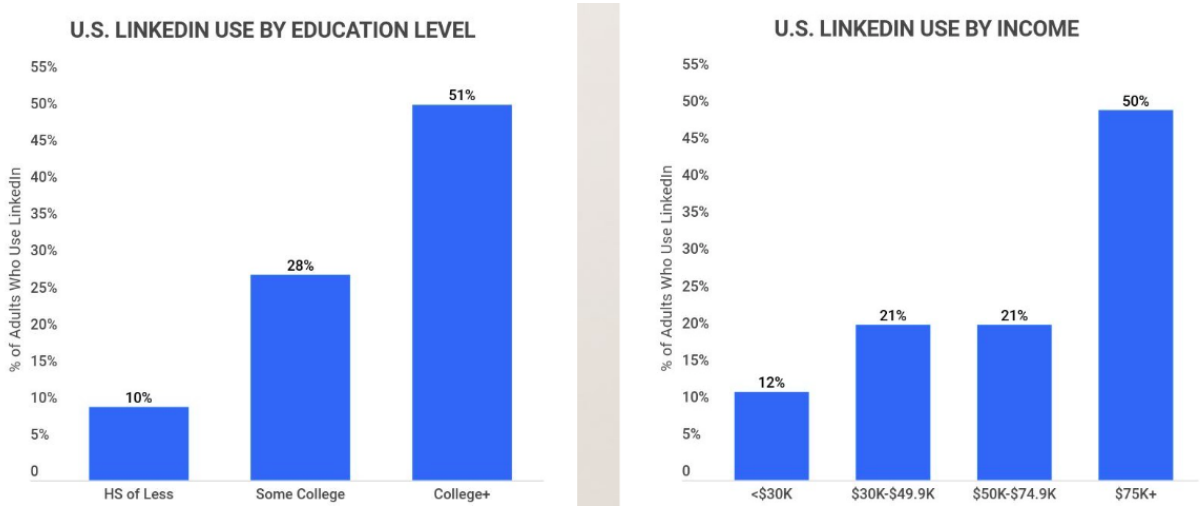
Category	Audience counts (in millions)			Number of countries with sufficient data
	Total	Women	Men	
Gender	460.18	196.06	264.12	234
Age group				
18–24	43.61	19.61	23.99	187
25–34	59.60	26.75	32.85	201
35–54	47.68	19.00	28.68	194
55+	14.14	4.53	9.61	133
Company industry				
Non-STEM	273.71	122.50	151.21	190
STEM	97.22	30.59	66.63	164
Field of study				
Non-STEM	152.87	73.62	79.25	175
STEM	70.51	17.98	52.53	147
Job function				
Non-STEM	226.35	106.55	119.80	203
STEM	87.53	25.40	62.13	201
Job seniority				
Chief X Officer (CxO)	8.14	2.01	6.14	137
Director	20.20	7.15	13.05	177
Entry-level	124.92	55.49	69.43	218
Manager	28.00	9.66	18.34	184
Owner	16.36	5.23	11.13	153
Partner	2.48	0.69	1.79	87
Senior	92.01	41.33	50.68	212
Training	6.14	2.82	3.32	126
Unpaid	5.03	2.11	2.92	98
Vice President (VP)	8.52	2.38	6.14	140

This descriptive data makes it clear that women are underrepresented on LinkedIn in relation to men in STEM disciplines and higher managerial positions. These gender gaps partly reflect the underrepresentation of women in technical fields such as software engineering, but they also reflect factors like gender biases within this platform that disadvantage women, cultural or algorithmic features that limit female participation, and behavioral differences in platform usage. (Kashyap & Verkroost, 2021)

Bias is not a problem intently created by algorithms, neither is it a problem that solely challenges LinkedIn. However, we must be highly cautious if bias is standardized, programmed, or even worse, justified by algorithms. As a leading company with a huge influence on the global workforce, LinkedIn should always pay special attention to this issue.

➢ **Labor Gap**

The second problem would be the huge labor gap in terms of LinkedIn active members. Some statistics of LinkedIn users will give us pictures about who is using this social networking platform. Take what can be drawn from U.S. users as an example.



(Source: Zippia, 2022)

According to the above graphs, LinkedIn is most popular among people with higher degrees and incomes, which reflects uneven distributions among general labor resources.

Just like algorithmic bias, this gap is not created by LinkedIn as a corporate organization, it is a phenomenon that inherently exists in the given society. However, this naturally raises a serious question when we are evaluating the values of this platform. Who has the greater need in finding a job? Is it people with fancy degrees, and a lot of experience, or people who are working as blue-collar workers, who are less educated, and less privileged?

This may not be a fair question, given that the gap between workers is a brutal reality that must be admitted. However, people always say information is changing our society, and that the internet is revolutionizing the way humankind lives. Can

we really say so if the sacrifice is a bigger gap between the privileged and the less privileged groups? The internet is not a utopia, of course, but we do have hopes for it, that is to push fairness, justice, and transparency globally, through the free flow of information. We want it to be less centralized so every person can benefit from this technological progress. Specifically, in this case, we would like to see more opportunities created for the less educated people on LinkedIn.

Focusing on this issue is not just a matter of corporate social responsibility for LinkedIn. It is absolutely an ethical issue, but at the same time, it is also a serious business issue. Considering the base of blue-collar workers in our society, this is a huge untapped consumer base. It can become a new breakthrough point and a new business opportunity for LinkedIn in terms of prospective users.

Opportunities: what LinkedIn can do in the next 5 years?

- **Audio/Video Integration**

The proposed system is to build an ML model to identify and store keywords and skill requirements asked in an interview in order to help map other job seekers to the appropriate job roles. As AI systems can learn from the content shared over audio/video, this prototype is primarily focused on leveraging this capability. Without requiring the use of a third-party tool like Zoom, Google Meet, etc., recruiters may conduct job interviews via LinkedIn. This increases user engagement on the platform, resulting in higher revenue and profit.

All of the unique lingo or keywords spoken in the interview will be kept in a data collection that the ML model will keep. Afterward, the job applicant may utilize this to comprehend what a corporation expects from a candidate for that specific job role.

- **LinkedIn AI Academy**

The goal of the AI Academy program is to equip employees across the company, from top to bottom, with knowledge in areas such as engineering and product management so they can provide the best AI experience for customers.

Currently, The AI Academy offers different courses based on different roles and business needs. For example, engineers can take a course named AI200 - “Building artificial intelligence products”. This includes a five-day weekly deep diving course, followed by a month-long apprenticeship with core AI teams. For product managers and executives, there is a one-day course that focuses on the domain knowledge they need to manage AI products. After completing these courses, participants get to understand which problems can be solved by AI and which cannot.

In the future, LinkedIn should expand this program for employees who work closely with AI teams, such as HR managers who work with LinkedIn Engineering and sales people who work with technology clients. The next step for advancing the AI Academy could be incorporating it as part of the onboarding process for new employees. This will help give all LinkedIn’s employees a common language in AI and finally achieve the vision of ensuring that every employee has the opportunity and understanding of the knowledge they need to work with AI in their specific role.

Threats: what challenges does LinkedIn currently need to address?

Although being an outstanding leader in the professional social networking area, LinkedIn still faces various challenges and threats.

- **Data Security**

With millions of people using LinkedIn actively, one of the major worries is the breach of privacy. In fact, scandals of data leaks have never disappeared in recent years. For example, in 2021, an archive with data allegedly scraped from 500 million LinkedIn accounts was listed for sale on a well-known hacker site, and the post’s author also leaked 2 million records as a proof-of-concept sample. The

released files incorporated details about LinkedIn members, including their full names, email addresses, phone numbers, employer information, and more. LinkedIn vehemently denied the leak and insisted in an open statement that the data being sold was an amalgamation of information scraped from other websites and businesses and was not obtained because of a data breach.(Shetty,2021)

However, this has not eliminated people's concerns about data security on this platform. Besides data leaks, problems such as fraud, scams, and phishing also frequently annoy its users. In fact, there have been many lawsuits against this company regarding data security over the past years. Obviously, the issue of data security will continue to challenge LinkedIn's reputation and brand.

➢ **Fake Profiles**

Bots have been a serious issue for many social media platforms. Despite having a reputation for being a more civilized social platform, LinkedIn also faces the threats of inauthentic behaviors, and they can be difficult to spot. In the past years, LinkedIn has been greatly criticized for fraudulent profiles that name significant firms as their employers or apply for high-profile job positions, as well as accounts with artificial intelligence-generated profile photographs that are used for cryptocurrency marketing or promotion.

According to one of the company's reports, in the second half of 2021, it deleted 11.9 million phony accounts at the time of registration and another 4.4 million before any other users ever reported them. Identifying and eliminating bot and fraudulent accounts can be a challenging and extremely individualized process. Bad actors may run an account using a combination of computers and human management, making it more difficult to determine whether it is automated; computer systems can quickly and repeatedly create numerous fake accounts; one person may be using an otherwise genuine account to continue scams, and the AI used to detect false accounts is not always an ideal tool. These make fake profiles a continuing threat to the development of LinkedIn. (Duffy,2022)

➢ **Political Regulations**

With its business spreading to a wide range of nations, LinkedIn has found it increasingly difficult to deal with political restrictions in many areas, particularly at a time when political tensions are extremely high, and businesses are frequently the targets of political rivalry.

For instance, in 2021 LinkedIn stopped offering certain of its services in China. In accordance with local regulations to conduct business in China prior to this revelation, LinkedIn already restricted posts there. From that point on, it would provide a brand-new software app for the Chinese market that was only focused on job postings and lacked social networking features like sharing and commenting, which were crucial to LinkedIn's success in other countries.Other difficulties loomed in addition to the censorship disputes. An even greater outcry may have been caused by a new Chinese data security law that obliges companies like LinkedIn to maintain more information about local users inside this country. (Weise & Mozur, 2021)

Considering that China, with several million users, is one of LinkedIn's largest markets, trailing only the United States and India, this restriction was a huge loss to LinkedIn's business. Besides China, concerns like data governance raised new issues in places like the European Union as well, posing ongoing operational challenges for the corporation.

➢ **Malicious content**

LinkedIn is a social network for professionals, but when a few people decide to harass and insult other LinkedIn members, it may occasionally be no different from Facebook or Twitter. When users get messages from strangers, for instance, the communications may initially appear innocent—a plea to connect, a hint to a common interest or comparable industry—but later they may become inappropriate, sexual, or aggressive. Women users on LinkedIn are reporting this behavior all the time. While women have experienced harmful and abusive behavior online since the advent of the internet, with numerous reports of harassment on platforms like Facebook and Twitter, LinkedIn, where users look for

professional connections, has now been added to the list of online spaces where women claim harassment happens on a daily basis. (Somos, 2021)

To clarify its stance on harassment, LinkedIn has launched a number of tools to tighten its Professional Community Policies. Reminders to keep posts, comments, and messages appropriate have also been added to the platform. However, as a network where user-generated content predominates, LinkedIn constantly produces malicious content like harassment, racism, hate speech, rumors, extremism, populism, and more. While it is common to screen or delete offensive content using technology like artificial intelligence, this is far from sufficient. LinkedIn continues to be under threat from this issue, which can have a very negative impact on its user experiences and brand reputation.

Recommendations: For a better future for LinkedIn

We have broadly classified the main ethical problems that LinkedIn are facing into two categories - one is making Linkedin more inclusive for non conventional workers and the second is tackling the bias in algorithms.

➢ Making LinkedIn more inclusive

- **Keyword tag for blue collar jobs** : LinkedIn should offer a feature or plugin that allows blue-collar workers to connect with recruiters or businesses for job opportunities. The extension would include a keyword tag to differentiate between white-collared and blue-collared positions and allow recruiters to access certain worker categories. It can assist recruiters/employers in filling labor gaps in their organizations and extending contracts as needed.
    - This will help blue collar workers become more visible to recruiters, and will help them generate more job opportunities. It is also more convenient for recruiters as they are already familiar with hiring through Linkedin.

    - To deploy this without promoting biases, LinkedIn can implement this as a separate platform as this will also help them to market their offerings in a diversified manner. Blue collar job industry does not currently have an organized platform as good as Linkedin and they can gain the early mover advantage if they dive into this arena.

- **Establishing a minimum pay scale criteria** on job postings to eliminate labor exploitation. This is a filter for the platform that the recruiters will use to determine the minimum compensation amount. Before submitting their applications for positions, the users of the platform (possible employees) would have a better notion of what to anticipate with this information.

- **Developing a mentoring program** that will enable workers with lower levels of expertise to receive guidance from professionals with higher levels of expertise in order to improve their knowledge and ability to perform well in interviews. This can also include the addition of courses for blue-collar workers that are geared toward the development of their skills, which would help them advance in their career trajectory.

➢ **Tackling bias in AI**

- **Setting different decision thresholds for different groups of users** : When it comes to optimizing search results across all profiles, having the same decision criteria can lead to the introduction of systemic bias into the process. Linkedin is able to take this into account by establishing different decision thresholds for different groups of users. This helps to ensure that people from a diverse range of backgrounds are represented accurately in search results.

- **Establish processes and practices to test for and mitigate bias in Al systems** :

    - Developers should make some preliminary assumptions about the function of an algorithm and take into account any relevant biases before actually running the algorithm.
    - In order to guarantee that a wide variety of viewpoints are incorporated into the process, it is imperative that a cross-functional and interdisciplinary team be assembled for the purpose of developing and implementing these algorithms.

- **Using internal third parties for auditing data and models**
    - the review of both the algorithm's input data and its output decisions, which, when carried out by an independent evaluator, can shed light on how the algorithm operates in practice.

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