A Positioning Framework for Generative AI and Robotics to Support Insourcing and Reduce Outsourcing Dependency

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ABSTRACT

AI is predicted to contribute $15.7 trillion to the global economy by 2030, higher than the combined output of India and China. Both the US and UK governments have announced programmes to embrace AI in 2025. There are many case studies of companies achieving cost savings such as Klarna reducing marketing costs by $10m. AI has now been extended into providing content which is referred to as Generative AI (GenAI). Generative AI has the potential to revolutionise the way work is undertaken across all industries, with predictions expecting AI to automate half of all work between 2040 and 2060. Recent advances in GenAI and robotics are transforming organisational decision-making, production capabilities, and global supply chains. While prior research has extensively discussed the economic and ethical implications of these technologies, there is limited theoretical guidance to support organisations in systematically adopting GenAI and robotics to enable insourcing and reverse long-standing outsourcing practices. This paper addresses this gap by proposing a holistic positioning framework to support organisational decision-making regarding GenAI and robotics adoption. Using a thematic analysis of academic literature, sixteen GenAI adoption challenges were identified and synthesised into four core dimensions, Human, Organisational, Environmental, and Technical, augmented by a fifth dimension addressing robotics-specific factors. This research contributes a novel positioning framework to the emerging GenAI and robotics literature and offers practical value for organisations considering insourcing as an alternative to trade tariffs and offshoring.

Keywords: Generative AI, Robotics, Positioning Framework, Insourcing, Reshoring

INTRODUCTION

The United Nations indicated that whilst the market size of Artificial Intelligence (AI) is estimated to reach $4.8 trillion by 2033 (greater than the highest value US company Apple $3.13 trillion (CompaniesMarketCap.com, 2025)), 40% of jobs worldwide could be affected therefore widening inequality and reducing the competitive advantage of low-cost labour in developing countries (World Economic Forum, 2025). This is an important concept and could reverse the trend to outsource business processes operations to low cost companies allowing companies to provide these Business Process Outsourcing (BPO) in host country improving job creation and reducing Supply Chain time scales (Atkins et al., 2010).

Generative AI (GenAI) has the potential to revolutionise the way work is undertaken across all industries, with predictions expecting AI to automate half of all work between 2040 and 2060 (MIT Technology Review, 2023). NVIDIA (2025) have announced that for the first time, they are developing American-made AI supercomputers in the US. Advanced AI and robotics will be utilised in these factories and it is expected to generate trillions of dollars in the following decades and create hundreds of thousands of jobs. The US is enforcing high trade tariffs and hopes to generate a manifesting boom with Howard Lutnick, the US Secretary of Commerce stating: '*This is the new model, where you work in these plants for the rest of your life, and your kids work here, and your grandkids work here*' (Burleigh, 2025, p. 1). Whilst there is a fear that robots will replace humans in industries such as manufacturing, Lutnick stated that people will be needed to repair robots and that robot technicians can earn high salaries with a low barrier to enter the field (Burleigh, 2025). This would support host country job creation and contribute to improving balance of trade as a softer approach to controversial recent imposed tariff

barriers implemented by the United States which is destabilising financial markets causing erratic decision making. This paper proposes a positioning framework to assist major commercial organisations considering in shoring business and/or BPO back to host country reversing the trend of outsourcing and it can assist in financial assessment, monitoring information for performance and quality of service and can be incorporated into service operations and benchmarking criteria. From the literature search undertaken to help businesses adopt GenAI and robotics no existing frameworks were identified

Despite the rapid growth of research on GenAI applications, ethical challenges, and economic implications, existing studies remain largely descriptive, sector-specific, or policy-oriented. While adoption frameworks have been proposed in areas such as education and entrepreneurship, as far as it can be ascertained from the literature there appears to be no framework that integrates GenAI and robotics adoption with insourcing and outsourcing reversal strategies. This study addresses this gap by developing a positioning framework that synthesises GenAI adoption challenges with robotics considerations and aligns them with established information systems and organisational theories.

BACKGROUND

A report by PwC (2025) predicts that by 2030 AI can contribute $15.7 trillion to the global economy, higher than the current output of China and India combined, outlining opportunities in the healthcare, automotive, financial services, transportations and logistics, technology, retail, energy and manufacturing sectors. The number of AI users is expected to continuously grow, a forecast from 2024 predicted the total number off AI users globally to reach over 729 million in 2030 (Statista, 2024b) as shown in Figure 1.

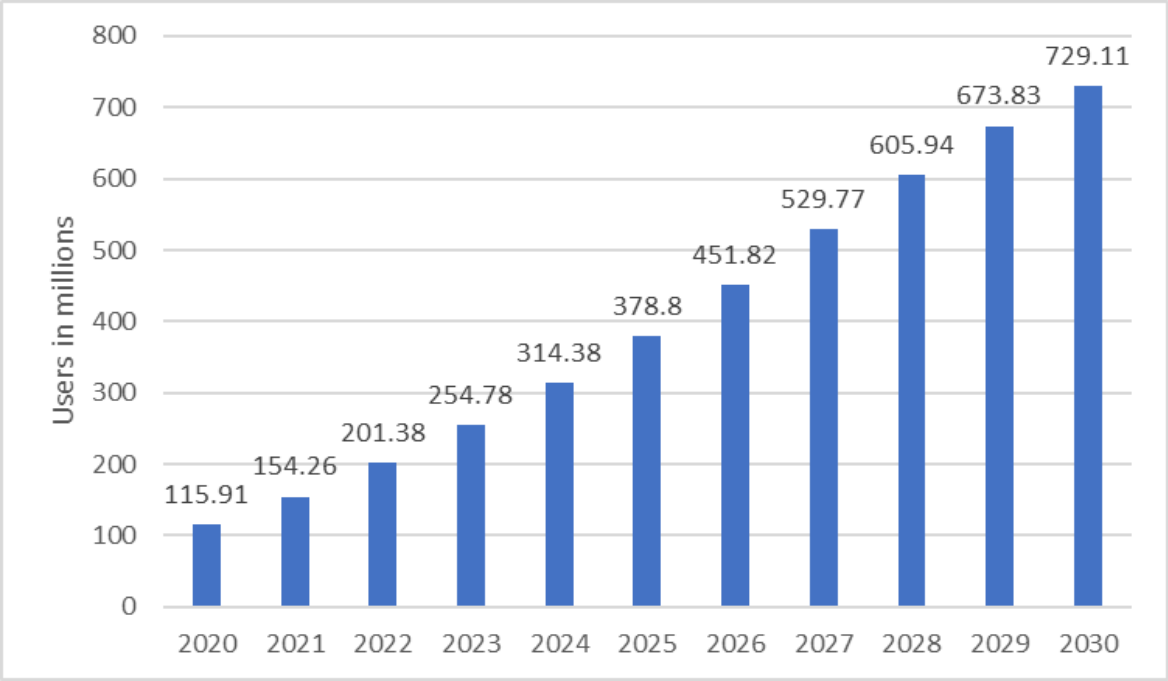

Figure 1: Number of AI tool users globally from 2020 to 2030 reproduced from Statista (2024b)

The launch of DeepSeek disrupted the GenAI market, the product was reportedly developed at a fraction of the cost of its GenAI rivals, becoming the most downloaded free app in the US within the first week whilst also causing tech giant NVIDIA to lose one sixth of its value (Hoskins & Rahman-Jones, 2025). It has been reported that DeepSeek is unable to answer questions about sensitive topics in China such as Tiananmen Square and Winnie the Pooh (Kumar, 2025) However, the app is completely banned in Italy, whilst government departments of the US, Taiwan and Australia have banned the use of the app, with Belgium, France and Ireland all investigating the way DeepSeek handles personal data (Cuthbertson, 2025).

Governments are investing heavily into AI, with the US Government recently announcing a $500bn infrastructure programme to build datacentres, computing infrastructure for the development of AI, funded jointly by OpenAI, Oracle and SoftBank and MGX (Hemphill, 2025). Similarly, the UK government also

announced an AI Opportunities Action Plan which by 2030 will increase 20-fold the amount of AI computing power under the public control by 2030 and to make Britain a world leader in AI (Booth, 2025). Controversially, the scheme also aims to allow public data to help drive the increase of AI businesses including anonymised National Health Service (NHS) data to allow researchers to train AI models however there will be "strong-privacy preserving safeguards". However, a study by the UK Government's Department for Science, Innovation & Technology (2024) revealed that the public remain anxious of AI, with the three most associated words with AI are "robot", "scary" and "worried".

Attitudes towards GenAI differ between countries and organisations. The UK Government's Department for Work and Pensions (DWP) banned the use of Chat GPT in their guidance to staff: 'Users must not attempt to access public AI applications – such as ChatGPT – when undertaking DWP business, or on DWP-approved devices' (Trendall, 2024a, p. 1). However, following this, DWP undertook experiments using Microsoft Copilot and are now set to embrace GenAI and seeking to engage with suppliers to invest in the technology (Trendall, 2024b). Similarly as described with DeepSeek, Italy were the first Western country to ban ChatGPT due to privacy concerns of massive collection and processing of personal data potentially used to train algorithms (Bertomeu et al., 2025).

The Buy Now, Pay Later company Klarna have reported that they have reduced their marketing costs by up to $10m by adopting GenAI for their marketing campaigns and generating images (Kshetri, 2024). Klarna reduced its sales and marketing budgets by 11%, utilising leading GenAI tools including Midjourney, DALL-E and Firefly AI were responsible for 37% of the cost reduction benefits. However, it has also been reported that Klarna reduced its number of full-time equivalent staff by 24% within a year, from 5,000 to 3,800 with plans to reduce to a target of 2,000 (Ingham & Baker, 2024).

A study undertaken by Sia Partners reviewed 1,000 work related tasks across 50 occupations which included healthcare, manufacturing, finance and education, finding that the majority will be impacted by GenAI (Consultancy.uk, 2024). For 28% of the occupations reviewed, 80% or more of tasks could be conducted by GenAI which could lead to reduced headcount. 79% of occupations could also see 10% of tasks be conducted by GenAI. However, despite the opportunities of GenAI there are growing concerns including security, ethical and privacy.

GenAI

Due to the growing popularity of GenAI, particularly the introduction of ChatGPT, it is important to differentiate AI from GenAI and understand the technologies from which it is built. IBM define Artificial Intelligence as: 'technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy' (Stryker & Kavlakoglu, 2024, p. 1). One of the seminal papers, Alan Turing's 'Computing Machinery and Intelligence' introduced the Turing Test which has become a central concept in AI as it is one way of measuring machine intelligence by assessing its ability to mimic human conversation and behaviour (Mucci, 2025). There have been periods of time where there has been decreasing interest in AI, known as 'AI Winters' due to high expectations and lack of progress with the technology between the 1970s and 1990s, with a short revival in the early 1980s (History of Data Science, 2021). By the mid-2000s, there was renewed interest in AI due to the evolution of machine learning techniques, especially the rise of deep learning leading to significant breakthroughs such as recurrent neural networks (RNNs) that improved natural language processing and convolutional neural networks (CNNs) which powered image recognition systems (Institute of Analytics, 2024). The rise in interest in AI has been defined by the explosive rise of generative AI, leading to significant interest from the public and commercial investment, however despite their impressive ability there are limitations with the technology such as difficulty being able to understand context or making judgements beyond the training data of the models (Institute of Analytics, 2024). There have been warnings of the need for a future AI winter as it is possible that the progress of AI could slow again, despite that seeming quite unlikely due to the growth of generative AI (Hamid, 2025; Lee, 2024).

Machine learning is the process of using mathematical models of data to enable a computer to learn without instructions, allowing it to continue to learn and improve independently (Kufel et al., 2023). The two primary

approaches to machine learning are supervised where labelled data is used to train the model and unsupervised where unlabelled data is used.

Deep learning is a subset of machine learning and AI which utilises neural networks containing multiple layers to represent the abstractions of data to build computational models (Sarker, 2021). It mimics the human brain to interpret data including images, sound and text, however it can take a long time to train but can perform testing quicker than other types of machine learning algorithms (Xin et al., 2018).

Generative AI (GenAI) refers to computational techniques which are capable of generating new, meaningful content including text, images or audio from training data (Feuerriegel et al., 2024). GenAI differs from traditional AI that specialises on specific tasks, GenAI aim to understand the underlying distribution of training data which enables them to produce novel content that shares similarities with the original data (Golda et al., 2024). Ronge, Maier and Rathgeber (2024) suggest that there is not one unified definition of AI or GenAI but there are four features which differentiate GenAI from other forms of AI: modality, interaction, flexibility and productivity. Currently we are in the fourth industrial revolution, known as Industry 4.0, which is being driven by technologies such as Internet of Things (IoT), Big Data, AI, Machine Learning (Javaid et al., 2022). The fifth industrial revolution, Industry 5.0 is defined by the European Union as: 'a vison of industry that aims beyond efficiency and productivity as the sole goals and reinforces the role and the contribution of industry to society. It places the wellbeing of the worker at the centre of the production process and uses new technologies to provide prosperity beyond jobs and growth while respecting the production limits of the planet. It complements the existing "Industry 4.0" approach by specifically putting research and innovation at the service of the transition to a sustainable, human-centric and resilient European industry.' GenAI is has the potential to support the transition to Industry 5.0 by shaping the future of industries fostering increased productivity, sustainability and creativity as its capabilities continue to evolve (Sai et al., 2024). There are different types of generative AI models tailored for specific tasks or types of content generation and these include Generative Adversarial Networks (GANs), Transformer-based models, Variational Autoencoders (VAEs) and Diffusion Models (DMs) (Sengar et al., 2024).

Large language models (LLMs) are a deep learning models which are trained to understand and generate natural language, built on a transformer which is a state-of-the art neural network architecture consisting of billions of parameters (Shen et al., 2023). OpenAI significantly contributed to the development of LLMs in 2018, the same year in which GPT (Generative Pre-trained Transformer) an additional transformer based architecture which has since evolved and powers ChatGPT, sparking interest in GenAI (Raiaan et al., 2024). Figure 2 shows the relationship between AI, Machine Learning, Deep Learning, GenAI and LLM reproduced from (Malandruccolo, 2024) and link to the 5 industrial revolutions (Noble et al., 2022).

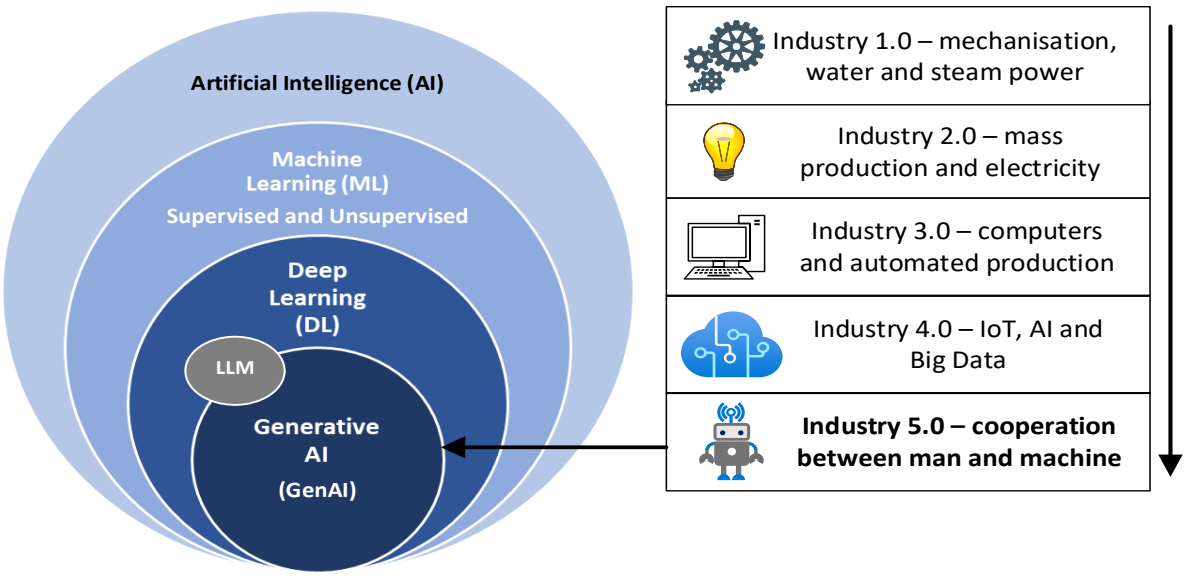

Figure 2: Venn diagram showing the relationship between AI, ML, DL, GenAI and LLM modified by authors from M. Malandruccolo (Malandruccolo, 2024)

The market size of AI grew by nearly $50 bn between 2023 ($135.93 bn) to 2024 ($184.03 bn) and this huge growth is expected to continue to over $826 bn in 2030 (Statista, 2024a) as shown in Figure 3.

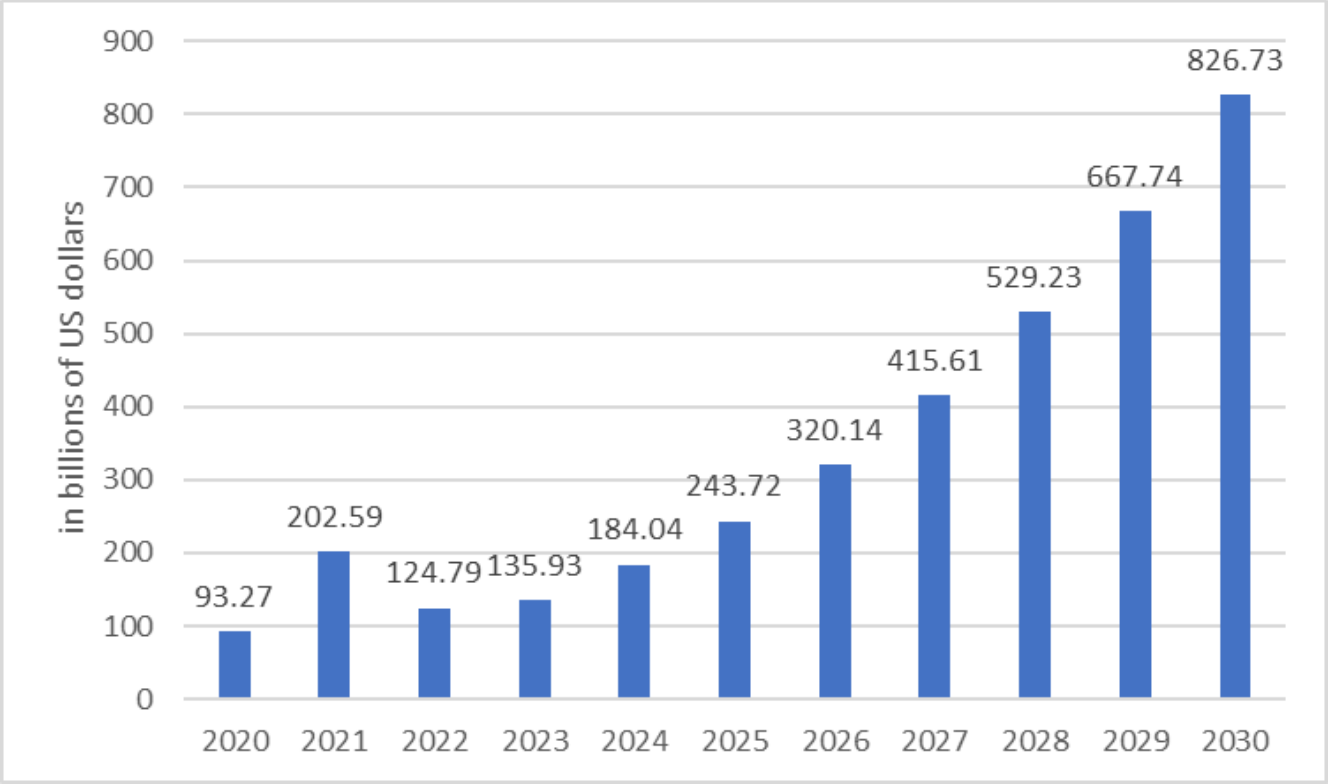

Figure 3: AI market size worldwide from 2020 to 2030 in billion US dollars reproduced from Statista (2024a)

Table 1 shows a sample of the growing number of GenAI products available.

Table 1. Sample of GenAI products by type

Text	ChatGPT (OpenAI, 2025), Claude (Anthropic, 2025), Meta AI (Meta, 2025), Gemini (Google, 2025a)
Images	Leonardo (Leonardo AI, 2025), Midjourney (2025), OpenArt (2025)
Presentations	Gamma (Gamma Tech, 2025), Presentations.AI (2025)
Music	Suno (2025), AIVA (2025)
Mind Maps	Mapify (Supermind, 2025), Whimsical (2025)
Trips	Gemini (Google, 2025b), Trip Planner AI (2025)
Logos	Recraft (2025), Looka (2025)
Video Editing	CapCut (2025), OpusClip(2025)
Voice Generator	ElevenLabs (2025), Resemble AI (2025)
Transcribe Audio	Notta (2025), Otter.ai (2025)

There are many case studies emerging of GenAI being used to provide tangible benefits. The Royal Institute of British Architects (2024) reported that 41% of UK architects had used AI on at least one project, with 43% agreeing that it made the design process more efficient.

In the retail industry, Walmart claims that the average American family spends six hours per week conducting household planning and shopping, and therefore developed the 'Walmart GenAI Search' tool to help customers find the products they need, generating personalised responses and product suggestions (Walmart, 2024a). Walmart has since unveiled its Adaptative Retail strategy, utilising AI, GenAI and augmented reality to provide customers with personalised shopping experiencing including returning orders, using decades of historical data and reportedly during testing customers have reported a smoother experience (Walmart, 2024b). Ferrari are

reported to have utilised an Amazon Web Services (AWS) GenAI solution for a variety of purposes including accelerating its vehicle design process resulting in 60% faster vehicle simulations and increasing the customer experience by increasing the speed of car configurations by 20% (Amazon Web Services, 2024). In the financial sector, banks such as Wells Fargo utilise traditional AI for a variety of purposes including marketing, and credit decisions but they are "going to move very slowly with GenAI" with potential to enable the automation of its call centres (Hamill, 2024). There are many opportunities for the use of Generative AI in education. For example GenAI could be used to reduce the workload of teachers, allowing them to refocus on innovative lessons plans, undertaking professional development and providing personalised coaching or mentoring of students (Grassini, 2023).

Robotics

GenAI can be deployed for a variety of use cases alongside robotics, a primary example of this is in the manufacturing industry. These include warehouse automation where GenAI can be utilised to identify optimal paths and identify efficiencies to allow robots to pick, sort and transport goods with high precision and speed (Sajid, 2025). Predictive maintenance and worker safety monitoring allows GenAI to learn human movement patterns which allow robotics to operate safely such as on assembly lines (Sajid, 2025). Amazon have identified through a study with MIT that 60% of their employees who have interacted with robotics and AI see the benefits including positive impact on safety, productivity and employee career development (Wheeler, 2024). Amazon also stated that the introduction of automation creates more opportunity for employees to progress into new, higher-paid positions and they have invested $1.2 billion since 2020 into training 300,000 employees in technological areas such as robotics and engineering (Wheeler, 2024). The literature categorises robotics into systems including their industry such as healthcare, manufacturing, agriculture, transport and logistics (Licardo et al., 2024). Robotics could also be classified on their technical application such as 'stand-alone' (for example a welding robot or an individual robot for assisted living or in a hospital for collecting equipment etc), automation (examples including production lines in a factory or medical analysis using automatic systems for loading samples) and digital transformation (hospital x-rays, QR codes and RFID tags to track items into the patients records). It is unlikely in robotic technology that there are 'one size fits all' scenarios and they would need to be considered for specific applications. It is anticipated that off-the-shelf solutions and/or customisation will be procured to prevent delays in implementation possibly using a generic robot model with interchangeable components for specific applications.

Challenges Of Using Genai

An extensive literature review was undertaken to identify challenges to GenAI adoption. As this is a relatively new field, news articles were also utilised to identify up-to-date information on the rapidly evolving GenAI landscape. A snowball sampling approach (Hiebl, 2023) was utilised using academic search engines such as Google Scholar to identify relevant literature documenting the challenges of GenAI and utilising the references in these articles to identify further sources. Additionally, news articles from the last 3 years were sought to find up-to-date information in this rapidly evolving field. The literature review has identified 16 challenges of GenAI adoption grouped into four categories: Ethical, Privacy, Security and Technical.

Ethical

Ethical issues concern the moral issues associated with the implications of GenAI such as copyright and content ownership, the implications of job displacement, exploitation of labour, overreliance on AI and plagiarism.

Copyright and Content Ownership

Copyright is described by the UK government (GOV.UK, 2025) as protecting the author's work and stopping others from using it without the author's permission. From a GenAI perspective there are two concerns regarding copyright: the usage of copyrighted material to train GenAI models and the ownership of content produced by GenAI. Al-Busaidi *et al.* (2024) stated in March 2024 the Wall Street Journal conducted an interview with OpenAI's Chief Technology Officer which highlighted concerns about the potential concerns about lack of transparency of OpenAI's data practices and the use of copyrighted data to train AI models.

Ownership of GenAI created content is much disputed issue with differing opinions of the ownership of content. Khosrowi, Finn and Clark (2024) highlight that some view GenAI as a tool such as a camera which enable the users to be sole creator of the content produced, others view GenAI as having creative control, another perspective is that the developers of the GenAI systems as taking ownership of the content, whereas the final perspective is that content ownership is a collaborative effort between these different parties. A high-profile example of ownership issues is the Post Office Horizon Scandal, where around 700 sub-postmasters were prosecuted between 1999 and 2015 for fraud, theft and false accounting cash shortfalls in branches which were reported by the Horizon System. In 2024, the convictions were overturned by the UK Parliament (Sivathasan & Beal, 2025). The Horizon system was developed by Fujitsu and the Post Office has spent over £2.5 billion on Fujitsu contracts for this system, including over £600m to continue using the system since 2012 despite agreeing a decade earlier to move away from Horizon. Fujitsu own the intellectual property for Horizon, yet the Post Office were ultimately responsible.

Job Displacement

A World Economic Forum survey reported that 41% of companies worldwide have plans to reduce their workforce by 2030 due to AI, however 77% also said that they are planning to reskill and upskill their existing workforce between 2025-2030 to allow them to work together with AI (World Economic Forum, 2025). McKinsey (2023) suggested that the impact of GenAI could automate nearly 10% of all tasks in the US economy which whilst it affects all spectrums of jobs it is more focused on the lower-waged jobs. Similarly a study by Ernst Young (EY) reported that higher skilled roles such as in the finance and insurance, information, utilities and professional services have a greater exposure to GenAI (Daco, 2024). Therefore, there is a risk that both low and highly skilled jobs could be displaced as a result of GenAI requiring workers to retrain in jobs where there is a demand for human labour.

Exploitation of Labour

It was reported that in November 2021, OpenAI utilised an outsourcing firm in Kenya which paid workers less than $2 USD per hour to label graphic data to reduce the likelihood of graphic content appearing on ChatGPT (Perrigo, 2023). The nature of the images reported to have been witnessed by the workers include sexual abuse, murder, suicide self-harm and incest. Therefore, there may be an ethical dilemma as to how AI models are trained as in this case, cheap labour in the third world has been exploited to work with distressing content.

Overreliance On AI

There is a risk that as GenAI becomes more accepted in undertaking routine tasks effectively, people will become over reliant on using it for decision making. A study undertaken by Klingbeil, Grützner and Schreck (2024) found that the participants over relied on advice generated by AI for financially risky and ethical decisions leading to undesired outcomes for themselves and third parties. This highlights the potential danger in placing trust in GenAI without undertaking any due diligence checks. From an academic perspective there are concerns about the negative implications of the widespread adoption of GenAI which is linked to a decline in the cognitive abilities, reduced capacity for information retention and an increased reliance on GenAI for access to information (Zhai et al., 2024).

Plagiarism

It has been reported that Australian academics have passed hundreds of students who have been suspected of cheating through the use of GenAI, which is threatening the integrity of universities and devaluing degrees (Cassidy, 2024). Despite GenAI's potential to enhance the learning environment, one of the key concerns for academics are the use of GenAI to produce content for students and it has been reported that tools such as ChatGPT are able to produce content which appears to be novel and can evade detection by traditional plagiarism detection software, which may accelerate further as AI technology continues to evolve (Grassini, 2023).Privacy

AI driven decisions introduce risks including unauthorised access, misuse and potential for AI-driven decisions to impact individual's lives without transparency and therefore may result in major challenges (Reis et al., 2024).

A survey undertaken by Deloitte found that 40% of professionals reported data privacy as their top GenAI concern in comparison to 22% in 2023, with 72% reporting it as a top 3 concern in 2024 (Jackson, 2024). Golda et al. (2024) outline that approaches such as Privacy-Preserving Techniques (PPTs) have been used to address privacy concerns, however they add noise to the data to preserve privacy but this can impact the quality of the generated data. An example is provided of medical research, where synthetic data generated using PPTs does not meet the same standard of the original data. Privacy related challenges refer to the threat of GenAI on an individual's privacy through the potential misuse of personal identifiable information and the bias of outputs from GenAI systems. It also includes the compliance with regulation and Deepfakes which are a threat to an individual's privacy.

Bias of Outputs

There is a potential that GenAI products could contain bias which could influence the outputs it generates. For example, it has been reported that ChatGPT previously reinforced gender stereotypes such as presenting doctors as males and nurses as females, which whilst efforts were made in the evolution from GPT-3.5 to GPT-4 in reducing bias, it has been demonstrated how they are still present (Currie et al., 2024). There are multiple ways how bias may be introduced including: through the training data used; through algorithmic bias such as how the algorithm has been trained or programming errors; and cognitive bias (IBM, 2023). An example of bias in AI is how Amazon stopped using a recruitment system which favoured words such as "captured" or "executed" which were more frequently found in men's resumes (Uymaz, 2021).

Compliance with Regulation

The privacy landscape has been transformed by the rapid technological advancements in recent decades including the internet, mobile devices, social media, data analytics and AI, which has led to unprecedented volumes of personal data being collected, processed and shared (Reis et al., 2024). The International Association of Privacy Professionals (2025) reported that 144 countries have data protection and privacy laws in effect. This highlights a major challenge as businesses with customers in multiple locations will need to comply with multiple regulations. Raman (2023) states that the lack of uniformity in international data privacy laws poses issues for global organisations and their cyber security. Therefore, the location of an organisation dictates how they store, process and transfer data and how they respond to data breaches. The EU's General Data Protection Regulation (GDPR) is claimed to be the toughest privacy and security law and it imposes obligations for organisations that target or collect data related to citizens of the EU (GDPR.eu, 2025). Using this law as an example, there are a number of challenges which businesses using or providing GenAI applications will need to consider.

One aspect of GDPR and other privacy legislation is the Right to be Forgotten, which Article 17 of GDPR defines as one of the rights of a data subject (a person) that they have the right to obtain from the data controller erasure of personal data concerning them and that the data controller is obligated to comply (Intersoft Consulting, 2025b). Similarly, Article 16 of GDPR outlines the right to recertification whereby the data subject has the right to correct inaccurate personal data (Intersoft Consulting, 2025a). Falconer (2023) suggests that this may not be possible at present as LLM's do not have the ability to selectively unlearn or delete specific items as data such as an individual's name or date of birth.

Data Subject Access Requests allow the data subject the right to request their personal data and the organisation responding to the request is required to: confirm if they are processing personal data concerning the individual; provide a copy of their personal data held; and provide information about the processing being undertaken (European Commission, 2025; Gucluturk, 2024). Complying with requests may be difficult if the individual's data has been processed by LLMs (Falconer, 2023).

Data localisation requirements are another challenge for users of generative AI. As countries have different legislation relating to how customer data should be stored, processed, and safeguarded adding further complexities for businesses with a global customer base to navigate (Falconer, 2023).

Governments' approach to AI regulation is currently mixed with some countries supporting regulation and others showing caution. The recent AI Action Summit in Paris was attended by nearly 100 countries of which 60

national governments including China, the EU and African Union endorsing the 'Statement on Inclusive and Sustainable Artificial Intelligence' 60 countries have backed AI regulation, however the US and UK signatures were absent from this (Cross, 2025). The EU have introduced the Artificial Intelligence Act which governs the development and/or use of AI in the EU and provides risk-based AI classification systems, with the risk level determining if more or less AI compliance is required (European Parliament, 2025). Non-compliance can result in fines of up to €35m EUR or 7% of the offender's annual turnover (Future of Life Institute, 2025). Therefore, the complexity of complying with international AI regulations may pose another challenge for multinational businesses.

Deepfakes

Deepfake are realistic audio, images or videos which are created using AI algorithms which can be difficult to differentiate between fake or real, therefore can infringe an individual's privacy (Alanazi & Asif, 2024). For example, personal photos and videos can be manipulated An example of how deepfakes can be used to deceive is when a finance worker at a multinational firm paid £20 million to cybercriminals who had utilised deepfake technology to impersonate the chief financial officer and other colleagues (Milmo, 2024). Another example is how 8 stolen identify cards in Hong Kong were used to make 54 bank account registrations and 90 loan applications, with AI deepfakes being used to deceive facial recognition authentication by imitating the individuals who the identity cards belonged to (Vecchietti et al., 2025).

Processing of Personal Identifiable Data

As an experiment, the researchers asked, ChatGPT (OpenAI, 2025), Claude (Anthropic, 2025), Microsoft Copilot (Microsoft, 2025b), DeepSeek (2025) and Gemini (Google, 2025a) the question: "Do you recommend inputting personal identifiable information into (GenAI product name)?". The experiment was undertaken on 13th April 2025. Each version of the product was a free to use, personal version of the product not a business licence. However, each product advised against inputting personal identifiable information (PII) into the respective products. Figures 4 to 8 show the output from each of the GenAI products.

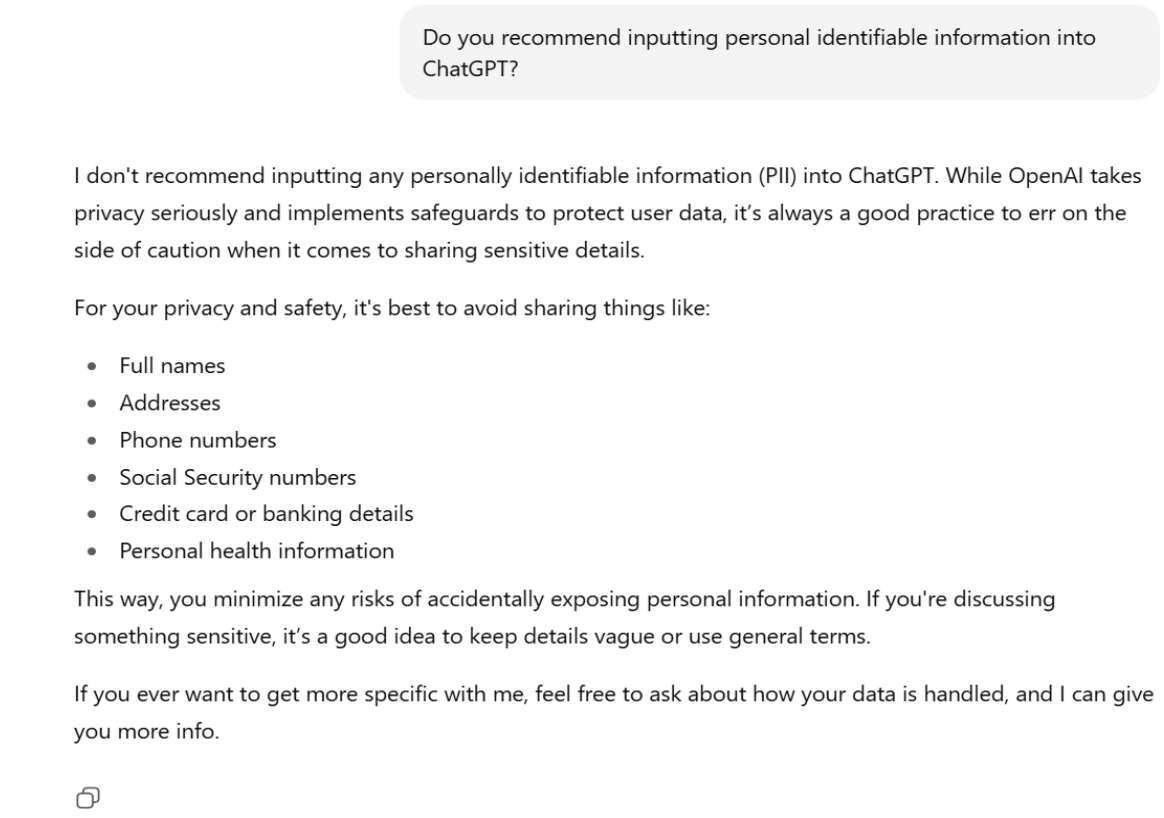

Figure 1. Inputting personal indefinable information into ChatGPT

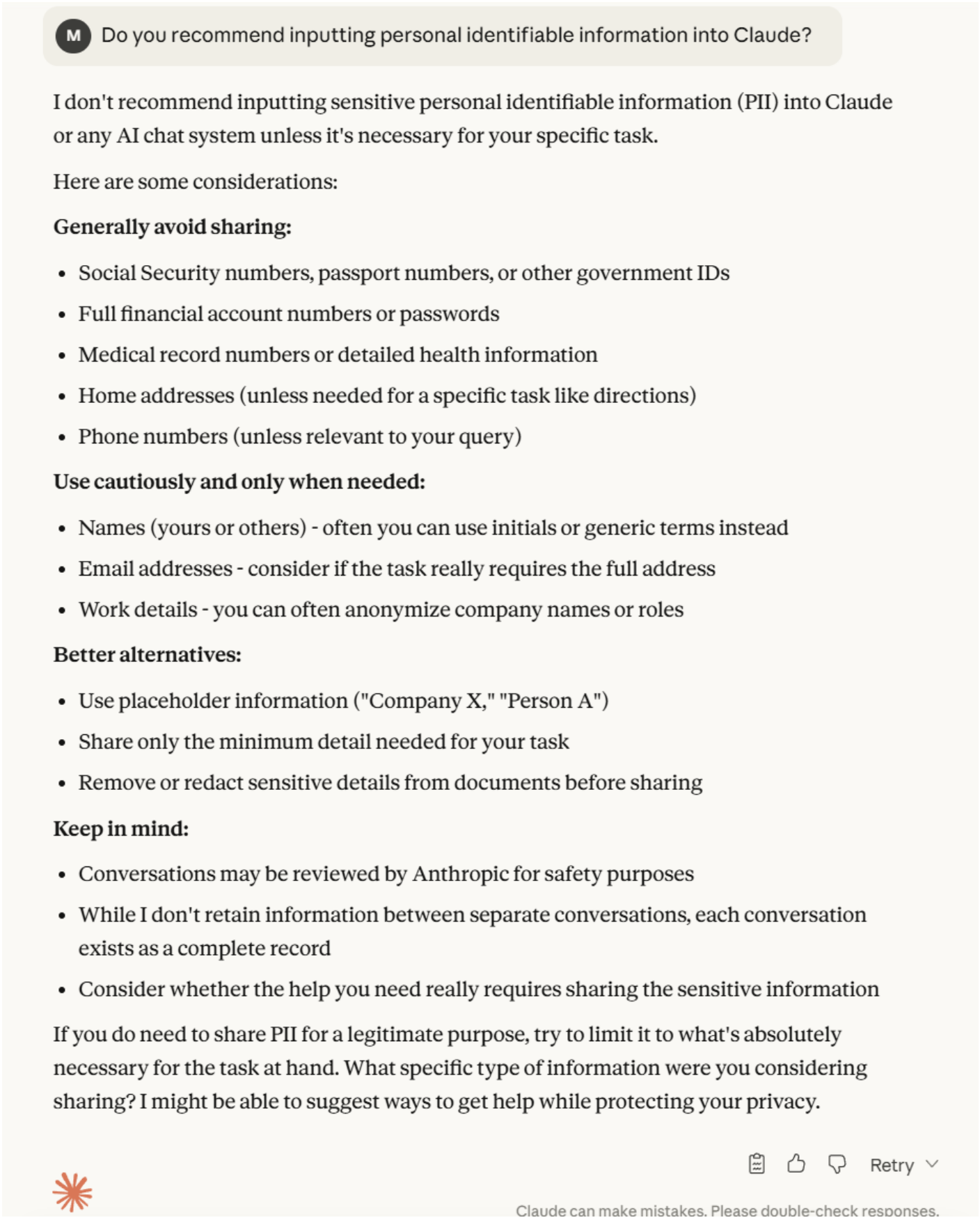

Figure 2. Inputting personal indefinable information into Claude

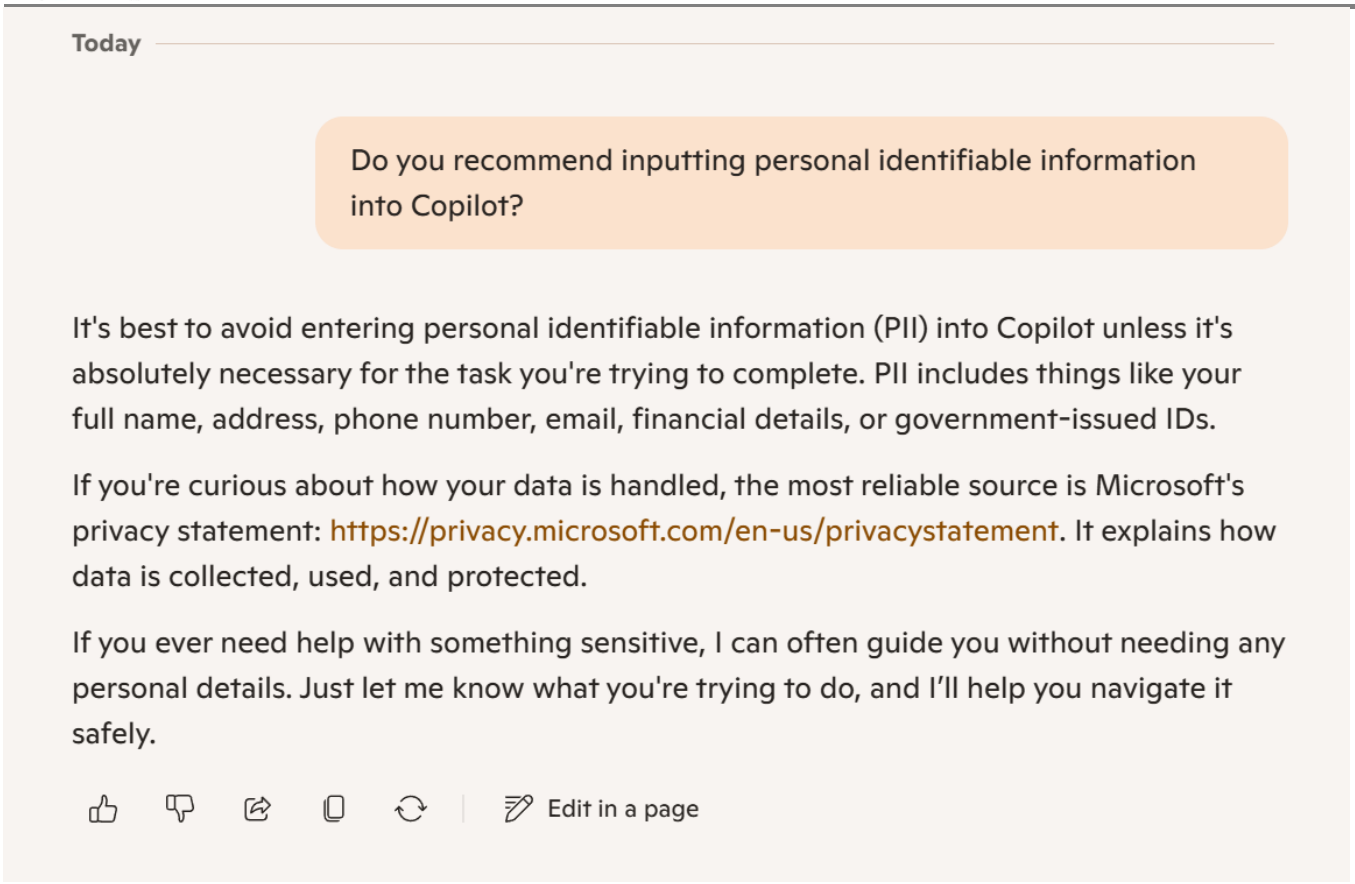

Figure 3. Inputting personal indefinable information into Microsoft Copilot

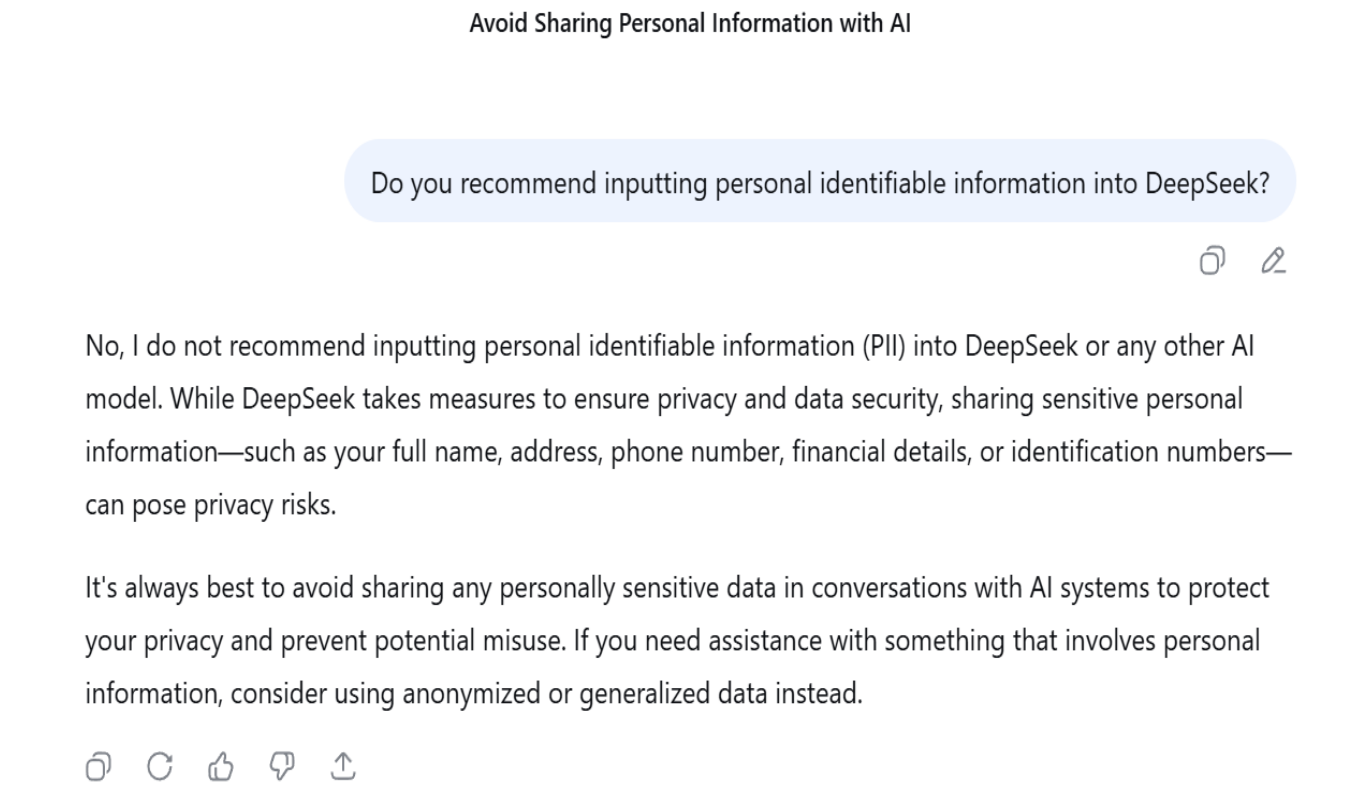

Figure 4. Inputting personal indefinable information into DeepSeek

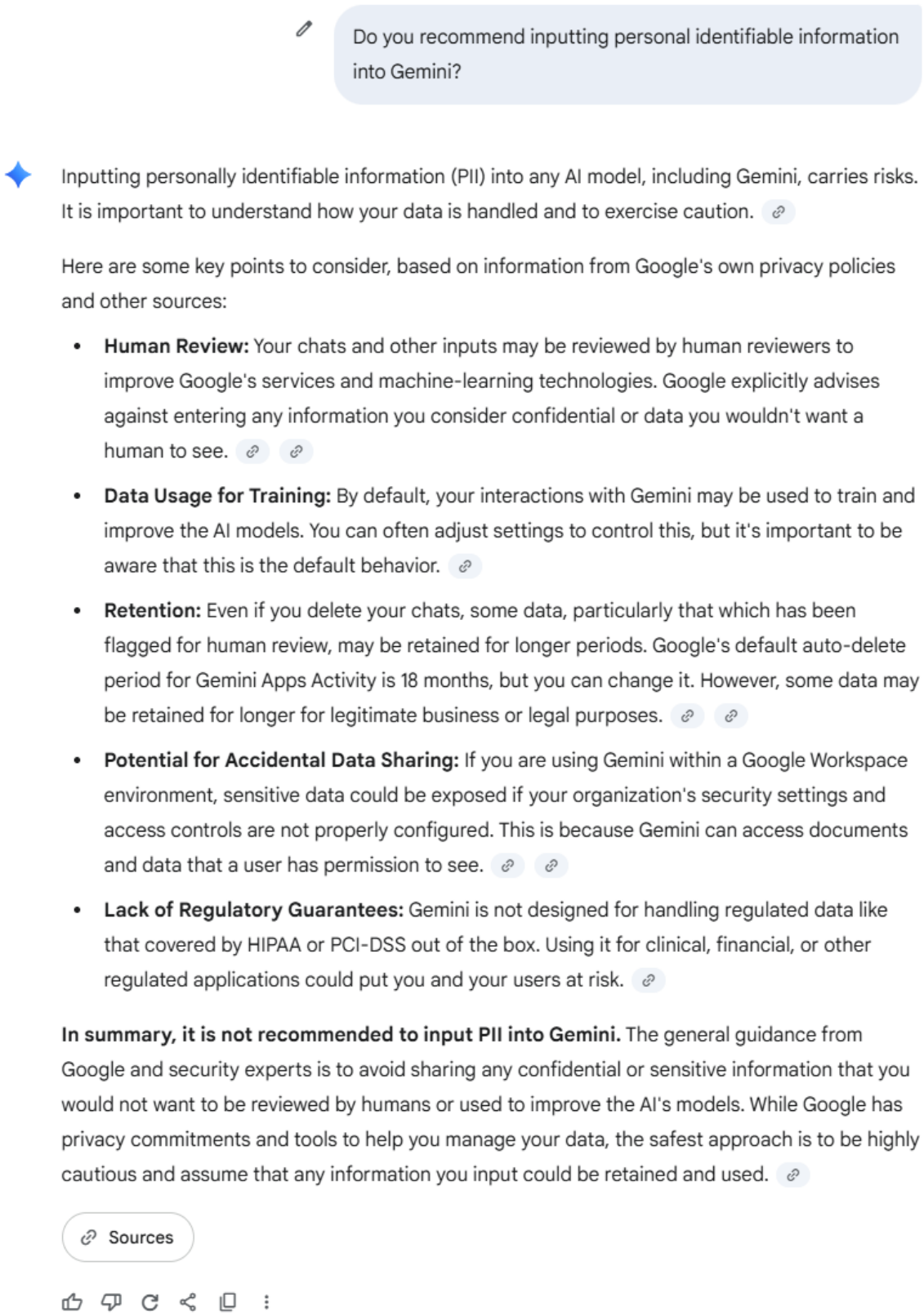

Figure 5. Inputting personal indefinable information into Google Gemini

Security

Security challenges relate to data security issues relating to GenAI including security vulnerabilities, data leakage, and malware creation.

Cross-Border Data Transfers

Gartner (2025) predicts 40% of AI data breaches will arise from cross-border GenAI Misuse by 2027, this is partially driven adoption rate of GenAI adoption outpacing the implementation of governance and security measures. Additionally, due to the computing power required to support GenAI it is usually centralised which also raises concerns of data localisation. Joerg Frisch, VP analyst at Gartner stated (Gartner, 2025, p. 1): '*Organizations are noticing changes in the content produced by employees using GenAI tools. While these tools can be used for approved business applications, they pose security risks if sensitive prompts are sent to AI tools and APIs hosted in unknown locations*'.

Data Leakage

There have been multiple reports of GenAI data leakage. For example one report claims that sensitive data such as user data and passwords were leaked to unrelated users' sessions whilst another incident claimed details of another user's proposals and presentations were leaked (Mudaliar, 2024). An earlier report claimed that repeating the word "poem" endlessly forced ChatGPT to reveal entire passages of its training data which is not expected to occur (Ye et al., 2024). OpenAI are currently investigating a potential data breach whereby it was reported on a hacking forum that 20 million accounts were compromised including email addresses and passwords, however OpenAI claim no evidence to confirm this has been found (Landi, 2025).

Malware Creation

It was reported that hackers may be able to use ChatGPT to generate malware code or seek advice for how to discover vulnerabilities in a system by deceiving the GenAI system through how the prompts are written (Wu et al., 2024). Whilst it would be expected that the threat of the malware generated would be evaded by secure systems, it could be used on less secure systems therefore allowing less skilled users to become hackers. Similarly, Google reported how government-backed attackers have attempted to use Gemini for purposes such as researching vulnerabilities, scripting development, developing phishing campaigns and troubleshooting code (Google Threat Intelligence Group, 2025).

Risks of Integrated AI Products

Microsoft Copilot differs from other GenAI browser-based products as it is integrated into the Microsoft 365 apps including Word, Excel, PowerPoint, Teams and Outlook. Copilot utilises Large Language Models (LLMs) with the user's data in the Microsoft Graph and the Microsoft apps to enhance productivity (Sparato, 2023). By utilising the user's data including emails, chats, documents, meetings, contacts and calendars, the user can ask prompts such as "Tell my team how we updated the product strategy" and Copilot will generate a status update utilising the data the user has access to. There are security measures in place, for example data being restricted to an organisation's tenants and not shared with other customers, in addition to compliance with privacy legislation such as GDPR and keeping EU data within the EU data boundaries (Microsoft, 2025a). However, One of the major concerns of using Microsoft Copilot are that the user permissions need to be carefully restricted, if users have access to data they shouldn't such as intellectual property, financial information and personal identifiable information this increases the risk of sensitive data being accessed or processed inappropriately unintentionally (Stone, 2024).

Vulnerabilities

The Open Worldwide Application Security Project (OWASP) published a community-driven report in 2023 detailing the top 10 current security issues specific to AI applications, example attack scenarios and how to address them (Open Worldwide Application Security Project, 2023). This has been updated for 2025 (Open Worldwide Application Security Project, 2025) and details security issues including prompt injection attacks, insecure output handling, data poisoning and model denial of service. This demonstrates that like many computer systems, GenAI also has security vulnerabilities which need to be monitored and addressed as they are identified.

Technical

Technical challenges refer to the architecture, the reliability dependency on vendors and the computational power required for GenAI.

Architecture

GenAI operates in a 'black box' manner whereby it is unclear how its internal functioning and processes for decision making are opaque and not easily understood by its users or creators, posing a major challenge from a data privacy perspective (Ye et al., 2024). A potential solution to this problem is explainable AI for GenAI (GenXAI) techniques which provide explanations to help provide an understanding of the outputs from a GenAI model and is has been suggested that they do not provide optimal solutions at present (Schneider, 2024).

Dependency on Vendors

Google's market share on search engines is 89.79% with Bing coming in second with 3.93% (Statcounter, 2025b). Similarly for desktop and laptop computers, Microsoft Windows has a 71.9% share followed by OS X in second at 15.02% (Statcounter, 2025a). This suggests that as AI technology matures, there is a risk that one or a small group of vendors could emerge as the dominant force in the market, reducing competition and increasing reliance. This could also result in a situation similar to the CrowdStrike outage which was one of the worst cyber-incidents in history, estimated to have affected 8.5 million Windows devices worldwide causing catastrophic issues globally (Mugu et al., 2024). Marks and Spencer's (M&S), an iconic UK retailer with a capital value of £13 bn, has been unable to sell items on their website since April 2025 because of a cyber-attack which is reported to hit profits by £300 m for this year, caused by suspected outsourcing issues to 3rd party vendors (Fraser, 2025). In the same period, major companies such as Harrod's and the Co-Op retailers have also experienced cyber-attacks, dramatically affecting their businesses (Fraser, 2025). This indicates the vulnerability to cyber-attacks from potential 3rd party vendors this should be considered as strategic internal systems and possibility of 'pooling' likeminded companies to enlarge their expertise in the field of cybersecurity within host country where legislation, dedicated police (London Metropolitan Police) and National Security are there to support them.

Hallucinations

A major concern of GenAI are hallucinations which are described as being a phenomenon where AI produces distorted false or inaccurate information (Sun et al., 2024). Farquhar *et al.,* (2024) state that the limitation of GenAI to provide consistently reliable outputs is a major barrier to widespread adoption, with examples given being the risk to human life in medical applications such as radiology (Shen et al., 2023) and in law where a party in a lawsuit unknowingly referred to legal proceedings which had been entirely fabricated by ChatGPT (Weiser, 2023). An example of this is when the BBC undertook research in the ability of GenAI to summarise 100 news stories and found that the GenAI products used (ChatGPT, Copilot, Gemini and Perplexity) were inaccurately summarising news stories (Rahman-Jones, 2025). Experts in the subject of the news articles judged the quality of the outputs, finding issues with 51% of the answers and 19% of which cited BBC content introduced factual errors, for example, ChatGPT and Copilot stating that Rishi Sunak and Nicola Sturgeon were still in office after they had left. Athaluri *et al.* (2023) advise that while GenAI can be trusted but they should not be solely relied on for generating research proposals such as in the medical or scientific fields, therefore they should be used alongside human authors who should accept liability for its erroneous results.

Power Consumption

Another major challenged posed by GenAI is the energy requirement. It has been reported that data centres will require double the amount of energy by 2030 and this is being driven through the usage of AI (Chen, 2025). It has also been claimed that the power needed for sustaining AI's growth is doubling around every 100 days, with it being estimated that a GenAI prompt can require 10 times as much energy as a Google Search and GenAI systems require 33 times more energy than task-specific software (World Economic Forum, 2024). Therefore, this suggests that running GenAI will likely result in increased costs unless it becomes more efficient as the

technology matures. There is also an environmental concern if the power consumption continues to increase as it is speculated.

Proposed Framework

This study adopts a qualitative design approach, using thematic analysis to systematically derive a positioning framework utilising both empirical literature and established theoretical models. A literature search was undertaken to identify any existing frameworks for GenAI and robotics adoption. Whilst frameworks were found for the adoption of GenAI in Education (Shailendra et al., 2024) and entrepreneurs (Gupta & Yang, 2024), there does not appear to be any theoretical frameworks in the literature on GenAI and Robotics. Therefore, a framework is proposed based on the literature review undertaken in Section 3. Braun and Clark's (Braun & Clarke, 2006) thematic analysis process was followed which is a qualitative approach to identifying, analysing and reporting patterns and themes from qualitative datasets. There are six phases of undertaking a thematic analysis: Phase 1 familiarisation with the data; Phase 2 generating initial codes; Phase 3 searching for themes; Phase 4 reviewing themes; Phase 5 defining and naming themes; and Phase 6 producing the report.

For the first phase, familiarisation with the data, the literature review in Section 3 was undertaken and 16 challenges of adopting GenAI were identified classified under 4 initial themes. The second phase, generating initial codes is the process of identifying a feature of the data reviewed. Four themes arose from the nature of the GenAI and these challenges became the pillars of the proposed framework: Ethical, Privacy, Security and Technical. The third phase, searching for themes requires the codes from the previous phase to be arranged into potential themes. Figure 9 displays a thematic map showing the challenges of GenAI adoption arranged into the four initial themes.

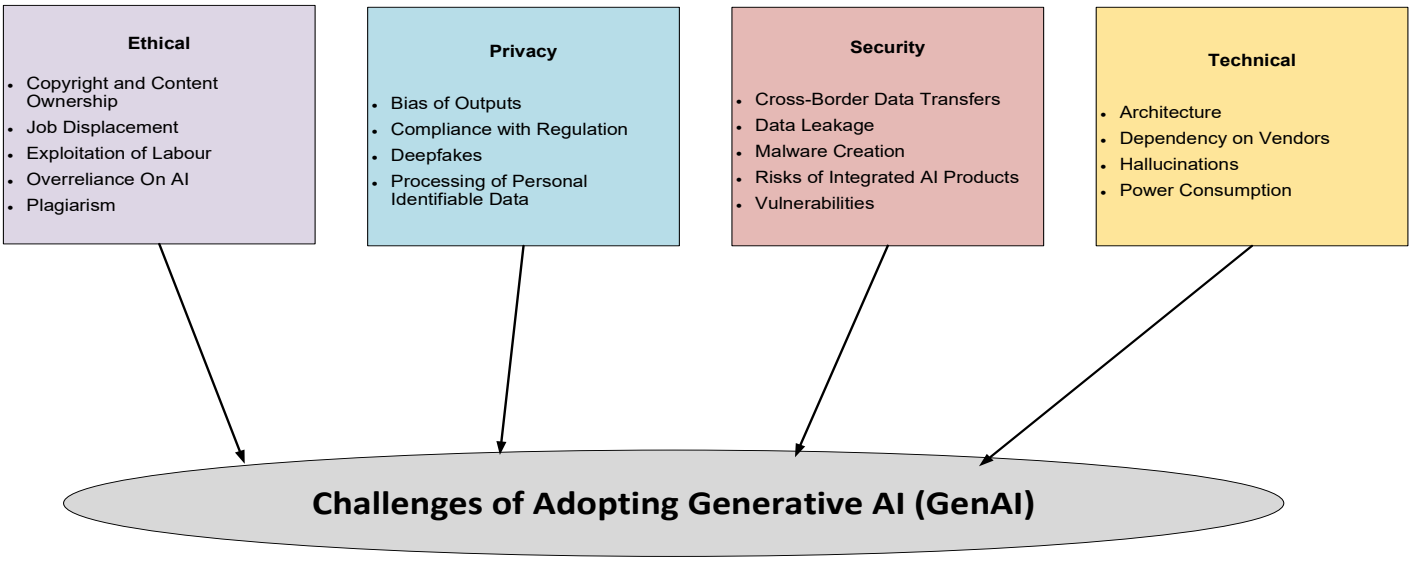

Figure 6. Thematic map of GenAI adoption

The fourth phase, reviewing themes, requires the themes to be reviewed and refined if appropriate. An additional pillar was incorporated into the framework to encompass the contribution of robotics. Generalised factors impacting the adoption of robotics (which includes automation and digital transformation) have also been added to the framework from the literature available (Barravecchia et al., 2023; Eder et al., 2024; Urrea & Kern, 2025). These include: the cost of a robot; implementation timescales; integration with existing systems as incompatibility may hinder adoption; scalability; and the specification of the robot as there are multiple types of robotics and a tailored solution may be needed depending on the application. This became the fifth pillar of the proposed framework.

The fifth phase, defining and naming themes, is the stage where final revisions are made to the themes and the final thematic map is created. Four themes have been identified at this point for GenAI with an additional theme for robotics added in the previous phase. However, the themes developed for this proposed positioning framework need to be linked to underpinning theoretical frameworks to provide traditional authentication and academic rigor to the process. The proposed positioning framework outlined in this paper is based on the concept

of combination of three theoretical frameworks: Technology-Organisation-Environment (Tornatzky et al., 1990), Human, Organisation, Technology-Fit (HOT-Fit) (Yusof et al., 2008) and the Information Systems Strategy Triangle (Pearlson & Saunders, 2009). These frameworks provide four overlapping themes: Environmental, Human, Organisation and Technology. Applying a previous approach which also utilised these theoretical frameworks to identifying barriers to adoption for Big Data Analytics and outsourcing led to the Big Data Analytics Framework for UK SMEs (Willetts et al., 2020) and the HABIO (Holistic Approach Business, Information Organisation) Framework (Atkins et al., 2010). Both frameworks are well established and are documented across a range of publications including the development (Willetts et al., 2020), validation (Willetts et al., 2022b; Willetts & Atkins, 2023b), evaluation (Willetts & Atkins, 2024) and application to commercial case studies of real businesses (Atkins et al., 2013; Willetts et al., 2021, 2022a).

The 16 challenges of adopting GenAI were recategorised under the 4 themes derived from theoretical frameworks. Technical challenges are related to the hardware and software required to utilise GenAI. The challenges under the technical theme remained under the same category. The 4 Security challenges were categorised as Technical as this was a logical fit as they relate to technical security issues related with GenAI. Human challenges relate to the impact on individuals of using GenAI for example job displacement and the impact on an individual's privacy. The majority of Ethical and Privacy challenges were therefore categorised as Human. Environmental challenges are the issues outside an organisation's control including legal, privacy and regulatory issues which must be complied with. Power consumption could be categorised as either organisational or environmental, due to the cost implications for the business and the impact on the environment of increased electricity consumption currently required for GenAI usage and consequently it has been classified as an Environmental challenge. The Organisational challenges refer to the impact on an organisation of adopting GenAI, for example ownership of the content produced by GenAI and becoming over reliant on GenAI. The remaining challenges were moved to the Environmental and Organisation pillars. The intention is that the proposed positioning framework would be integrated to previous documented (Willetts & Atkins, 2023c) business analysis and performance measurement software tool to measure the business benefits to related performance targets based on the Balanced Scorecard (Kaplan & Norton, 1992).

The 16 challenges of GenAI adoption were assigned to the 4 pillars and the 5 robotics factors were assigned to a fifth pillar. The final thematic map in the form of a framework displays a deck of cards next to each pillar, symbolising the barriers as cards and therefore additional barriers could be added or existing barriers could be replaced. The design incorporates this feature to allow for variations in application as not 'one solution fits all'. There may be additional challenges, however the cards in the framework allow for additional factors to be added. The proposed framework is displayed in Figure 10.

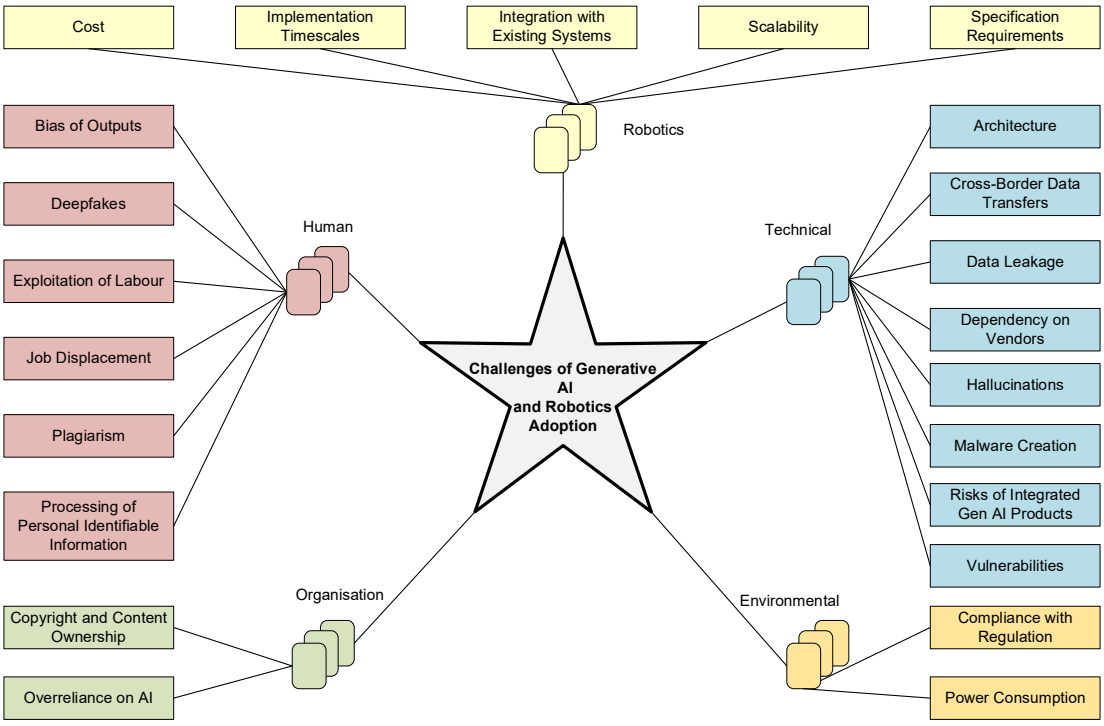

Figure 10. Proposed GenAI and Robotics Adoption Framework

The framework is designed using a holistic pattern. It is possible that additional challenges to GenAI adoption could be identified and similarly challenges may be overcome and therefore can be removed from future versions of the framework. The cards in the framework allow for change as these additional challenges can be added or removed. Similarly, not one solution will fit all businesses who use this framework as some of the challenges may not be applicable, therefore this adaptable framework gives flexibility. A scoring tool has been developed using the previous frameworks which have been applied to businesses allowing them to benchmark themselves and score where they want to be as weights have been applied to the cards (Willetts & Atkins, 2023a). The scoring tool allocates a question to each of the cards in the framework and a score is assigned between 1 and 5, which is multiplied by the weighting applied. The sum of all the weights provides a score between 1 and 5. The framework can also be used to measure performance using the balanced scorecard approach and benchmarking (Willetts & Atkins, 2023c) which have been used in Big Data Analytics framework for SMEs which have received positive feedback from the businesses, therefore this approach may be beneficial for businesses intending to adopt GenAI and robotics. The final phase of a thematic analysis is producing the report, which is the content of this paper.

DISCUSSION

The recently enforced trade tariffs have created global economic uncertainty, influencing interest rates cuts and unemployment. GenAI and robotics are disruptive technologies which can provide a variety of benefits particularly automating processes and efficiency which have the potential to replace humans in industries such as manufacturing. However, this paper proposes that this technology could actually be utilised as an alternative to tariffs. Many countries such as the UK have previously outsourced manufacturing, however GenAI and robotics present an opportunity to bring back manufacturing onshore which can generate higher paid employment. In manufacturing, robotics and GenAI require humans to collaborate with them and therefore higher skilled jobs will be required which have a low barrier to entry, resulting in higher pay for workers. The US government are confident that this will result in secure, high paid jobs long-term, suggesting that this approach could be successful worldwide.

To achieve the benefits of adopting GenAI and robotics, businesses will need assistance adopting the technology as proven with other disruptive/emerging technologies such as Big Data. A previously proven approach of a positioning framework has been proposed, developed through a literature review of challenges to GenAI adoption. This will allow businesses to identify what they need to overcome the challenges to adoption. This approach is flexible and can be tailored to fit the needs of a business where some of the challenges are not applicable or new challenges not currently in the framework can be added. The proposed framework is based on an approach which has been applied to commercial companies and documented in case studies, receiving positive feedback. Performance measurement is important because adopting a technology such GenAI and robotics should deliver benefits (tangible, intangible and/or hidden), therefore a way of measuring performance is needed. The proposed framework compliments scoring techniques including the Balanced Scorecard approach which measure performance based on four perspectives: financial, customer internal, learning and growth (Willetts & Atkins, 2023c). Another supported approach is benchmarking which allows businesses to understand their current position and how they compare to their competitors (Willetts & Atkins, 2023c).

GenAI and robotics technology is rapidly evolving, therefore this research was undertaken at a point in time, providing a perspective of the landscape at the time of completing the paper. It is highly likely that there are more challenges of using GenAI and robotics which are not documented in this paper. However, the proposed framework can be updated to include further challenges identified. Therefore, research is being undertaken to apply the framework to real-world businesses to develop studies in this field which will be documented in future work.

Framework Validation and Rigor

The validity of the proposed framework is supported in three ways. First, analytical validity is achieved through theoretical grounding in the TOE, HOT-Fit, and Information Systems Strategy Triangle models, all of which have been extensively validated in prior information systems research. Second, methodological rigor is established through systematic thematic analysis following Braun and Clarke's six-phase approach. Third,

external validity is supported by alignment with previously validated positioning frameworks applied to Big Data Analytics and outsourcing contexts. Current research will involve empirical application of the framework within commercial organisations.

CONCLUSION

This paper has outlined what GenAI is and how it differs from AI. Current news articles and publications highlight the negatives of GenAI contributing to job displacement however, this paper has outlined the potential for GenAI and robotics to provide an alternative to outsourcing and bring back manufacturing to host countries and therefore creating jobs. This is an alternative to controversial tariffs and a softer approach, reducing the possibility of losing markets. This approach can support businesses to bring back jobs back which were outsourced offshore in the 1990s for cheap labour. GenAI and robotics can lead to the creation of higher paid jobs and opportunity in state-of-the-art technology hub factories such as Amazon and NVIDIA. The vulnerability of companies in recent cyber-attacks should be a ‘wake-up call’ for reconsidering strategically to insource within the company within the host country, where GenAI could be beneficial in solving the problems and also the possibility of 'pooling' likeminded companies to enlarge their expertise in the field of cybersecurity within host country where legislation, dedicated police (London Metropolitan Police) and National Security are there to support them. To support this a positioning framework has been proposed, developed using a thematic analysis which can assist in reversing the controversial trend. It is believed that the framework is the first specifically developed to help businesses adopt GenAI and Robotics. The positioning framework is based on 2 well known frameworks in the fields of outsourcing and Big Data Analytics which were based on commercial case studies. The proposed positioning framework can also be linked to performance measurement, as if performance cannot be measured or the benefits cannot be achieved, then it may result in false promises being made. Future work will be used to develop, refine and apply it to real life businesses to obtain feedback.

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