Embracing intelligent machines: A qualitative study to explore the transformational trends in the workplace

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Abstract

Purpose – With Industry 4.0 and the extensive rise of smart technologies, we are seeing remarkable transformations in work practices and workplaces. Scholars report the phenomenal progress of smart technologies. At the same time, we can hear the rhetoric emphasising their potential threats. This study focusses on how and where intelligent machines are leveraged in the workplace, how humans co-working with intelligent machines are affected and what they believe can be done to mitigate the risks of the increased use of intelligent machines.

Design/methodology/approach – We conducted in-depth interviews with 15 respondents working in various leadership capacities associated with intelligent machines and technologies. Using NVivo, we coded and churned out the themes from the qualitative data collected.

Findings – This study shows how intelligent machines are leveraged across different industries, ranging from chatbots, intelligent sensors, cognitive systems and computer vision to the replica of the entire human being. They are used end-to-end in the value chain, increasing productivity, complementing human workers' skillsets and augmenting decisions made by human workers. Human workers experience a blend of positive and negative emotions whilst co-working with intelligent machines, which influences their job satisfaction level. Organisations adopt several anticipatory strategies, like transforming into a learning organisation, identifying futuristic technologies and upskilling their human workers, regularly conducting social learning events and designing accelerated career paths to embrace intelligent technologies.

Originality/value – This study seeks to understand the emotional and practical implications of the use of intelligent machines by humans and how both entities can integrate and complement each other. These insights can help organisations and employees understand what future workplaces and practices will look like and how to remain relevant in this transformation.

Keywords Intelligent machines, Qualitative research, Future workplace, Transformational trends, Future work practices

Paper type Research paper

Introduction

Intelligent machines have been around for decades. Whilst they first presented themselves in a cruder form, humans have managed to elevate them to highly sophisticated machines capable of much more than we had ever imagined. What started out as simple automation of routine tasks has now grown to become machine intelligence (Chiou & Lee, 2023) and is rooted in the disciplines of science, engineering and organisation theory. The term

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"automation" was coined by D.S. Harder in 1936 to describe how parts and components in a production process were transferred between machines without any human intervention. Although the term is technically made up of two words; "automatic" and operation", it is also used interchangeably with the term "mechanisation", which means the replacement of manual labour by machines. Therefore, automation is understood as the phenomenon by which both mental and physical tasks are replaced by machines (Hitomi, 1994). Technological advancements in the field of automation have helped industries become more competitive and collaborative, which ultimately leads to improvements in society and higher standards of living because workflows and processes are becoming smarter and more efficient. With the global workforce becoming more prevalent in the 21st century, automation and the use of technology are becoming necessary to maintain the expected level of productivity (Ing & Zhang, 2023).

With the rapid advancement of technologies and uncertainty regarding the workforces of the future, there is a need to understand the developments that have happened and are happening in the field of automation, which is connected to the usage of artificial intelligence (AI). Also, there is a need to understand how different stakeholders opine about these developments. Given this background, this paper examines the opinions of human workers in the midst of these changes. Despite the progress of AI, machine learning, robots and so on, intelligent machines are still at a nascent stage, contrasting many media reports that lead to more fear. This paper focusses on the following areas: firstly, how companies are currently employing intelligent machines. Secondly, how intelligent machines currently affect work, work practices and workplaces. Thirdly, human worker satisfaction whilst co-working with intelligent machines and how they feel whilst co-working. Fourthly, what anticipatory strategies are being employed to prepare human workers for the technologies on the horizon.

Literature review

We can look at the history of technology and its advancements through the technological revolutions, which are phases in time that describe the development of science and its application in production processes, the first of which began in the latter half of the eighteenth century with the use of coal and oil as primary sources of energy. The transition from this first phase to the second industrial revolution was brought about by the introduction of electricity as a new source of energy (Rymarczyk, 2020). The second industrial revolution lasted for approximately 70 years, and although rapid technological changes were occurring, the increase in productivity was quite slow due to the overall reluctance to adapt to newer technologies (Atkeson & Kehoe, 2001). The third industrial revolution was characterised by information technology and digitisation or digital automation, with computers, amongst other electronics, paving the way. The fourth industrial revolution made its entrance in the year 2000, the beginning of the 21st century. It is now popularly known as Industry 4.0, and its key drivers include AI, robotics, autonomous systems and the Internet of Things (Bahrin, Othman, Azli, & Talib, 2016). Industry 4.0 has introduced more refined and cultured technologies, often referred to as "intelligent machines", which are able to engage in more complex tasks than ever before. Decades ago, these intelligent machines were a mere concept, a dream that visionaries hoped would one day become true. Today, they are leveraged across the globe in every industry and organisation. But what exactly are intelligent machines, why are they so prevalent in our workforce and how does their presence affect us?

Intelligent machines are distinguished from others by their autonomy and heightened abilities to learn, interact and communicate with both fellow machines as well as humans. They are primarily driven by AI and robotics technologies and combine the skills of machines and human beings (Coombs *et al.*, 2021). Intelligence itself was generally applied to only humans and animals and machines were not considered "intelligent" until the recent past and

the determining factors of intelligence are the abilities to learn autonomously and adapt to one's surroundings (Jain, Quteishat, & Lim, 2017). The term can be defined as a "very general capability, that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience" (Deary, Spinath, & Bates, 2006). In other words, intelligence indicates improvement as time passes (Schank, 1991). Whilst intelligence has been defined by numerous dictionaries, psychologists and researchers, most of the definitions have common features. The first feature is that intelligence is a characteristic possessed by an entity whilst interacting with its surroundings. The second is that intelligence is related to the entity's ability to achieve its goals. The third and final feature, intelligence, differs based on whether the entity can adapt to its changing goals and surroundings. Based on these three features, it can be said that "intelligence measures an agent's ability to achieve goals in a wide range of environments" (Legg & Hutter, 2007). Although machines were earlier viewed as very primitive and basic tools, today we can see just how much they have advanced, and it is essential that we change the way of how we view them (Minsky, 1990). These advancements then lead to the question of whether humans are safe in the workforce, given the capabilities of intelligent machines that range from routine tasks to highly complex, data-driven analyses. The increased use of such technologies has led to widespread fear that humans will be undermined and that autonomous machines even pose a threat to human rights (Schippers, 2018). Although the fear of being replaced by machines is not unfounded, as we can see throughout history where automation has taken up jobs of human workers, research points out that there will actually be more jobs created, albeit of different requirements and skills than were previously sought after. Since Industry 4.0 made an appearance, automation has snuffed out a fair number of jobs from human workers. By 2025, it is predicted that 97 million new roles will be created, with 85 million jobs becoming redundant and replaced by machines (World Economic Forum, 2020). However, it is essential that we look at intelligent machines not as a replacement for human workers but as a collaborative tool to augment and extend their skills (Jarrahi, 2018). This is because, ultimately, intelligent machines and humans have widely differing skillsets. Whilst intelligent machines are capable of making more consistent and rational decisions considering a larger number of parameters, they lack the emotional, intuitive and cultural sensitivities that humans possess (Cremer & Kasparov, 2021). This, in turn, must be communicated to the workforce to mitigate the fear of job insecurity.

The current and future workforce will involve teamwork between humans and machines and will be more of a collaborative relationship, wherein intelligent machines and humans complement and enhance each other's skills. Human workers are required to assist machines in three primary ways: they train the machines to perform their designated tasks, explain the importance of machines to those who fear them or do not understand why they are needed, and finally, maintain and sustain machines so they may continue to evolve without harming us. Machines also carry out three essential roles in assisting humans: they amplify the competencies of humans specifically our cognitive strength, they interact with end users so human workers can make better use of their time to complete higher-level tasks, and they embody the physical abilities of humans (Wilson & Daugherty, 2018). Collaborative robots, also known as cobots, are the result of machines embodying the physical capabilities of humans. A practical example of this is how Volkswagen has been leveraging robotics in its production plant. Employing the human-robot-collaboration (HRC) principle, highly skilled employees work alongside robots with no barriers between them. These robots have been programmed to identify engines and are able to perform their tasks at rapid rates with an equal amount of precision (Volkswagen Newsroom, 2018). HRC can be defined as "a form of direct interaction between humans and robots, principally aimed at achieving a common goal", with the purpose of this being to combine the divergent but complementary skills of humans and robots and is one of the cornerstones of Industry 4.0 (Gervasi, Mastrogiacomo, &

Franceschini, 2020). Due to the unique combination of man and machine, it is an interdisciplinary subject drawing from robotics, psychology and cognitive sciences (Bauer, Wollherr, & Buss, 2008). Some key distinguishing factors are present between cobots and traditional robots or automation machines. Cobots are designed primarily to co-exist with humans in the same workspace, as opposed to traditional robots or automation that would simply replace humans. This makes cobots safer than the average robot because their function is to assist. Additionally, cobots can learn on the job and are more flexible and agile (Kumar, 2021). This flexibility is because of the re-programmable nature of cobots and the large modifications they can undergo, allowing them to be leveraged for multiple tasks (Roehl, 2022). Cobots are also used to compensate for the lack of skilled workers and lead to higher profitability, especially in the medical field. Clinics and hospitals struggle to provide appropriate treatment to patients whilst ensuring affordability and profitability without compromising on quality. By integrating them into surgical processes, cobots can be the answer to this problem (Beuss *et al.*, 2021).

Whilst cobots are a pillar of Industry 4.0, other intelligent machines are also advancing. AI, machine learning and deep learning have given machines the ability to imitate humans, but cobots are not the only manifestation of such technologies. Chatbots have been popular for years and there have been many versions of them over the years. Primitive chatbots were programmed using written templates and were highly inflexible. In contrast, chatbots today use deep learning to evolve and better handle end-users' requirements (Korzynski *et al.*, 2023). Despite significant progress in the development of chatbots, they have still not reached complete autonomous conversational capabilities. Chatbots follow a sequence of three broad steps whilst conversing: understanding the language input, generating a relevant response and creating natural and fluent responses. The issue with current chatbots is owed to the industry's underdeveloped natural language processing capabilities, leading them to experience difficulty in understanding certain inputs, ultimately restricting their ability to provide a quality response as an output (Suta, Lan, Wu, Mongkolnam, & Chan, 2020). Whilst many companies currently use chatbots, there are still a large number of cases that need to be handled manually.

Contrary to popular belief, many stakeholders are actually looking forward to this transformative and collaborative relationship between humans and machines (Chignell, Wang, Zare, & Li, 2023). This outlook has changed drastically over the years. Many still have reservations, but studies show that a significant number of workers eagerly await the adoption of automation and intelligent machines and are aware that their jobs will be made easier instead of being replaced (James, 2020). Furthermore, a study conducted by the Pew Research Centre showed that despite being wary of intelligent machines, many are already experiencing the benefits and improvements they bring in both their personal and professional lives and expect it to exponentially increase in the future (Anderson, Rainie, & Luchsinger, 2018). Additionally, despite the futuristic abilities of intelligent machines, the general consensus is that we have not yet reached the stage where machines will rule over mankind. Intelligent machines are not only replacing old jobs but are also creating new ones. However, there is no elimination of work as such that is occurring. In the era of intelligent machines, there will be prosperity and also loss, but the consequences can be mitigated by involving all stakeholders, be they government bodies, employees, educational institutions and so on (Autor, Mindell, & Reynolds, 2022). Since intelligent machines are being used to complete more repetitive and routine tasks that are normally carried out by lower-skilled workers, upskilling is the need of the hour. An increasingly global workforce is also allowing companies to choose from the best of the best, leaving millions behind. It is estimated that upskilling could lead to the net creation of 5.4 million new jobs by 2030, and these jobs will require creativity, innovation, empathy and technology skills (World Economic Forum, 2021). There are several technologies that companies must prepare their employees to work with,

including AI, quantum computing, 5G and 6G, the Internet of Things, data science and business intelligence, cybersecurity and green energy. This reskilling and education can be imparted through experiential learning, technical and vocational courses, certifications and self-study courses (Li, 2022).

Method

Participants and procedures

We used an exploratory qualitative method for data collection. A structured list of leaders involved with intelligent machines in their day-to-day work was not readily available; hence, we adopted multiple ways to locate the prospective participants. We approached various leadership forums, industrial associations, professional groups and previous consultancy and research clients to locate leaders involved with intelligent machines as part of their role. With the participants who agreed, we used snowball sampling and received consent from 15 leaders to participate in this study. As per Hennink and Kaiser (2022), qualitative studies can reach saturation at smaller sample sizes, which can be between 9 and 17 interviews in total. We conducted extensive structured interviews (Segal, Coolidge, O'Riley, & Heinz, 2006) with 15 leaders, through emails, phone calls, video calls or in-person interactions. There were 3 female participants and 12 male participants. The work experience of the respondents ranged from 1.5 to 30 years. Table 1 presents the details of the respondents who participated in the study.

Measures

The interview schedule consisted of six theme questions, with adequate follow-up questions. These questions were related to how and where the respondents use intelligent machines in their work, how the use of intelligent machines has impacted their work, and their thoughts about the future workforce given the widespread use of intelligent machines. The questions covered the emotional and practical perspectives of using intelligent machines.

Respondent	Designation	Industry	Gender	Experience (In years)
1	Account Manager (OEM Sales)	Automotive	Male	16
2	Senior Programme Manager	Automotive/ Engineering industry	Male	20
3	Senior Manager	IT Industry	Male	27
4	Senior Vice President	Cybersecurity and banking industry	Male	30
5	Engineering Manager	Automotive	Female	18
6	Group Engineering Manager	Information technology	Male	17
7	Innovation Team - Head	Retail	Male	15
8	Data Science Leader	Information technology	Female	30
9	Data Scientist	Oil and gas	Male	16
10	AI Engineer	IT consultation	Male	1.5
11	Program/Product Manager	Automotive	Male	15
12	Security Analyst	Cyber security	Male	3
13	Senior Manager	Retail automotive	Male	15
14	Vice President (Software Products)	Information technology	Male	24
15	Head - Robotics Process Automation	Information technology	Female	5

Source(s): Authors' own elaboration

Table 1.
Respondent detail

Findings

Respondents described where they are currently using intelligent machines, how their usage has affected their work, work practices and workplace, how they feel co-working or co-creating systems with them and how they influence their job satisfaction. The respondents also shared the anticipatory strategies their organisations are employing to address intelligent technologies on the horizon.

1. Application of intelligent machines: transformative trends

The interviewed respondents are from various industries as well as functions within their companies, which gave insights into how intelligent machines are currently leveraged across different domains. The technologies have their uses ranging from simple chatbots and helpdesk assistants to the making of automobiles. Whilst the degree of usage may vary across organisations, it is clear that they are used by everyone, in major or minor capacities. Major uses of these machines are in the areas of development, testing, forecasting, predicting, etc.

Chatbots: Chatbots are being used by a large number of companies today. They reduce the reliance on human responders and are able to solve a large number of problems to the point where only a few queries and complaints need to be passed on to human workers. Intelligent machines are used in customer care services, where the helpdesk is capable of providing the necessary solutions to the person in need. It understands what the customer is going through or the problem they are facing and provides solutions that are predefined and available already. Then, it suggests the appropriate action to the customer, what to do and what not to do.

> . . . let's say you call and you are trying to figure out what you want to buy, and what fits your needs. Even for those kinds of things, we use chatbots before we put anybody with the client. Before, we used it for problem resolution and helpdesk, but now we also use it very proactively to figure out customer preferences (Respondent 8)

Intelligent sensors: These sensors use algorithms, advanced signal processing and data fusion techniques to extract and understand the data pattern. These devices procure inputs from the surrounding environment and process them using in-built computing resources. They either perform a predefined function using those inputs as programmed or detect a condition in the input pattern before giving feedback or performing an instruction. For example, intelligent sensors are used today to perform the work that was done by human supervisors earlier, detecting an error or reducing downtime.

> . . .if something is wrong, it will already send an indication to the plant controlling team, and it will even stop the machine to reduce the scrap cost. By doing that, a lot of money is saved, and also, sometimes, there's downtime, yeah? So, there is unforeseen maintenance and downtime. For some of the critical machines, this means the whole plant will be affected if this machine is stopped. So there, to predict this downtime, we use a lot of intelligent sensors and controlling systems. (Respondent 1)

Similarly, intelligent machines are used to enable predictive downtime instead of being caught off guard by sudden maintenance requirements,

> . . .having a bigger prediction model, when exactly you have to replace things, when downtime for the replacement is to take place, or what are the causes for a failure that can happen when we are conducting an extraction – that is another level of algorithm that is built. (Respondent 9)

Cognitive systems: These are systems which are replicas of human cognitive capabilities and skills. These cognitive systems perceive, understand things, draw conclusions and learn from the process, thereby further building their capabilities. In other words, they create their own knowledge. It can be considered as an artificial brain or mind, comprising software and hardware with cognitive abilities, replicating human and animal brains. Organisations develop and use these cognitive systems for a variety of purposes. Leveraging intelligent

machines that are in the form of cognitive systems helps organisations reduce manual efforts, save costs, reduce processing time and proactively locate errors.

> . . .each software engineer used to spend close to 15 days to manually complete the task. Now that we have automated this whole process, it takes less than 5 minutes to complete end-to- end. That's in terms of effort. In terms of cost, imagine one software engineer who gets 300 000 dollars per annum, spending close to 15 days on this, versus the built model that is replacing their work. (Respondent 6)

Such intelligent machines are used to understand and prepare complex documents that usually require a lot of manual work. For example, they are used in Bidirectional Encoder Representations from Transformers (BERT) for keyword extraction (Respondent 10); used to process physical documents faster and simpler. On the other hand, these cognitive systems are used as scanners to read through large applications and point out discrepancies and errors rather than employees engaging manually, which has made their job much easier (Respondent 12). These intelligent machines, in the form of cognitive systems help in forecasting sales, to prepare for orders and customer needs and determine the size of the workforce required for projects (Respondent 7). Further, they support the more efficient pricing of products and have enabled the identification of fraudulent customers (Respondent 14).

Computer vision: Respondents from the automotive industry spoke about how intelligent machines have been used in both development and non-development areas. Most brought up the technology of driverless cars and how efforts are being put into bringing that to fruition and how the intelligent machine corrects the error by itself. From a more practical aspect, these machines have enabled the development of autonomous driving to reach a level where cars can apply brakes without the driver manually pressing them (Respondent 13).

> . . . computer vision of autonomous cars is written by humans, and the errors or defects within the millions of lines of code are detected by intelligent machines. (Respondent 5)

Respondent 9 stated that they use intelligent machines to analyse large amounts of data to aid in decision-making, as well as leveraging it in tech support.

Replica of human entity: The era of intelligent machines may have started with developing a replica of one single human system like an intelligent conversational device or a smart sensing application or a device with a sharp vision. But today, intelligent machines are combinations of all those singular systems into one whole entity, like a human entity. Human workers either create such robots or associate with such an intelligent entity in their workplace. For example, such an intelligent machine is used in warehouses to fulfil and pack orders without any human intervention.

> . . ..in one of the FMCG companies, in their warehouses, when a particular order arrives, it has to be dispatched. The warehouse is completely automated; the exact location of the item - the shelf, row, column – all this information is automatically managed by intelligent or AI-based robotics. (Respondent 3)

> . . ..while intelligent machines have enabled a global workforce, replicating human workers, it also increases the threats and dangers to companies, which, in turn, are protected by intelligent machines. All these intelligent machines enable a distributed workforce, and with that, you have to deal with the distributed challenges around security. All this adds up to how you secure a distributed workforce, how you secure your assets, which are globally distributed, and how intelligent devices and software make that happen. (Respondent 4)

2. Influence on work practices

We asked the respondents about their perception of how intelligent machines influence their current work and work practices. Almost all the respondents opine that the use of intelligent

machines has changed how employees engage in their tasks. The primary benefits listed by most were the reduction of manual effort in routine and monotonous activities, as well as a large amount of time saved. However, there are many other points highlighted.

Decision-making: Intelligent machines have aided organisations in identifying the best use of scarce resources and improving decision-making by providing the best alternatives to top management for their judgement. Since human employees cannot analyse larger amounts of data with as many parameters as intelligent machines can, their work is cut down and they are able to use their skills more efficiently.

> . . . Typically, humans can only think through 4 or 5 dimensions when making decisions. Now, with so much more ability to look through data and find out some of the trend and patterns we would not see, we can at least see many more options versus what I would have applied, the 4–5 dimensions or variables that I would have applied. That's where we see an optimisation of decision-making. Also, resources. Scarce resources, and you have to prioritise and say, what are some of the best places where I need to apply those scarce resources? (Respondent 8)

Increased productivity: As mentioned previously, the use of intelligent machines leads to less time spent on each task, which then leads to increased productivity. Since these machines are able to complete routine and repetitive tasks at a much faster pace, they are leveraged to a great extent, especially in the manufacturing industry. The use of intelligent machines reduces not only the amount of time spent but also the amount of money spent. Whilst companies need to make large investments initially to leverage intelligent machines, it is more cost-effective than maintaining the equivalent workforce. Because of this, many organisations are currently seeing a transformation in their business activities that will lead to more profitability.

> . . . we manufacture 100000 toys per day today, instead of 1000 toys earlier. The primary role of intelligent machines is to increase speed, make them high quality, and make them highly productive (Respondent 3).

> . . . This has high relevance to make the organisation more efficient. Manual efforts are reduced, and lot of workflows and processes become automated (Respondent 14).

> . . . One is your regular, day-to-day operations, and the second is the transformation job. So slowly, we see that the weight of this transformation is gradually increasing because we are using automation and intelligence to reduce our time for daily activities. In terms of the work aspect, this is a shift which is happening (Respondent 13).

> . . . And that, combined with no downtime, ultimately reduces your manual effort. The other thing is, even if you limit the machine and yourself to the same number of tasks you can run parallelly - I work 8 hours a day, and a server will run 24 hours a day. That's 3 times the amount of work I'm doing. So, anything that would take me 9 days will only take 3 days for the server, even if I limit it to the same amount of work I do. And then, because it's technology, you can scale it to as big as you want (Respondent 12).

Supply chain and logistics enhanced: The prediction and forecasting abilities of intelligent machines has been highly praised; with many respondents saying they have improved their inventory management and sales. They can reduce downtime, scrap waste and improve overall efficiency.

> . . . It gives a positive impact because you don't need to spend a lot of time compared to how much time was spent previously. Also, the error percentage when the work was done manually rather than depending on the machine is improving. That way, it is definitely improving the efficiency (Respondent 2).

Ease of deployment: With the prevalence of software and applications such as Microsoft Azure, employees no longer need to create their own code from scratch; they can leverage the tools from these packages provided and spend minimal time modifying a pre-existing code to their requirements. This makes their job much easier.

> Azure has come up with Azure ML Studio where we can just use the ML model or ML Studio of Azure; we just have to provide the images and it has pre-trained models, and when we use this, we can get all the results, whatever we are expecting. In most cases, we will not have that flexibility, so we have to write our own algorithms using a package like Python or MATLAB. So, we train the models and then deploy them into the cloud system (Respondent 9).

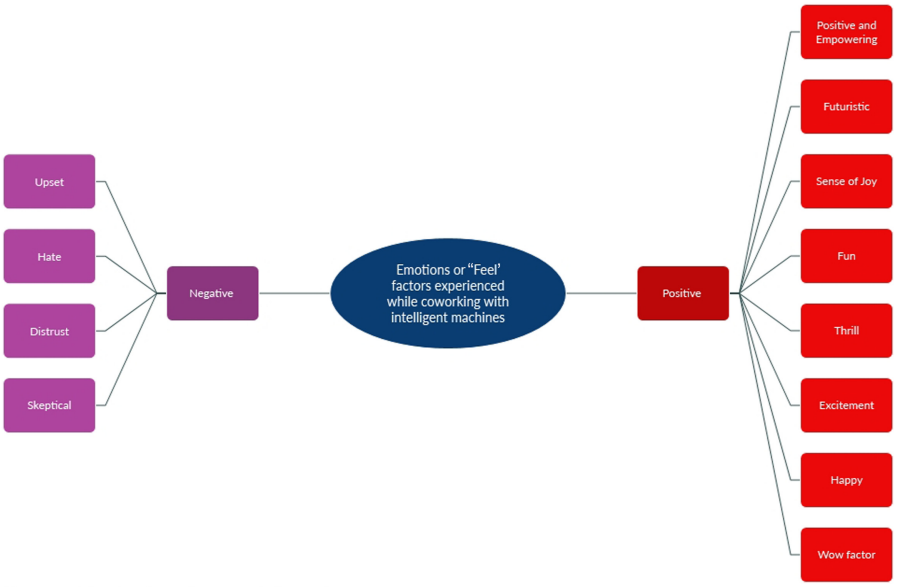
Complementary skills: The general consensus of all the respondents was that intelligent machines in collaboration with humans only improve workflows and improve processes. Whilst many of these intelligent machines have a long way to go in terms of replacing highly skilled workers and subject matter experts, they do enhance their work and make it easier to complete tasks.

> . . .if I can delegate something to a machine, let it do it. Why should I do it if I can focus on something for the future? In that regard, if you see, definitely it's not a competition between machines and humans here. We are working in a complementary way. I will do work where my efforts are really needed, and if something can be delegated, I'm not going to delegate it to another human being; I'll delegate it to machines. That's how it is (Respondent 6).

> Earlier, there were only humans, and then there was a level of automation. Now, we are in a state where there are humans in the loop, as well as intelligent systems in place. It is a phase where both are still operating and then after a couple of more cycles and iterations wherein, we can really say these are reducing human effort, the laborious human effort. Of course, the menial jobs and really mundane work are being reduced, but we are now spending that time on making those intelligent systems more intelligent. Manpower is still required in different capacities and areas (Respondent 5).

3. "Feel" factor, job satisfaction and embracing intelligent machines

We went around and asked people how they felt working alongside intelligent machines and how it influenced their job satisfaction level. Figure 1 consolidates all the "feel" factors ranging



Source(s): Authors' own elaboration

Figure 1. Mind-map from NVivo projecting the "feel" factors or emotions whilst co-working with intelligent machines

from wow, thrilling, exciting, positive, empowering, futuristic, awesome, magic, joy, fun and humour, sometimes annoying, upset and sometimes even hate. When employees experience the phenomenal benefits they reap, the advancements made in their work efficiency, the time reduction for a task or processing huge data for analysis, they feel a "wow" factor. One respondent called it "magic". They feel positive whilst realising the promising advancements they are making in their job, which was not possible earlier. With all the "wow" factors experienced by the respondents, we cannot completely ignore the negative perception about the usage of intelligent machines. There are instances where the immediate effect of the application of intelligent machines is replacing a set of human workers. When this is experienced in your organisation, you will obviously feel upset for your peers who have lost their jobs or in some cases, you might lose your current job. Overall, job satisfaction evolves over time and the factors that satisfy us keep changing. At least the priorities keep changing.

Anticipatory strategies employed to address technologies on the horizon

We asked the respondents what anticipatory strategies they and their organisations employ to prepare their workers to co-work with intelligent machines. We also asked for their observations about how various stakeholders like their employees, prospective candidates, peer members in their industry and how other industries are responding to the rise of intelligent machine usage. We received several distinctive strategies they and their counterparts adopted.

1. *Learning Organisations:* Many organisations are rethinking their current approach to building talent and learning systems. With intelligent machines on the brim and set to see progressive growth in various applications, organisations are building their systems to become learning organisations. *"... most organisations have now declared themselves as learning organisations (Respondent 5)."* Learning organisations are in the process of constantly upscaling their capacity to reach the desired results. For this, new and extensive patterns of thinking are nurtured, collective aspirations are encouraged with people learning to see a larger picture (Senge, 1990).

> ... This is one such small example where we are bringing employees, customers, and even competitors in one place. We try to tell them what direction we are going in, where we are going – this is the future, and the skills and attitudes you need to have to embrace such a big change. (Respondent 6)

2. *Ownership of learning:* Many organisations have transferred the ownership of upskilling to the employees and make their own learning paths. Organisations have created an eco-system for the learning to take place by providing mentors, supportive leadership and facilities, but the workforce is empowered to decide on their own upskilling. Although the application of intelligent machines has covered a variety of areas; it is still in a nascent stage and such empowerment opens up new areas of using intelligent machines in their businesses.

> ... we have given the choice to own the learning and make our own paths. Of course, there will be mentors who will also talk about where the business is heading. All those directions from the leadership will be there in most of organisations. Still, by owning up the responsibility of learning and deciding what to learn, we should empower the workforce to choose what they want to do and then upskill (Respondent 5).

3. *Upskill or Hire:* Not all the organisations we approached focus on training their employees on the needed technologies to work with intelligent machines. There is a mixed

opinion connected to whether they design and deliver a training program or go ahead and hire candidates already trained in those competencies.

> . . . we hire people who already have those competencies, or we hire people who can be trained in those areas, and then we put them onto extensive programs so they can be trained for the current technologies we are working on. (Respondent 5)

4. *Social learning events:* Human workers are not only involved in co-working with intelligent machines. A lot of developments are happening in exploring where intelligent machines can be applied in businesses they are currently working in. Organisations are aiming to improve their employees' exploration skills. For this, several organisations regularly conduct social coding events (also known as code fests or hackathons).

> . . . This is all about everybody coming to one place, thousands of employees. We even invite our customers, our end users, our dev community. Everyone is going to be part of this. Anyone can come up with a simple idea of where they can apply ML and AI. And you just have to work on that simple proof of concept to depict what your idea is and come and present it. You will be sponsored completely to build a big organisation based on that. (Respondent 6)

Apart from hackathons, big meetups or conferences are also organised. Such events encourage anybody to register without a fee and provide opportunities to work with the brightest minds in leading large organisations.

> . . . If you are an end-user, a retailer or on the customer side, you will get a chance to know what products are coming into the market in the next six months. You can try it and see if they will be useful for you. (Respondent 6)

5. *Futuristic technologies:* To associate with intelligent machines and co-work, we tried to probe what technologies are considered to be the prime focus areas of various organisations.

> . . . Microsoft Azure, or AWS platforms wherein data engineering or some skills for Python, these are the things that one should be equipped with in our field (Respondent 5)

6. *Programming language is the world's new language:* As children, we grew up learning a language to connect with our parents, siblings and other fellow human beings. It is considered to be a natural process of growing up. Like a language to connect with other human beings, a programming language to interact with intelligent machines has become essential today. Knowledge of at least one programming language, irrespective of our profession, will become the new workplace norm.

> . . . I prefer everyone to know at least one programming language and also companies to provide training. (Respondent 10)

7. *Accelerated career paths:* Many business organisations have developed accelerated career paths for employees who are fast-tracking with intelligent machines. Abundant sponsorships and recognitions are provided to those employees who get certification in futuristic technologies.

> . . . The growth for people who embrace the change is that they are going to be on the fast track. If it takes 4 years to get from software engineer to senior software engineer, it'll take one year if you are on such a path because we need such people, who are up to these challenges and changes. (Respondent 6)

Anticipatory strategies are not adopted by business organisations alone. Individual employees or prospective future employees develop their own strategies to gear up a career working with intelligent machines. First, they join a certificate course in automation or do a joint project with others to learn the progress. Experienced employees who are new to this field volunteer for projects where intelligence machines are developed or used so that they can upskill on the job or project itself.

> . . . start with some basic automation languages and scripts so that they get used to the basic level of automation or start with small projects or trial projects on their own; redo something already existing to practice and apply their learnings. People who have been in the industry for some time engage in cross-functional projects and work with a group of people so they learn about product development and technologies (Respondent 2)

Apart from business organisations, several educational institutions are designing and offering new courses in AI, machine learning and data science. Apart from that, lot of training institutions have come specifically to train the students in a particular technology or technologies.

> . . . most of the engineering colleges now have a degree in AI/ML, data science, and all these new technologies. B Tech in Robotics and automation are degrees in some of the new computer colleges now (Respondent 3).

Discussion

(1) Any major evolutionary change in society disrupts the existing system; one such evolutionary change is the emergence and use of intelligent machines. This change has affected several stakeholders in the value chain, namely customers (new products and services, invasion into private data), business organisations (new opportunities to create profit and wealth), employees (more potential by augmenting with intelligent systems and also the risk of complete automation). The question is: Are all these stakeholders ready to embrace this change? How prepared are they? In the process of change, most of the stakeholders are aware of the changes happening and predict them to deep root in the future. Preparation and readiness are in the nascent stage, like how the application of intelligent machines is in the nascent and exploratory stage.

(2) Eight out of ten organisations convey that they focus on diversity, equity and inclusivity (DEI) as a practice in their workplace. When we probe what kind of diversity they are into, this ranges from gender diversity, ethnicity-based diversity, generation-based diversity, ability-based diversity (people with disability) to sexual orientation-based diversity, to name a few. In the future, with the emergence of intelligent machines with emotional intelligence, we predict that intelligent machines will become a part of a diverse workforce along with human workers. Today, they are augmenting the human workforce, but gradually. They will be a part of the total workforce along with the human workforce. This is expected to change a lot of workplace dynamics.

(3) Organisations are in the exploration stage today when it comes to intelligent machines. Most of the respondents we spoke to conveyed that their current focus is on where, in their business operations, they can bring in intelligent machines. Which

processes are to be considered to bring in intelligent machines? The usage of intelligent systems and their stability is yet to mature. This calls for regulatory mechanisms to avoid misuse of intelligent machines, like invading privacy, capturing personal data and using them without the knowledge and consent of the people.

(4) Intelligent systems also can err. However, intelligent machines can be developed or made to develop on their own learning. Their knowledge is developed only through humans and human-developed repositories of data and knowledge. It has been observed that intelligent machines also display implicit bias whilst taking or recommending decisions. When probed, the organisation found out that their intelligent system learnt from the decisions taken by their human predecessors through the past data fed into the intelligent system and those past data patterns comprised of implicit bias by human workers, which get replicated by intelligent machines. Such trends will be very dangerous in the future, with a high potential to crunch huge amounts of data and a high speed of operation, but with biases in the process, damages will be enormous.

(5) The future is the rise of intelligent machines. There is no looking back or imagining a world without that. Though we say that intelligent machines augment human workers, we cannot ignore the fact that, in many places, they have replaced human workers in the factories. Respondent 1 shared his experience in one of the factories located in Thailand. Intelligent machines have replaced 800 employees (they have just 200 people working currently in the place where 1000 employees used to do the same operation). It is expected that other tyre makers will follow this path in order to minimise process errors, development costs and manpower costs. Today's trending skills that are in demand are tomorrow's obsolete skills. With the progressive growth of intelligent machines, human workers must develop skill sets that constantly explore how to augment intelligent machines for human betterment.

Many insights that evolved from our interviews are consistent with previous research studies. With respect to the automotive industry specifically, a study related to the importance of micro-work in the sector concluded that humans are in fact an integral part of the supply chain and is fundamental to companies' success (Tubaro & Casilli, 2019). The study highlights how self-driving car technology is heavily reliant on human input, for example, in identifying emotions and potential reactions of the driver in case of distractions to warn nearby cars of potential accidents and also in terms of speech interfaces to enable drivers to "access all the functionalities of computers and mobile phones, without ever taking the driver's hands and eyes of the road". Another example that highlights the continued requirement for micro-workers is the instance in which a French employee assisted in the training of a virtual assistant by correcting its automated transcriptions and had to do so by listening to hours of original recordings, compare her notes to the ones produced virtually and finally suggest modifications and provide feedback on how the virtual assistant understood contextual factors. Similarly, Tubaro, Casilli, and Coville (2020) highlight three key tasks that micro-workers perform for AI: preparation, verification and impersonation. In terms of growth and employment, AI has the potential to increase growth by replacing labour, but it can also inhibit growth if there are improper competition policies (Aghion, Antonin, & Bunel, 2019). It is up to policymakers to explore and identify exactly how AI can partner and collaborate with humans rather than be a threat and rival (Zirar, Ali, & Islam, 2023). Agrawal, Gans, and Goldfarb (2019) proposed a framework to further explain how automation impacts productivity, tasks and work. Their framework included countervailing forces, which emphasised that, whilst automation can displace labour, it is counterbalanced by the creation of new tasks which, in turn, leads to more labour demand and automation simply changes the

nature of the jobs required. Moreover, the reallocation of labour from existing jobs to new ones is a time-consuming process. Whilst AI has made considerable progress in the automotive and healthcare industry, it has yet to carve out a niche in the people management space due to its casual reasoning and randomisation (Tambe, Cappelli, & Yakubovich, 2019). Plastino and Purdy (2018) identified a set of 8 strategies to help companies successfully adopt AI technologies. One such strategy is "learn with machines", which proposes that companies will need to shift their focus from hiring employees with technical skills to hiring employees with communication, judgement and creative thinking skills which complement AI technologies. This has been highlighted multiple times, and the general consensus is that humans and AI must find a way to co-exist and collaborate rather than annihilate each other.

Companies must prepare for the future by creating facilitating environments where their employees do not fear the technology but welcome it. Appropriate training must be given to ensure workers are at a competent enough level to leverage newer technologies (Arslan, Cooper, Khan, Golgeci, & Ali, 2021). Also, with humans and AI working side-by-side comes the need to evaluate performance metrics (Plastino & Purdy, 2018). Human resource (HR) will have to identify ways to appropriately measure the performance of not just the human workers but also the AI workers. Howard (2019) highlights that there are two key implications of AI: job displacement and human-machine interactions. Whilst job displacement has been discussed at length and there are other economic factors that influence it, the aspect of human-machine interactions also has uncontrollable factors that can be mitigated only to a certain extent by risk management. For example, in the event of an accident, who is held accountable: the human worker or AI? Further, in the era of fake news and malicious content, how do we trust AI to vet what is often, created by AI? In 2020, Microsoft laid off 27 journalists in favour of AI software. The journalists were concerned about the ability of the software to present the content in a manner that was appropriate for all ages, edit and format the stories as needed and encourage the spread of the right type of content (Waterson, 2020).

Huang, Rust, and Maksimovic (2019) describe the advent of a "Feeling Economy" where AI focusses on the technical aspect whilst humans focus on the interpersonal aspect and highlight the implications of the increasing use of AI for all stakeholders: managers, employees, consumers, business, research and educators. Broadly summarised, the implications are as follows: to consider the value that the human element brings to the table, to shift the focus to humans and AI and not humans or AI, to explore factors that contribute to the feeling economy apart from AI and to focus on bridging the gap between human intelligence and AI. Chamorro-Premuzic and Akhtar (2023) claim that there are three traits' humans possess that AI can never replace: curiosity, humility and emotional intelligence.

Limitations and direction for future research

We collected data from respondents belonging to various industries like automotive, information technology, banking, oil and gas, to name a few. A structured list of business organisations across industries and leaders who are involved with intelligent machines as part of their day-to-day role is not available. Hence, we adopted a non-probability snowball sampling technique to reach our participants. We consider this to be a limitation where generalisation with accuracy may not be possible, but this is a scenario for all research topics which are in their nascent stage. Future research studies can focus on developing databases and repositories of organisations and leaders using advanced intelligent systems. Also, in each industry, the potential of using intelligent machines will be distinctively unique, along with challenges specific to that industry, which have to be researched thoroughly. We recommend that future research focus on particular industries and how intelligent machines augment the operations there with their unique challenges and issues to have in-depth knowledge created in each cluster, where future developments are foreseen.

Implications to stakeholders and conclusion

Working with intelligent machines is in a nascent stage in many industries today. Several organisations are still exploring the best usage of intelligent systems. Given this background, employees fully engaging with intelligent systems become necessary for successful implementation and hence how human workers feel, emote and the challenges they experience needs to be identified by the business organisations. Such efforts will help organisations develop support systems for their employees to embrace integration. This study will help the organisations understand the employees' mindset, experiences and challenges in embracing intelligent machines clearly.

Organisations that have yet to invest in intelligent machines will need information from players who are already using such technologies. This study will help those organisations that have yet to invest in intelligent technologies. The lessons learnt by leaders who have embraced intelligent technologies already will be helpful for those leaders who have yet to immerse in this process in preparing themselves and proactively developing anticipatory strategies, policies, practices and systems to embrace new intelligent technologies on the horizon.

It is evident that intelligent machines also make errors and biases are visible in the decisions they make. How much can we depend on intelligent systems without human intervention, how much trust we can have in intelligent machines when it comes to value-based, emotion-based or moral-based decisions is a major question people ask today. Given this scenario, the study would help societal members, policymakers and regulatory bodies reflect on what new regulations and guidelines are needed whilst embracing intelligent machines in the human world.

Research on intelligent systems is in the exploratory stage and studies similar to this would help strengthen this domain area and create new knowledge for academicians, students, scholars and various organisations associated to this field.

To conclude, intelligent machines are used in a variety of ways today, from a simple chatbot to a replica of a whole human entity. Second, they are being used end to end in the value chain, from improving productivity, enhancing better decisions, backed with big data, developing new ideas and transforming them into new products or services. Third, it is observed that there is a blend of both positive and negative emotions amongst human workers, whilst co-working or co-creating with intelligent machines ranging from the wow factor, excitement, thrill, joy, fun to hate, fear and insecurity amongst human workers. It affects their job satisfaction level accordingly. Fourth and final, we observe organisations and other stakeholders using a variety of anticipatory strategies towards preparing and becoming ready to embrace new intelligent technologies on the horizon. We conclude by stressing the fact that business organisations, education and training institutions, regulatory bodies including government bodies, and mainly employees and prospective employees all have to play a major role constantly in preparing the workplace, workforce and work practices to embrace the intelligent machines and the transformational changes they bring.

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