



Continuum of job loss and job creation: Insights from automotive organisations in South Africa



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Orientation: The automotive sector in South Africa plays a crucial role in the country's economic growth as an adopter of technology and developer of talent.

Research purpose: The study explores employee perceptions of job loss and job creation in the automotive sector within the context of Industry 4.0 based on selected demographic and organisational characteristics.

Motivation for the study: Globally, only 25% of employees indicate confidence in retaining their jobs because of Industry 4.0. This uncertainty has implications for talent management and skill retention.

Research approach/design and method: This article reports on a mixed-method study conducted in the South African automotive industry, with data collected from human resource management, engineering and production managers and employees selected through purposive, convenience and snowball sampling.

Main findings: Job loss and especially job creation were observed within organisations that have adopted Cobots. Job loss was associated with technological change and a lack of skill, and job gain with specialised skills.

Practical/managerial implications: Adopting advanced technologies in organisations is essential for leapfrogging Industry 4.0 and meeting sustainability goals. Automotive organisations in South Africa need to continue collaborating with government, educational institutions and SETAs to ensure a pipeline of employees with a set of hybrid skills. Employees must engage in lifelong learning and identify career opportunities in the changing world of work.

Contribution/value-add: This study sheds light on perceptions of employees of employment outcomes in the Industry 4.0 context and provides insights for automotive organisations.

Keywords: automotive industry; continuum; Industry 4.0; job creation; job loss.

Introduction

Industry 4.0 depicts an evolving industry in which machines, people, systems and products are digitally interconnected across geographical and organisational boundaries, enabling interoperability, virtualisation, real-time capability, decentralisation, service orientation and information security (Chigbu & Nekhwevha, 2020; Mohamed, 2018). In a global study, including 2100 executives across the globe, 48% of the respondents confirmed that it was a top priority to adopt advanced technologies, and specifically in pursuit of the economic, social and governance (ESG) agenda (KPMG, 2023). With the breadth, depth and speed associated with accompanying technologies, greater value and efficiency can be attained, which are the main economic reasons for adopting industrial revolution technologies (Gonese & Ngepah, 2024; Mohamed, 2018). Almusharraf (2025) highlights the complex dual impact of automation on sustainable development. On the one hand, greater production, operational efficiency and resource optimisation are obtained, whereas, on the other hand, automation could also result in job loss, income inequity and social displacement. For South Africa, a developing country facing socio-economic problems such as poverty, unemployment and inequality, successfully leapfrogging Industry 4.0 by replacing outdated systems with innovative technologies is imperative for both economic growth and social stability (Burlamaqui & Kattel, 2016; Le Guern, 2017).

The adoption of Industry 4.0 technologies such as robots, artificial intelligence (AI), 3D-printing, and the Internet of Things raises concerns about both potential job losses and the emergence of

new jobs for which skills are not readily available (Acemoglu & Restrepo, 2017; Almusharraf, 2025; Gonese & Ngepah, 2024; Narkhede & Dohale, 2024). In South Africa, with a population of 64 million and expected low gross domestic product (GDP) growth of 1% for 2024, these concerns are valid (Harambee, 2024). During the 2023–2024 financial year, the manufacturing industry in South Africa and specifically the glass, automotive and non-metallic minerals industries lost more than 50 000 jobs (StatsSA, 2024), and this could be because of a multitude of factors, including the adoption of automation. Almusharraf (2025) and Gonese and Ngepah (2024) indicate that Industry 4.0 leads to both job creation and job losses and that sectors are affected differently. The main reason for adopting Industry 4.0 technologies, including robotics, AI and sophisticated information communication technology (ICT), is to improve productivity and efficiency, but Chigbu and Nekhwevha (2020) highlight that the adoption of these technologies also brings uncertainties for employees working in the motor manufacturing sector. These uncertainties sprout from employees being deskilled and deployed to assembly lines. Consequently, these researchers opine that organisations also have a social responsibility to create jobs and upskill employees in the face of automation. This view is echoed by Almusharraf (2025) who, in applying a quantitative methodology and regression modelling to data from 2000 to 2023, found a 25% increase in labour productivity, which was offset by a 12% rise in the Gini index. This discovery prompted the researcher to advocate for a balanced and transformative approach in integrating technological advancements with sustainability goals, taking into consideration organisational as well as employee imperatives.

Industry 4.0 causes widespread change in workplaces, but an ambiguous and complex picture of the consequences for employment emerges (Kiliç & Güven, 2023). The optimistic view highlights the emergence of new business models (greater connectivity, collaboration and shared use of real-time data) and economic expectations of improved effectiveness and efficiency, whereas the negative view emphasises the devaluation of labour and large-scale job loss. It is envisioned that globally more than 600 million jobs could be created as a result of the evolution of Industry 4.0, whereas at the same time, more than 4 million skilled manual jobs could be lost, 2.5 million because of automation and 2.7 million as a result of moving operations to regions that enable a greater competitive advantage (The World Bank, 2023). As with previous industrial revolutions, it is expected that lower-skilled employees will lose their jobs, and that 'technological unemployment' will emerge as a long-term phenomenon (Gonese & Ngepah, 2024). The impact of Industry is therefore not universal across nations, regions or sectors. It is also expected that greater customisation will occur, leading to new types of high-level skill job categories enabling employees to collaborate effectively with emerging technologies. South Africa, with a backlog in education, mismatch of skills and migration of qualified and skilled employees, experiences a shortage of employees possessing the required Industry 4.0 competencies, contributing to a

paradoxical challenge (Gonese & Ngepah, 2024; Marwala, 2018). Phillips (2018) suggested that South Africa possessed only 16% of the competencies needed for Industry 4.0, and it is also reported that 38% of organisations in the country struggle to fill Industry 4.0 related jobs (Macpherson et al., 2022). To address the challenges and opportunities posed by Industry 4.0, the South African government has established the Presidential Commission on the Fourth Industrial Revolution (4IR), which promotes the integration of coding and robotics into the national school curriculum (Gonese & Ngepah, 2024).

The automotive industry in South Africa plays a pivotal role in the country's economy both as an important contributor to GDP (4.3%) and as a large employing sector (approximately 112 000 employees) (Augustine, 2024). Mthembu (2024) states that the sector is evolving rapidly and is expected to play a pivotal role in establishing an eco-system across Africa, with collaboration across industries and borders using advanced technologies. For this transition into a greater eco-system, advanced technologies will be used and advanced collaboration is needed, requiring a skill set vastly different from a decade ago and a new approach to talent management and the continuous upskilling of the workforce.

This article explores the perspectives of human resource management (HRM), engineering and operational managers and employees of job loss and job gain within their organisations. The study is motivated by an understanding that the automotive industry in South Africa is a leading sector with regard to economic growth, the adoption of technology, employment and skills development in South Africa. Considering perceptions on job loss and job gain during a period of industrial evolution is important, as these perceptions could influence aspects such as employee tolerance for uncertainty, attitude towards learning, readiness for change and mobility to other fields, with implications for the employer (Chigbu & Nekhwevha, 2021).

Research objective

The objective of this study was to explore the perceptions of HRM, engineering and production managers and employees of job losses and job creation in their organisations within the automotive sector in South Africa, and to determine whether perceptions held varied based on organisational size, nature of the organisation, function, level of employment, and what they perceive as the extent and type (industrial versus collaborative) of robot adoption. Based on the results, managerial implications were identified, and recommendations were made.

Literature review

Industry 4.0

The evolution of Industry 4.0 is characterised by increasing digital interconnectivity, transforming systems, organisations, the marketplace and products, with consequences for the way in which people live and work (Calitz et al., 2017;

Chigbu, & Nekhwevha, 2020; Mohamed, 2018). This transformation optimises quality and efficiency in the value chain in a flexible manner through the integration of a range of technologies. These state-of-the-art technologies called the Internet of Things produce real-time information and intelligence across digital networks and systems, enabling largely self-managed production systems across the entire product lifecycle (Gao et al., 2020). The concept 'Industry 4.0', which originated in Germany in 2011, is also labelled as integrated or advanced industry, digital or connected enterprise and smart factory (Schwab, 2016).

Although Industry 4.0 should not be viewed in isolation from previous evolutions, it is distinctly different in terms of pioneering machinery, equipment and techniques, such as Cobots, 3D printers, predictive analytics, Cloud Computing, AI, machine learning and real-time networking (Goel & Gupta, 2020). Unlike its predecessors, Industry 4.0 emphasises the exchange of data and digital transformation of organisations through the automation of production processes and end-to-end digitalisation of physical assets. The creation of these new digital ecosystems is characterised by improved efficiency, productivity and profitability, quality products and customer satisfaction, innovation and global competitiveness, and greater workplace safety, which has been described as the core of Industry 4.0 innovation (Da Silva et al., 2020).

Theoretical frameworks for understanding the adoption of Industry 4.0 practices

Various theoretical frameworks (Table 1) extracted from the current literature in relation to this study explain Industry 4.0, its applications, complexity and multifaceted nature. It also demonstrates different angles taken in theoretical and empirical research, ranging from a focus on the characteristics of Industry 4.0, its application in the workplace, competencies required, change processes, challenges and solutions, and theory underpinning human resource requirements.

The human factor in Industry 4.0

Although Industry 4.0 brings fears about job loss and adjustments, humans remain integral to the effective implementation of Industry 4.0 technologies (connectivity, machine learning, human-machine interaction and data analytics) and overall organisational effectiveness (Ligarski et al., 2021). Effectiveness in Industry 4.0 does not solely require technical and mathematical skills (hard skills), but it also requires competencies such as creativity, problem-solving and critical thinking (soft skills) (Macpherson et al., 2024). The required blend of skills enables humans to collaborate effectively with technologies, adapt and innovate, and navigate the challenges emerging from human-robot collaboration.

Fears and concerns brought about by operational changes and competency requirements associated with Industry 4.0 should be addressed in a humane manner (Kadir & Broberg, 2021), with empathy, open communication, transparency and swaying opinions regarding the benefits of adopting Industry 4.0 technologies and practices. In addition, an effective

TABLE 1: Theoretical frameworks explaining the adoption of Industry 4.0 practices.

Model or framework	Description	Authors
Industry 4.0 maturity models	Parameters for characterising Industry 4.0 and evaluating organisations' progress in adopting Industry 4.0 technologies Measurement of management, technical competencies and graduate capabilities	Angreani et al. (2020); Mrugalska and Stasiuk-Piekarska (2021); Müller et al. (2018)
Model for assessing the maturity of Industry 4.0 concepts	Systematic evaluation of the application of Industry 4.0 characteristics in organisational processes Focuses on strategy integration, planning, development, implementation and operation	Honorato and De Melo (2021)
Scenario-based learning approach	Scenarios for facilitating Industry 4.0 competency development and enhanced problem solving Three-dimensional check for identifying Industry 4.0 challenges and solutions	Erol et al. (2016)
Categorical framework for classifying challenges	Classification of Industry 4.0 challenges based on criteria and rationale extracted from previous studies	Mohamed (2018)
Competence model for Industry 4.0	Addressing the need for an encompassing competency framework for Industry 4.0 based on workforce segments and industry requirements Include personal, interpersonal, human and technical skills	Fitsilis et al. (2018)
Conceptual framework for industrial digital transformation	Focuses on the adoption of Industry 4.0 characteristics throughout the entire value chain of organisations Emphasis is on the establishment of smart factories through collaboration among management, employees and technology	Verina and Titko (2019)
Dynamic capabilities theory	Strategies for developing and adapting abilities to achieve a competitive advantage Key features include intelligence, responsiveness, data and information management, simulation, visualisation and remote interaction	Teece et al. (1997)
Competence-based view	Focuses on identifying, developing and leveraging core competencies for achieving organisational success	Sanchez et al. (1996)
Human capital theory	Strategies for cultivating organisational productivity and profitability Focuses on investing in development, education and training for enhancing the competencies of the workforce	Becker (1993)
Hybrid skills set for automotive organisations	A set of interrelated set of conceptual, human, personal and technical skills associated with Industry 4.0, with implications for talent management strategies	Macpherson et al. (2024)

Note: Please see the full reference list of this article [Macpherson, W.E., & Werner, A. (2025). Continuum of job loss and job creation: Insights from automotive organisations in South Africa. *SA Journal of Human Resource Management/SA Tydskrif vir Menslikehulpbronbestuur*, 23(0), a2895. <https://doi.org/10.4102/sajhrm.v23i0.2895>] for more information.

integration of cyber-human systems and cyber-physical systems for synergetic human-robot collaboration is vital in an industry focussed on increased mechanisation. Human-robot collaboration requires technical skills such as coding, troubleshooting, data analytics, quality control and the design of user experience, as well as soft skills such as critical thinking, problem-solving and creativity (Macpherson et al., 2024). For these reasons organisations need to adjust their talent approaches (recruitment, development and retention), invest in training and development to close potential skills gaps and prepare employees for emerging roles and responsibilities. Industry 4.0 is rapidly evolving and requires lifelong learning (Fantini et al., 2020). An increase in human-robot collaboration presents ethical considerations that need to be addressed. These include finding balance between human competencies and robot capabilities, optimising productivity improvement while reducing strain, and retaining human dominance in decision-making, creativity and oversight (Flores et al., 2020). In addition, employees' well-being should be considered by developing guidelines for the implementation of technology, and maintaining job satisfaction (Nardo et al., 2020).

Impact of Industry 4.0 on employment

Industry 4.0 promises improved working conditions, greater safety, reduced physical labour, increased productivity, new career opportunities and improved competitiveness, depending on industry and nature of work. These outcomes could be the result of the adoption of technology, reskilling and upskilling, or transfer to emerging jobs or competitive areas. As much as the impact of Industry 4.0 is not uniform across regions and industries, globally only 25% of employees indicated that they were confident about remaining in their current jobs with their current employer (Robertson, 2022). It becomes clear that the impact of Industry 4.0 on employment is a complex interplay of job loss, job creation and competency shifts as new jobs emerge and the existing jobs are transformed. According to worldwide projections, it is expected that the year 2030 will produce 600 million new job demands compared to a global job loss of approximately 4 million skilled manual and repetitive jobs (The World Bank, 2023). On the other hand, a report by the OECD (2024) suggests that between 4% and 40% of existing jobs were likely to be displaced by emerging technologies, putting people residing in areas with high unemployment and low productivity at higher risk.

The impact of Industry 4.0 on employment is complex, considering that the level of employment in South Africa is also influenced by multiple factors, including technological advancements, government policies, and economic conditions (Naderi et al., 2019). To effectively leapfrog Industry 4.0, the upskilling and reskilling of employees for new job categories and changing demands should be a priority. This is a challenge considering the global skills gap and competency mismatch in relation to Industry 4.0 competency demands. To address skill challenges, it had been well established that employers, employees, government

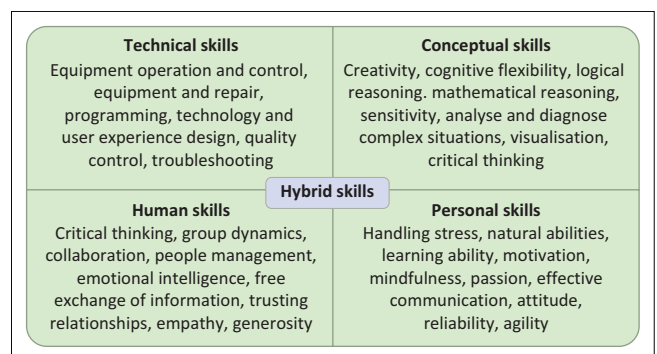
and educational institutions need to collaborate (Macpherson et al., 2022). These actors need to target lifelong training and development initiatives to minimise job loss. Industry 4.0 is also promoting remote work, flexible working arrangements and collaboration, which require adaptive ways of working and effective communication, but contribute to a more human-centric workplace.

Maisiri and Van Dyk (2021) noticed that some South African manufacturing organisations managed to adopt Industrial 4.0 technologies without shedding jobs, and this was achieved by automating routine tasks, directing employees towards a greater focus on innovation and problem-solving, in-sourcing functions that were previously outsourced, in-house upskilling and reskilling, and adopting technologies that benefit employees while promoting competitiveness. The authors pointed out that protecting jobs was a joint effort between human resource (HR), operational professionals and digital experts, implying that protecting jobs is not an easy or simple task (Tripathi & Gupta, 2021).

An Industry 4.0 competency framework

Industry 4.0 challenges organisations to deskill, upskill and reskill employees to deal with both technology and real-time networks. A robust competency framework is vital for guiding both employers and employees in terms of the required competencies (Flores et al., 2020). Such a competency framework classifies tacit knowledge, which is not easy to identify and share, and explicit knowledge, which is disclosed and easy to share (Srinivas, 2018), as well as required attitudes (Lichtenthaler, 2010) and a hybrid skillset (Macpherson et al., 2024), with the latter being illustrated in Figure 1.

Competency models guide the identification, development and evaluation of competencies required for Industry 4.0, which could negate job loss at individual, organisational and national levels. However, if the overall demand for specific skills decline, no amount of training will negate job loss. On a national level, a focus should be on providing an enabling environment, human resources, infrastructure, ecological sustainability, innovation capability, cybersecurity and consumers (Tripathi & Gupta, 2021). Indicators of human capability for Industry 4.0 involve identifying basic and



Source: Macpherson, W.E. (2021). *Emerging job categories and competencies informing talent strategies for Industry 4.0 automotive organisations*. PhD thesis. Nelson Mandela University. Retrieved from <http://hdl.handle.net/10948/54002>

FIGURE 1: Hybrid skills set for Industry 4.0.

tertiary educational skill levels in focus areas such as design, management, engineering, ICT, whereas the employability of staff is determined in terms of training, employment level and ICT expertise. Treviño-Elizondo and García-Reyes (2023) propose an organisational change roadmap for the development of Industry 4.0 competencies. Their model focuses on the level of maturity of employees in four main competencies and presents a process for competency development.

Using these models as a guide for Industry 4.0 readiness, South African organisations could evaluate the current competencies of their workforce, identify existing gaps and address these gaps with targeted interventions such as training. Employees not only need hands-on exposure to new technologies but also need to develop problem-solving and decision-making competencies in realistic settings. A culture of learning and continuous improvement requires management commitment, effective communication and collaboration with other stakeholders (Prifti et al., 2017).

Other strategies for developing Industry 4.0 competencies include communicating the benefits of Industry 4.0, promoting mobility and job rotation, performance management, competency mapping and addressing psychological reservations (Schwab, 2018). In doing so, organisations will not only promote the adoption of emerging technologies but also create a more resilient, adaptable and innovative workforce.

Continuum of job loss and job creation in Industry 4.0

The continuum of job loss and job creation, as presented in this study, depicts perceptions of major job loss on the one hand and perceptions of major job creation on the other hand, in the context of Industry 4.0. The middle of the continuum reflects perceptions of no or minor job loss or job creation. The introduction of new technologies is influenced by various factors, including the speed of technological advancement, the availability of skilled employees, the monetary investment required, and the support given by the government for technological development and education (Macpherson, 2021). Rapid technological advancement is likely to result in a shortage of skill, as organisations in South Africa are less likely or able to invest large amounts of money in the development of employees. At the same time, the creation of new jobs could be hampered by the high cost of emerging technologies, and a lack of government policy development and support for training (Calitz et al., 2017).

Research design

The study is conducted from a social sciences perspective and reports on perceptions of participants. It comprised two phases. During the first phase, in-person semi-structured interviews were conducted with operational managers and HR practitioners working in the automotive sector in South Africa. In the second phase of the study, data were collected via a self-administered online questionnaire with close-ended questions and a Likert scale. As such, mixed methods were used, reflecting both an interpretative and positivistic paradigm.

The purpose of the interviews was to identify new job categories that the participants perceived as emerging within their organisations, as well as to identify competencies that they associated with Industry 4.0, which informed their talent management strategies. To this end, the qualitative study was purposive, interpretive and exploratory in nature (Hammond & Wellington, 2013). Thirty managers in the fields of engineering, HRM and production within the automotive sector were interviewed face to face, and with consent. An interview schedule was used, addressing the perceived extent and nature of automation, the influence on job loss, types of new jobs emerging, competency requirements, challenges experienced and talent management strategies employed. Interviews were conducted until saturation was achieved. Twenty-four of the 30 participants worked in organisations supplying parts to motor vehicle assemblers, and the rest were from motor vehicle assemblers. Twelve participants indicated their organisations as extensively automated, whereas the rest (18) indicated that their organisations were not extensively automated. The collected data were analysed in line with the six-step thematic data analysis suggested by Saunders et al. (2011). Patterns and similarities in responses were identified and served as the basis for developing themes using open coding.

The survey utilising an on-line questionnaire targeted managers and employees working within the automotive industry and explored the importance placed on a hybrid skills skill set (Table 1) in their organisation's talent strategy (recruitment, development and retention). The QuestionPro platform was used for administering the questionnaire, with a web-based link disseminated via social media, using convenience and snowball sampling. The online questionnaire consisted of three sections, the first collecting demographical data and perceptions of the level of automation in the organisation employed in. The second section contained questions on the hybrid skills set and the last section questions on talent management strategies. The cover letter explained the purpose of the study, issues of voluntariness, anonymity, and the right to withdraw from the study. A pilot study was conducted.

A total of 137 respondents (26.0% response rate) who completed questionnaires were included in data analysis. The respondents were mostly from organisations employing 1000+ employees (43%), followed by organisations employing 500 or less employees (34%), and organisations employing 501–999 employees (23%). Most respondents worked for motor vehicle manufacturers and assemblers (47%), or automotive component suppliers (38%). Sixty per cent indicated that they worked in production and operations, and 21% indicated HRM. The largest cohort was employees (39%), followed by managers (22%), team leaders (21%), supervisors (11%) and senior managers (7%). Responses to the level of automation ranged from 'not automated at all' (18%), 'automated to some extent' (64%), to 'extensively or almost fully automated' (9%), as per the Likert-type scale. Fifty-eight per cent of the respondents indicated that traditional robots (58%) were mostly utilised in their organisation, 23% indicated that Cobots (23%) were mostly used, whereas the rest (19%) indicated none.

Data collected from the survey was automatically captured on a web-based spreadsheet. Descriptive statistics reported in this article include frequency counts and percentages. Chi-square tests were used to determine the levels of independence among factors. Where independence could not be established, Cramer's V was used to determine the strength and practical significance of relationships.

Data quality and integrity strategies

Prior to conducting the interviews, the interview schedule was scrutinised by the research supervisors for face and content validity. With the consent of the participants, all interviews were recorded and transcribed to enhance the quality and integrity of the reported data, avoid bias and, in turn, ensure credibility. Transferability and credibility were ensured through selecting participants that could be considered experts in their respective fields by virtue of being operational managers or HR practitioners. The interviews took place in person and in a quiet venue, allowing enough time. Confirmability was ensured by extracting codes from the responses based on similarities found, which were cross-checked to ensure the dependability of the data collected (Hammond & Wellington, 2013).

Prior to conducting the survey, the questionnaire was scrutinised by the research supervisors and a statistician and piloted among experts in the fields of HR, engineering and production to ensure content and face validity. Exploratory factor analysis was conducted to ensure the construct validity of the questionnaire. The reliability of the gathered data was confirmed by Cronbach's alpha scores above 0.70 obtained per factor, which is an acceptable level (Cassim, 2011). The Statistical Package for Social Sciences (SPSS) was employed, and the statistician assisted with the processing of data.

Ethical considerations

Ethical clearance to conduct this study was obtained from the Nelson Mandela University Research Ethics Committee (Human) (No. H19-BES-HRM-010).

Results

Interviews

Interview participants were first tasked on what they perceived as the influence of the introduction of robots on job loss and secondly on what they perceived as the influence of the introduction of robots on job creation within their organisations. The results were then depicted on a continuum as illustrated in Table 2.

TABLE 2: Continuum of job loss versus job creation (interview results).

Job loss				Job creation			
Major	Moderate	Minor	None	None	Minor	Moderate	Major
0	6	6	18	18	12	0	0

Note: Overall for job loss and job creation respectively = 30.

Most responses are depicted in proximity of the middle of the continuum, indicating no job loss nor no job creation. Minor (6) and moderate (6) job losses were reported, and also a minor job creation (12).

The following responses are comments on job loss in the organisation because of the introduction of robots. The responses indicate that job loss was to be expected, that job loss was inevitable and most likely because of a lack of appropriate skill, with one participant expecting a loss of about 33.3% per cell (4 out of every 12 employees working in a cell):

'I believe robots are the future, and in our instance, it is inevitable that jobs will be lost because a person you had five years ago might not have the skills sets to work with robots now. You need to replace him or her with a person who has the necessary skills and as technology enhances in two years' time you are going to need another type of skill so you might have to replace that employee you appointed recently.' (Participant 23, Male, HRP)

And:

'The introduction of robots into any business, I think, will probably have an effect on reducing the numbers. Let us say in a cell you had 12 employees but with robots there you can probably cut a quarter of that cell and have like eight people in that specific cell. So, it has a big impact on manual labour and the amount of people in a cell.' (Participant 12, Male, Production Manager)

The results of the interviews reflect a minor job creation on the continuum of job loss to job creation. To this end, 12 participants stated that in their organisation, the introduction of robots led to a minor job creation, whereas another 18 participants indicated that the introduction of robots did not lead to any major job creation. The quotes extracted from the interviews, as depicted next, reflect the experience of job creation rather than of job loss and show that job creation was because of a need for specialised skills, and the reason for the minimal creation of new jobs was that employees were adequately skilled to fulfil their current functions:

'In the 4 years that I have been here, and, in this position, the introduction of robots has not led to any job losses but rather created new jobs.' (Participant 07, Female, HRP)

And:

'Look, yes there is job creation, but it is minimal because it is for specialised positions, and I am just talking in a very narrow sense. If I look at our own company, the number of positions created so far is minimal because what we strive for is for our current people are correctly skilled to perform the functions we expect from them.' (Participant 23, Male, Production Supervisor)

The respondents were asked to reflect, based on their experience, on the type of jobs that were vulnerable to job loss and the type of jobs that were likely to emerge and lead to employment. The results are presented in Table 3.

Types of jobs perceived as most vulnerable to the introduction of robots were that of artisans (30), material handling (21) and welding (15). What is also noticed from what the participants shared is that they referred to ‘less human intervention’ and jobs being in the ‘firing line’:

‘Where we normally had human intervention to produce a certain part, it is now actually just robots so material handlers are being replaced because we save a lot in terms of robots.’ (Participant 15, Male, Production Manager)

And:

‘When it comes to manufacturing, the operators, the spot welders and the spray painters are in the firing line because that is done by the robots so the job of the humans on the line now is to do the quality inspection, metal finishing and that is all.’ (Participant 11, Male, HRP)

In terms of job creation, the results suggest that the types of jobs that emerged from the introduction of robots were engineering (24), technical (22), production management (21) and robot setting (21). The following sentiments were shared, and words that should be noted here include ‘speaking the language of the robot’ and ‘get trained’:

‘In certain areas of our organisation we have the best what there is to offer in terms of automation; however, you need double the amount of engineers because it is now more than just an operation, but it is about speaking the language of the robot.’ (Participant 01, Male, Production Manager)

And:

‘Well by implementing robots now there is a market for robot technicians, robot setters and maintenance people because they also get trained on robots, so there is a gap for people to be employed more and more.’ (Participant 16, Male, HRP)

Survey

This section presents an analysis of data collected via the survey. The aim was to explore the perceptions of the respondents, based on selected demographical and operational characteristics, of job loss and job creation in relation to Industry 4.0, and specifically in terms of the adoption of robots. The demographic characteristics considered in the study were organisational size (number

TABLE 3: Spectrum of job loss and job creation in the automotive industry.

Types of job associated with job loss	Response rate	Types of job associated with job creation	Response rate
Artisan	30	Engineering	24
Material handling	21	Technical	22
Welding	15	Production management	21
Spray painting	12	Robot setting	21
Inspecting	9	Electrical	17
Reworking	9	Robotic programming	16
Sealing	9	Robot operating	16
Picking	6	Robotic controlling	14
Packing	6	Quality inspection	12
Electrical working	3	Maintenance	11

of employees), nature of organisation, employment function and level of employment. The operational variables included the extent of robot adoption, and the type of robot predominantly adopted.

For the purpose of comparison, the extent of job loss versus job creation was categorised into three categories: (1) moderate or major job loss, (2) no or minor job loss or job creation and (3) moderate or major job creation. The Chi-square test of independence was used to determine whether an association was evident between the biographical characteristics and the extent of job loss or job creation. For an association to be found significant, the Chi-square *p-value* should be less than 0.05, and for practical significance the *p-value* should be less than 0.05 plus Cramér’s *V* greater than the recommended threshold value for the Chi-square test (Gravetter & Wallnau, 2009). Table 4 presents the results for the association between organisational size and job loss or job creation.

Although the results in Table 4 suggest that large organisations (1000+ employees) were more prone to moderate or major losses (29%) than small (15%) and medium-sized (13%) organisations, and small organisations (0–500 employees) more prone to job creation, the *p-value* (0.213) indicates that these differences are not significant. Further testing revealed no significant associations between the nature of the organisation (motor vehicle manufacturing and assembly and components supply) and job loss or job creation (Chi² degree of freedom [*df*] = 4, *n* = 133) = 0.96; *p* = 0.916).

Table 5 presents results for the association between employment function and job loss or job creation.

From Table 6, it is apparent that there is no significant association between employment function and job loss or job creation (Chi-square *p* = 0.631). In addition to the employment function, no significant association was found between the

TABLE 4: Association between organisational size and job loss or job creation.

Organisational size (no. of employees)	Job loss or job creation							
	Moderate or major job loss		Minor or no job loss and minor job creation		Moderate or major job creation		Total	
0–500	7	15%	29	63%	10	22%	46	100%
501–999	4	13%	23	74%	4	13%	31	100%
1000+	17	29%	32	55%	9	16%	58	100%
Total	28	21%	84	62%	23	17%	135	100%

Note: Chi² (degree of freedom [*df*] = 4, *n* = 135) = 5.82; *p* = 0.213.

TABLE 5: Association between employment function and job loss or job creation.

Employment function	Job loss or job creation							
	Moderate or major job loss		Minor or no job loss and minor job creation		Moderate or major job creation		Total	
Human resources management	9	31%	15	52%	5	17%	29	100%
Productions and operations	16	20%	51	63%	14	17%	81	100%
Other	4	15%	18	69%	4	15%	26	100%
Total	29	21%	84	62%	23	17%	136	100%

Note: Chi² (degree of freedom [*df*] = 4, *n* = 136) = 2.58; *p* = 0.631.

TABLE 6: Association between level of robot adoption and job loss or job creation.

Extent of robot adoption	Job loss or job creation						Total	100%
	Moderate or major job loss		Minor or no job loss and minor job creation		Moderate or major job creation			
Almost fully or extensively automated	6	24%	7	28%	12	48%	25	100%
Automated to some extent	21	24%	58	67%	8	9%	87	100%
Not at all automated	2	8%	19	79%	3	13%	24	100%
Total	29	21%	84	62%	23	17%	136	100%

Note: Chi² (degree of freedom [df] = 4, n = 136) = 23.76; $p < 0.0005$; $V = 0.30$ medium.

level of employment and job loss or job creation (Chi² [df = 4, n = 132] = 6.25; $p = 0.181$). Irrespective of employment function or level of employment, experiences about job loss or job creation in relation to Industry 4.0 were similar.

Table 6 presents the results for job loss or job creation based on the level of robot adoption.

Based on the results in Table 6, a significant and practical significant association of medium effect is found between the extent of robot adoption and job loss or job creation (Chi² degree of freedom = 5.82; $p = 0.213$; Cramer's $V = 0.30$). Job creation was perceived as more evident (48%) in organisations that were almost fully or extensively automated organisations. More job loss (24%) than job creation (9%) was observed in organisations that automated to some extent. Further testing revealed no significant association between the type of robot (industrial versus collaborative) adopted and job loss or job creation. Job loss or job creation was associated with the adoption of robots and not with the type of robots adopted.

Testing of hypotheses

With regard to associations between the demographic and operational variables and job loss or creation in automotive organisations within South Africa, the following research hypotheses were postulated:

- H1:** There is a significant association between organisational size and job loss or job creation.
- H2:** There is a significant association between the nature of an organisation and job loss or job creation.
- H3:** There is a significant association between employment functions and job loss or job creation.
- H4:** There is a significant association between employment level and job loss or job creation.
- H5:** There is a significant association between the level of automation and job loss or job creation.
- H6:** There is a significant association between the types of robots adopted and job loss or job creation.

Organisational size, nature of the organisation, employment function, level of employment and the types of robots adopted were not associated with job loss or job creation in automotive organisations. *H1, H2, H3, H4 and H6* are therefore not accepted.

A moderately significant association was found between the level of automation ($p < 0.0005$; $V = 0.30$) and job loss or job creation with medium effect (Table 6). As such, only *H5* is accepted.

Discussion

Industry 4.0 holds the promise of greater organisational effectiveness and efficiency (Gonese & Ngepah, 2024; Mohamed, 2018) and serves as a mechanism for fostering ESG sustainability (KPMG, 2023). At the same time, it raises concerns about potential job loss because of the emergence of new job categories for which skills are not readily available (Almusharraf, 2025; Macpherson et al., 2024). The possibility of large-scale job loss is a threat to South Africa, a country with a low GDP and high levels of unemployment (StatsSA, 2024). However, there is also a more positive perspective to the adoption of Industry 4.0 technologies (Kiliç & Güven, 2023), namely a perspective of new business models that could lead to higher levels of collaboration and productivity, extending the eco-system and job creation (Mthembu, 2024). The literature review revealed various models or frameworks that depict the complexity of the evolution of technology, its implementation in organisations and related changes (Table 1). It is also evident that to cope in the context of Industry 4.0, employees not only need advanced technological skills but also a blend of cognitive, human, personal and technology skills (Macpherson et al., 2024). This makes targeted talent acquisition, the upskilling and reskilling, and redeployment of employees necessary, implying that large-scale job loss is not necessarily inevitable, as also noticed by Maisiri and Van Dyk (2021). The purpose of this study was to explore a continuum of job loss and job creation in the automotive sector in South Africa, from the perspective of managers, engineers, HR practitioners and employees, using a qualitative approach with interviews and a quantitative approach with the use of a survey and questionnaire. The study also led to the identification of types of jobs perceived as most likely to be affected by job loss and job creation, and investigating whether these perceptions differed based on biographical differences within the sample group and in terms of differences in organisational size, nature of the organisation, function, level of employment, and perceived extent and type (industrial versus collaborative) of robot adoption.

Interviews were conducted with 30 participants (operational managers, engineers, and HR practitioners) from the automotive industry in South Africa. The results revealed that Industry 4.0 and specifically the introduction of robots were not perceived to have a significant impact on job loss and job gain. Job loss was described as moderate and minor, and job gain was described as minor. However, interviewees viewed job loss as inevitable and a consequence of not have the desired skills. The perception was that organisations created new jobs in cases where specialised skills were required and that employees were upskilled with the required competencies.

Job loss was observed in areas where physical work was prevalent, such as in material handling, welding, spray painting and in general artisanal jobs. On the other hand, job creation was expected in types of jobs that required a higher level of education, information technology and robotic type skills, as well as cognitive acuteness. These include engineering, production management and robot-related (e.g. robot setting, programming, operating and controlling) types of jobs, which also have a strong technical orientation. One respondent remarked that double the number of engineers were required, and that it was not just about operations, but being able to 'speak the language of the robot', suggesting that Industry 4.0 required immersion into the field of robotics and a human–robot interface.

Chi-square results from the survey conducted among managers and employees working in the automotive sector revealed no significant differences in the responses based on the size or nature (manufacturing/assembly versus components supply) of the organisation. Almost half (43%) of the respondents were from organisations employing a thousand or more employees, and the other (47%) from motor vehicle manufacturers and assemblers. Larger organisations have the benefit of scale, which will make the implementation of Industry 4.0 technologies more cost-effective and attractive, but in this study, significant differences were not found in job loss and job creation based on organisational size.

No significant differences were found in the survey responses obtained from HR practitioners and production or operational managers in terms of job loss and job creation. Those from production or operations represented 60% of the sample, and those from HR represented 20% of the sample. Significant differences were also not found in responses on job loss and job creation, based on level of employment. This means that senior- or middle-level managers, supervisors or team leaders and employees had relatively similar experiences and perceptions about job loss and job creation.

The only practically significant difference that was found in terms of responses related to job loss and job creation was based on the level of adoption of robots. Interestingly, respondents from organisations that were described as almost fully or extensively automated experienced most job creation (48%), reflecting 31% more than the average obtained (17%) for job creation for the total group surveyed. For this group job creation was offset by a 24% response for job loss, which is the same percentage obtained for respondents from organisations that were perceived as automated to some extent. It is evident that organisations that do not automate at all were perceived to have the least job loss and least job creation, reflecting apparent stability. However, not automating may put them at risk in future, considering that job loss was observed to be 'inevitable' in the face of Industry 4.0. The results revealed that the type of robot adopted did not significantly affect perceptions of job loss and job creation. Whether organisations adopted industrial robots or

collaborative robots (Cobots), the impact on employment was observed to be the same. In this case only slightly more job loss (23%) was observed in comparison to job creation (19%) in the case of industrial robots, with the adoption of Cobots being associated with 23% job loss and 16% job creation.

Management implications

The results of this study have implications for South Africa in general and specifically for organisations in the automotive sector. The study highlighted positive outcomes in relation to the adoption of Industry 4.0 technologies and practices, including a possibility of leapfrogging, and ensuring greater ESG sustainability. By adopting business models that garner the power of automation, networking and real-time data, organisations can enlarge their territories and competitiveness and, in the process, create new jobs. However, taking this route should be done in a responsible manner, with cognisance of potential influences on job loss and employees (Almusharraf, 2025). As such, it is recommended that South African organisations study the various models for the adoption of Industry 4.0-related technologies and also adopt an organisational change model, incorporating an analysis of current competency levels against future competencies requirements and interventions aimed at upskilling, reskilling and deploying employees to areas where their skills will be of benefit to the organisation. The study reveals that more physical types of jobs, such as welding, spray painting, material handling and other artisanal jobs, are likely to be negatively impacted by automation and the adoption of robotics, and the upskilling or deployment of these employees into other positions should be performed proactively.

Managers should revisit the hybrid competency set developed by Macpherson (2021) and ensure that these competencies are considered and incorporated as criteria in HR processes such as recruitment, selection, training and development, re-training and onboarding of employees, in consideration of the unique nature and strategic goals of the organisation. Although the implementation of Industry 4.0 technologies and practices is associated with some job loss, this should not be accepted as an inevitable consequence of Industry 4.0. The results of this study demonstrated that the operational and engineering managers, HR managers and employees that participated in the study were also confident that Industry 4.0 would result in more job creation. Considering the dire employment situation and level of poverty in the country, managers should purposefully devise strategies to retain employees, upskill them and create new jobs to be aligned with the overarching sustainable development goals. In South Africa, job loss and unemployment are wicked problems, and organisations and managers should consider how engineering, robot and networking specialists who are future-oriented could contribute to the design and utilisation of technologies in a way that alleviate these problems in the country to create

more economic and social sustainability. This will require collaboration between the government, organisations, universities, technical and vocational education and training (TVET) institutions and other training providers, and the promotion of an educational and continuous learning model to provide a pool of talent for the future. For examples, interventions are required for the education of young people in areas such as design, management, engineering and ICT and lifelong learning must become a habit once a qualification has been attained.

Limitations and future research

As with most studies, limitations are noted. The study explored the perceptions of operational managers, HR practitioners and employees in the automotive sector of job loss and job gain within the current context of Industry 4.0. Exploring perceptions provides for less objective results than a data-driven approach as is mostly used in econometric studies, but it still provides valuable insights into the experiences of managers and employees with regard to job loss and job gain in their work spheres. The sample was relatively small and most participants and respondents were from the Eastern Cape province in South Africa, which limits the generalisation of results. There is room for future interdisciplinary studies, notably in both social sciences and economics, and for long-term studies across sectors and regions, taking into account the complexity of technological evolution and variegated influence thereof in different contexts.

Conclusion

The evolution of Industry 4.0 triggers the adoption of advanced technology and practices within organisations with the aim of increasing productivity, efficiency and effectiveness. Industry 4.0 is also associated with the emergence of new job types and the obsolescence of jobs that are automated. The results of this study showed that managers and employees within the automotive sector observed job loss as well as job gain especially as a result of the adoption of cobots in production processes. Job loss was perceived as a consequence of not having the necessary skills, although job creation was linked to specialised skills. The challenge for leaders and managers within the automotive sector is to find ways to ensure a pipeline of talent that can serve the needs of the organisation. It is evident that there is already collaboration between the automotive sector, government and educational providers to ensure that the necessary human resources will be available. Employees who are at risk for job loss should be counselled and directed towards alternative jobs or even career options. Employees need to embrace opportunities to shift to areas where their skills are needed, pursue educational and training opportunities to develop their technical acumen, and become more engaged in areas that require critical thinking, trouble shooting and innovate, to safeguard their careers.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

W.E.M. was responsible for data collection, data analysis and preparing the manuscript – the article is based on his PhD studies. A.W. supervised the study. All authors discussed the findings and contributed to the final manuscript.

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Data availability

The data that support the findings of this study are available from the corresponding author, W.E.M., upon reasonable request.

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