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Industry 4.0: Emerging job categories and associated competencies in the automotive industry in South Africa

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Orientation: Industry 4.0 is causing significant technological and operational changes in the South African automotive industry and adapting human resources to these changes is essential for enhancing organisational productivity and competitiveness.

Research purpose: This study investigated emerging job categories in the South African automotive industry and the competencies associated with these job categories.

Motivation for the study: The automotive industry is the largest contributor to South African gross domestic product (GDP), and the evolution of Industry 4.0 in the automotive industry influences the competencies required from employees.

Research approach/design and method: A qualitative descriptive research design was used. Purposive and convenience sampling were used and 30 semi-structured interviews were conducted with HR managers, engineers and production managers working in South African automotive organisations.

Main findings: Organisations in the automotive industry in South Africa were making strides in adopting automation in operational processes, yet experienced challenges related to human resources. New job categories were emerging requiring a hybrid competency set.

Practical/managerial implications: The constant changes associated with Industry 4.0 in the automotive industry requires the continuous re-alignment of employees' competencies with emerging job categories which, in turn, requires organisations to reconfigure their talent management strategies. Existing employees should be upskilled and reskilled, new recruits should meet future needs of the organisation.

Contribution/value-adding: The study guides HR practitioners and automotive professionals in terms of emerging job categories and skills sets required. Knowledge of these changes will assist them in developing an effective talent management strategy.

Keywords: Industry 4.0; Robotics; human–robot collaboration; emerging job categories; emerging competencies; knowledge; skills; attitude; Industry 4.0 talent; Industry 4.0 talent management.

Background

Industry 4.0 has become a buzzword worldwide, with this industrial evolution being characterised by the rapid advancement of technology and adoption of the Internet of Things (IoT), Robotics, three-dimensional (3D) printing and Artificial Intelligence which, in turn, result in the creation of Smart Factories. Industry 4.0 is a worldwide phenomenon, and organisations in South Africa (Marwala, 2018) must adapt to these changes to stay competitive.

The increasing adoption of Industry 4.0 technologies in South Africa and specifically in the automotive industry poses a threat to one-third of jobs (5.7 million) (Accenture Consulting, 2018) in the country. This is because of greater automation and the creation of human–robot collaboration (HRC) environments, which are currently still in infancy in South Africa (Calitz, 2019; Marwala, 2018) and therefore more drastic changes can be expected in the near future.

An HRC environment requires highly skilled employees who add value to their organisations (Spiesshofer, 2017) by being flexible, innovative and performing tasks accurately and in synergy with complex technical systems. Changing to this environment creates tension between employees' world experiences and the world of collaborative robots (Cobots). To adjust and deal with the

tension specialised competencies in line with Industry 4.0 job requirements (Li, 2017) should be developed.

South Africa is known for having an oversupply of young people who lack work experience and education to fill key roles in automotive organisations. This leads to large mismatches between the actual supply and demand of key work-related competencies, with 38% of employers reporting difficulties in filling jobs (Li, 2017) while it is believed that only 16% of the competencies needed to meet the requirements of Industry 4.0 are available (Phillips, 2018).

Therefore, managers in South Africa's automotive industry need to identify, retain and develop talent to match the demands of Industry 4.0 through effective talent management strategies. Schwab (2018) reported that organisations worldwide were grappling with developing talent management strategies suitable for Industry 4.0. It had therefore become essential to identify emerging job categories and competencies required in Industry 4.0 automotive organisations, which motivated this study.

Research purpose and objectives

A study by Maisiri, Darwish and Van Dyk (2021) revealed a lack of empirical studies on emerging jobs and competencies in the South African automotive industry.

This article, therefore, reports on a qualitative study that formed part of a larger mixed-method study in the South African automotive industry to determine emerging job categories and competencies, to inform talent strategies. The research objectives of this study were to:

1. explore the views and experiences of human resource (HR) managers, operational managers and engineers working in the South African automotive industry of the extent to which the emergence of Industry 4.0 has affected the automotive industry in South Africa in terms of automation
2. explore the views and experiences of the research participants in terms of emerging job categories and associated competency requirements in their organisations
3. explore talent strategies that could be adopted by automotive organisations in South Africa to meet Industry 4.0 talent demands.

Literature review

Industry 4.0

Industry 4.0 is a trending buzzword that originated in the German manufacturing industry during 2011 (Schwab, 2018). Industry 4.0 refers to an evolving industry characterised by synchronising technological breakthroughs and sophisticated human technical capabilities to create real-time value streams that produce quality products and services aimed at satisfying changing customer preferences and demands. Industry 4.0 is taking the world by storm as organisations seem to increase their global competitiveness through technological innovation (Keywell, 2017). These innovations include Artificial Intelligence, the IoT, Robotics, 3D printing and nanotechnologies (Schwab, 2016).

The impact of Industry 4.0 is explicitly connected to the VUCA – Volatility, Uncertainty, Complexity, Ambiguity world as its complexity results in ambiguous decision-making while leaders craft the best future for their organisation. To effectively respond to Industry 4.0, organisations are moving away from traditional methods of operating to augmented reality (Keywell, 2017). An augmented reality involves the integration of all work processes to effectively respond to individual customer demands through a collaborative process (Laugsand, 2017).

In the manufacturing industry, global organisations have added collaborative robots to traditional industrial robots on their production lines (Calitz, Poisat, & Cullen, 2017). Robotics refers to automated machines that can be reprogrammed to perform multifunctional and complex tasks, which relieve employees of repetitive, boring, stressful, labour-intensive and potentially dangerous tasks and release them to utilise their competencies elsewhere in the organisation (Acemoglu & Restrepo, 2017).

These repetitive and labour-intensive tasks include painting, welding, material removing, assembly and parts transferring and machine tending (Universal Robots, 2018). The adoption of Robotics increases quality, volume and safety, which leads to increased productivity and reduced operational costs, thereby increasing organisational competitiveness (Schwab, 2016).

Emerging job categories

The vision of transforming the workplace in line with Industry 4.0 can only be realised through the availability of a skilled and prepared workforce that is able to increase organisational effectiveness and performance. The transformation of the working environment leads to the emergence of 'new' or emerging job categories (Keywell, 2017).

Emerging job categories refer to the classification of jobs according to responsibilities, duties and competencies on different levels as required by organisations to effectively operate, collaborate and compete in relation to the design demands of Industry 4.0 (Heathfield, 2018). Job categories indicate the tasks associated with a job, the competency requirements, the level of education needed as well as the experience required to effectively perform the job (World Economic Forum, 2017).

As with the previous industrial revolutions, Industry 4.0 brings about an increase in job complexity and is said to make one in every three jobs absolute (Gray, 2016). As such, many of these job losses are linked to lower-skilled job categories while job creation is linked to higher-skilled job categories.

Calitz (2019) calculated that, between 01 April 2018 and 31 March 2019, more than 300 new job categories emerged in South Africa (Calitz, 2019). However, the study of Calitz (2019) did not specifically focus on the automotive industry where interconnected and intelligent manufacturing systems are adopted.

For purposes of this study, a review of job advertisements specifically in the automotive industry in South Africa revealed that the most frequently advertised jobs between 01 April 2018 and 31 March 2019 included jobs for technicians, Robotics programmers, engineers, Robotics controllers and production managers. The emergence of these new job categories gives an indication to organisational leaders of the types of competencies required by employees in the automotive sector in Industry 4.0 (Hammer, 2018).

Emerging competencies

New job categories also imply new job competencies. It is evident that the success of organisations in Industry 4.0 does not solely depend on the introduction of advanced technology but also on the level of employee competence. It was reported (Accenture Consulting, 2018) that only 81% of jobs in the automotive industry were filled, which alluded to the lack of applicants with the required Industry 4.0 competencies.

Emerging competencies refer to a new set of personal skills, knowledge and behavioural traits, obtained either through experience or training interventions, which enable employees to meet the demands of Industry 4.0 effectively and habitually (Noyce, 2016). Employees working on a production line where robots are used need a positive mindset, understand operational processes, think strategically and know how to manage the interpersonal aspects of the job (Calitz et al., 2017).

The skill set of employees plays a vital role in the success of organisations leapfrogging Industry 4.0 (Marwala, 2018). In Industry 4.0, employees must be multi-skilled and possess a set of hybrid skills consisting of technical, human, personal and conceptual skills (Noyce, 2016). Furthermore, employees need to combine and leverage their individual attitudes, knowledge and skills to ensure a greater competitive advantage for organisations (Schwab, 2017).

The above is reiterated by Goldin (2014) who indicated that the concept of 'talent' refers to employees who are able to use their competencies to adapt to change and, in turn, provide organisations with a competitive advantage. High-potential or high-performance employees are creative, have a diverse set of competencies, exceptional expertise, different intelligences, the ability to make moral judgements, a positive attitude and self-motivation and use these competencies to drive organisational success (Tansley & Tietze, 2013).

Talent strategies

Schwab (2019) stated that South Africa was rich in talent, but that the talent strategies utilised in South Africa were not as effective as they should be. In addition, the 'war' for talent was continuing, which required organisations to creatively adopt an integrated approach to nurture existing talent or produce required Industry 4.0 talent (Keywell, 2017).

Talent management is the cornerstone of any organisation, and in Industry 4.0 the ability to effectively manage talent is vital to remain competitive (McLean-Conner, 2015). Talent management is referred to as an integrated approach to attracting, developing and retaining high-potential employees through anticipating the challenges posed by the ever-changing labour market (Bussin, 2014). In Industry 4.0, organisations have moved away from the traditional methods of managing human resources to the management of talent relevant to the ever-changing business environment (Korn Ferry, 2017).

Talent management is associated with a set of integrated activities to ensure that the right person is in the right position at the right time. The successful implementation of talent activities is the responsibility of key people (leaders, line managers and mentors) at different levels in the organisation, and not only that of the human resource management unit (Phillips, 2018). Key functions in talent management include talent planning, talent acquisition, creating talent pools, succession and career management, talent development, performance management and talent retention. Organisations need to collaborate horizontally and vertically with other organisations, academia and government to meet Industry 4.0 talent demands (Babshet, 2017).

Research design

The purpose of this article was to uncover emerging job categories and related competencies required in automotive organisations to inform talent management strategies by adopting Interpretivism as the research paradigm. To achieve this purpose, the perceptions, views and experiences of experts in human resource management, engineering and production in the automotive industry were sought.

The study was interpretive, qualitative and exploratory in nature, using interviews to uncover the knowledge, experiences and perceptions of knowledgeable and experienced individuals by asking the who, what and where of events and/or their experiences (Cassim, 2011; Hammond & Wellington, 2013, p. 132). Ethical clearance was obtained to ensure the integrity of data collection methods used in the study, analysis of data as well as reporting.

Research participants

The study was focused on the South African automotive industry. Thirty semi-structured interviews were conducted with representatives from the automotive sector employed in human resource management, engineering and production management. Table 1 presents the biographical information collected from the study participants.

In order to be included in the study, participants had to be employed in either human resource management, operations or production, or engineering. The participants represented organisations assembling motor vehicles (6) and organisations supplying parts to motor vehicle assemblers (24). Fifteen participants were employed at the middle management level, and 15 at either the senior management level (11) or as a professional employee (4).

Data collection method

Semi-structured interviews were conducted face-to-face and on-site (pre-coronavirus disease 2019 [COVID-19]). An interview schedule was used, focusing on the extent and nature of automation (robot adoption), challenges experienced with the introduction of robots, the influence of adoption on job loss, types of new jobs emerging, competencies and skills required and talent management strategies suitable for ensuring a supply of competent skill. The interviews were conducted to a point of data saturation when no new meaningful information was being shared.

Quality and integrity of data

To ensure the credibility and integrity of the data, and avoid bias, all interviews were recorded and transcribed with the consent of participants (Hammond & Wellington, 2013). In addition, field notes were taken and consulted. To ensure the trustworthiness of the responses and analysis, participants were carefully selected to ensure that they were experts in their fields, the interviews took place face-to-face in a quiet environment allowing enough time and were recorded, codes were extracted from the responses based on similarities found and these were cross-checked by academic peers to ensure accuracy.

Data analysis

The six-step thematic data analysis approach suggested by Saunders, Lewis and Thornhill (2011) was used to manually analyse the collected data. Deductive open coding was used by identifying patterns and similarities in the responses and formulating categories to identify themes.

Reporting style

The overall trend in responses is indicated, followed with a table presenting the themes that emerged with response frequencies and thereafter descriptive summaries with verbatim responses as illustration.

TABLE 1: Biographical information of participants.

Category	Item	Frequency
Nature of organisation	Motor vehicle automotive and assembly	6
	Components supply	24
Function of employment	HRM	10
	Engineering	10
	Productions/operations	10
Level of employment	Senior manager	11
	Middle manager	15
	Professional	4
	Total interviewees	30

HRM, human resource management.

Study findings and discussion

The first question focused on the extent of automation based on the adoption of robots in the operational process and the functions of these robots.

Theme 1: Extent of robot adoption and main functions of robots

Drawing from the participants' responses, it was found that organisations in the automotive industry in South Africa were not fully automated but were making strides in achieving automation. Of the total participants, 60% (18) stated that their organisation was extensively automated, while the rest 40% (12) indicated that their organisation was automated to some extent (Table 2). In terms of the main functions of the robots, consensus among the participants was that parts transferring (18), packaging (18), material handling (18), welding (15) and inspection (15) were the main functions performed by Robotics (Table 2).

Notably, organisations in the automotive sector embraced and adopted technologies associated with Industry 4.0. One participant explained that:

> 'I think robots are the future and we are phasing in robots at a rapid pace, so we have a lot, actually we are a world class organisation competing with world class organisations across the world and 85% of the section where I work is made up of robots, with only 15% needing human intervention.'

The above finding is in line with the discussion in the literature review that suggests that the automotive industry had exerted extensive efforts to stay up to date and relevant with technological advancements, specifically Robotics to advance productivity and competitiveness (Acemoglu & Restrepo, 2017; Kearney, 2018; Magruk, 2016; Marwala, 2018).

Although most of the participants agreed that automation was the future, this study found that the adoption of Robotics depended greatly on the kind of service provided by the organisation. One participant explained:

TABLE 2: Extent of robot adoption and main functions of robots.

Item	Themes	Response frequency
Adoption of robots	Extensively automated	12
	Automated to some extent	18
Functions performed by robots	Parts transferring	18
	Packaging	18
	Material handling	18
	Welding	15
	Inspection	15
	Placing	12
	Assembling	9
	Painting	9
	Palletisation and de-palletising	9
	Trimming and cutting	6
	Sealing	6

> 'I think that it really depends on the industry because some industries just cannot have robots, e.g. I do not know how you cut a seat cover of many variants with a robot.'

Robotics was predominantly adopted to perform labour-intensive tasks. This finding supports the literature that suggests that organisations move to automation to maintain competitiveness through creating precision and dependability in labour-intensive tasks (Acemoglu & Restrepo, 2017; Calitz et al., 2017; Schwab, 2016). The findings are also similar to that of Calitz et al. (2017) who in their study found that in the automotive industry Robotics was predominantly adopted for the purpose of welding, assembling, packaging, material handling and painting.

Theme 2: Impact of Industry 4.0

The theme 'Impact of Industry 4.0' comprises four categories: challenges with the adoption of robots, job losses, job creation and employee experiences. Major challenges for the South African automotive industry with the adoption of Industry 4.0 technology were to keep up with rapid changing technology, slow fault detection, losses because of breakdowns of robots and an ageing engineering workforce (Table 3).

One participant explained:

> 'All the robots we have are imported and need an electrician on all of them but in-house training is not done because there are no training facilities in South Africa that provide training on these specific robots and we rely on new guys coming from the university but even with their qualification they are struggling, so if there is a stoppage or breakdown the company needs either to correspond globally or fly someone in from Europe to solve the problem which is costing the company a lot of money.'

In addition, other significant challenges indicated by the respondents included the unwillingness of employees to update skills, lack of robotic training, and health and safety issues. In support, one participant further explained that:

> 'What we also find is that when we arrange training for employees, they are just not willing to attend and come up with a lot of excuses but if you do not send them on training, they blame the company.'

TABLE 3: Challenges faced by automotive organisations with the introduction of robots.

Themes	Response frequency
Inability to keep up with technology	22
Slow fault detection	20
Losses because of breakdowns of robots	18
Ageing engineering workforce	18
Unwillingness of employees to update skills	15
Lack of robotic training	15
Health and safety	12
Maintenance of robots	12
Recruitment of skilled employees	12
Limited artistic knowledge	9
Negative employee attitudes	8
Training costs	6

These findings are consistent with the literature review that suggests that organisations often struggle to keep abreast of technological advancements, that some employees are unwilling to update their skills and that health and safety issues are of huge concern in workplaces where robots are adopted (Kearney, 2018; Keywell, 2017; Laugsand, 2017).

In terms of job loss, 18 participants (60%) indicated that the adoption of Robotics in their organisation had no major impact on job losses. Previous studies have found that the emergence of Industry 4.0 will lead to major job loss environments where repetitive jobs are performed (Keywell, 2017; Schwab, 2016).

The reasons given for the low job losses experienced in their specific organisations included the relocation of employees to other workstations or other plants. One participant explained that:

> 'From a managing perspective, it has not really impacted us because we did not have to retrench anybody. Although we moved from three to two people performing a job, we basically just relocate people.'

Job loss was a reality for some of the respondents. One participant stated that in their organisation, the introduction of Robotics led to a reduction in the workforce by 33%. The participant explained why job reduction was a reality:

> '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 twelve 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.'

The above-mentioned findings allude to the importance of talent management in Industry 4.0 as many job losses are as a result of competency redundancy, which could be rectified by upskilling and reskilling rather than replacing employees. In support, responses such as 'in two years' time you are going to need another type of skill' and 'allocate employees to a different workstation' reiterate the urge for organisations in the automotive industry to engage in talent strategies that are future focused and continuously updated.

In terms of the type of jobs loss, it was found that in organisations where the introduction of Robotics led to job losses, artisans, material handlers, spray painters and welders were mostly affected (Table 4). Artisans (30) and material handlers (21) were indicated as the most at-risk jobs in organisations where robots were adopted. The literature (Caruso, 2018; Marwala, 2018; Schwab, 2016) reiterated that robots were introduced to relieve employees from performing repetitive tasks and new methods of work result in new job categories while some job categories become redundant as the skills required change.

TABLE 4: Types of jobs lost as a result of the introduction of Robotics.

Themes	Response frequency
Artisans	30
Material handlers	21
Welders	15
Spray painters	12
Inspectors	9
Rework operators	9
Packers	9
Material handlers	6
Rework operators	6
Electricians	3

The results showed that lower-level employees were most at risk in terms of job loss with the introduction of robots and requiring a new set of skills. One participant explained:

> 'At this point in time the biggest job losses will unfortunately be at the lowest level in your organisation, your operators, because one robot performs the job of three, four, five people depending on where you utilise it.'

This important finding made in this study was that lower-level employees seemed to become redundant with the introduction of robots, which reflects the need to repurpose existing talent, especially within the automotive industry as being one of the largest job creators in the country.

In terms of job creation, there was consensus among participants that the introduction of robots led to minor or no job creation in their organisation. Eighteen participants indicated that the introduction of robots did not lead to any major job creation in their organisations, while another 12 participants stated that in their organisation the introduction of robots led to minor job creation.

One participant stated that:

> 'Like I said, we are a world class organisation competing with other organisations across the world. The current product that we are making, which is a 4.8-billion-rand project, if it created 200 jobs it is a lot. Our organisation believes in lean manufacturing, so they bring in a lot of robots to make more profits.'

The introduction of robots required specialised skills, and impacted job losses in the automotive industry in South Africa rather than job creation. Notably, this finding differs from the discussion in the literature review where it was noted that the emergence of Industry 4.0 will lead to major job creation (Keywell, 2017; Marwala, 2018; Schwab, 2016).

However, another interesting finding from this study which is in line with the literature is that more HRC will be required and that labour brokers will be used to source the required skills (Calitz et al., 2017; Schwab, 2016). Therefore, in this context, the responses allude to a need for continuous improvement in talent strategies, for example, 'strive is for our current people to be correctly skilled' and 'need the human eye to evaluate if the thing is right'.

TABLE 5: Types of jobs created as a result of the use of Robotics.

Themes	Response frequency
Engineers	24
Technicians	22
Production managers	21
Robot setters	21
Electricians	17
Robotic programmers	16
Robot operators	16
Robotic controllers	14
Quality inspectors	12
Maintenance	11
Welders	9
H&S representatives	4

H&S, Health and Safety.

Participants generally indicated that the introduction of robots in the automotive industry led mostly to the development of engineering jobs (24) (Table 5). Participants emphasised the importance of engineers in organisations where robots were introduced:

> '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 no more just an operation, but it is about speaking the language of the robot.'

In support, another participant added that:

> 'The advantage of robots is now we have more technicians because in the past you did not need technicians in a factory but now all of a sudden with robots here you need them to look after the robots. You also need engineers such as process engineers, production engineers and also quality engineers which we are looking for in our business.'

In addition to the above, other significant job categories that emerged in the automotive industry included technicians (22), production managers (21) and robot setters (21) 'to manage a volatile product' and 'to interpret results'. Furthermore, the introduction of robots created openings for more health and safety representatives.

These findings are in line with observations made by Calitz (2019) who claimed that more than 300 new job categories emerged in South Africa during the 2018–2019 financial year and of specific interest was the types of jobs created in the automotive industry as a result of the introduction of robots.

Participants stated that the introduction of robots in the automotive industry had the following positive experiences for employees (Table 6): increased productivity (27), improved quality of work (25) and better developed employees (21). Participants emphasised the following: '[*t*]hese new robots run at [*a*] higher speed, so production volumes and outputs are beneficial and make it easier for employees to reach their targets', 'our quality directly affects the safety of the end user, so to improve quality we had to automate', and 'in our case employees have a positive experience because now you have more developed workers'.

A reduction of down time was also mentioned, 'on the positive side one can see as we upgrade the robots the downtime reduces because if I am able to go online, trouble-shooting becomes a lot quicker'.

Other participants indicated expansion of professional prospects:

> 'One of the more positive things for employees is if they want to grow, they can educate themselves and expand their knowledge and even shift into the department of their interests and avoid being replaced by these robots.'

The negative experiences of employees as a result of the introduction of robots were mainly fear and anxiety (16) and a lack of motivation (13) (Table 6). Participants highlighted 'fear and anxiety that comes with the introduction of new technologies due to upgrades'. Regarding lack of motivation, the participants highlighted that 'some of them are just happy to be an artisan who can nowadays sit back and who do not have to stress when the robot stops'. Reluctance to attend training was also mentioned: 'there is a reluctance among employees to go for training'. These findings emphasise the need to identify characteristics required by employees to be successful in the Industry 4.0 environment and to consider these in the talent management strategy.

These findings are also in line with the literature review that indicates that the technological advancements associated with Industry 4.0 lead to a slow speed of or reluctance in adopting technological breakthroughs and great effort is required for preparing training data necessary for supervised learning (Vaidya, Ambad, & Bhosle, 2018).

Theme 3: Industry 4.0 competencies

Participants were asked to indicate the competencies required by employees in an automated system in the automotive industry where they were working. Participants highlighted that a hybrid skill set was required to effectively operate in Industry 4.0 automotive organisations where robots were introduced: 'In production specifically you need to know how to work with people and how to manage people, you need to know how to handle difficult situations, take the negative feedback', 'Look, for us communication, problem solving skills, collaboration, driving for results, time management, and depending on the field that you are in we add the Technical skills', and 'So yes, Technical skills will be important but also skills such as communication, collaboration, good decision making, quick thinking and good time management'.

The hybrid skill set is divided into technical, conceptual, human and personal skills (Marwala, 2018; Schwab, 2018). The top 10 Industry 4.0 competencies required to effectively operate and collaborate on a production line shared with robots that emerged from the interviews were the following: engineering skills, collaborative skills, computer literacy, troubleshooting skills, effective communication, swift decision-making, reliability, critical thinking, adaptability and effective time management (Table 7). These findings are in line with research that indicates that in Industry 4.0 employees need a hybrid skill set to effectively collaborate with emerging technologies (Berger, 2016; Marwala, 2018; Schwab, 2018).

Apart from the main competencies required, other skills mentioned (Table 8) that are important to effectively operate on a production line with robots include ethical behaviour and creativity: 'From a point of view, I can always teach you the technical stuff, but I cannot teach you how to behave and that is imperative' and:

> 'With the new robots comes a lot of problems so you need a lot of people to brainstorm, especially people with knowledge of how the system works to find a common solution and make it more perfect for everyone's benefit.'

TABLE 6: Positive and negative experiences for employees with the introduction of robots.

Positive experiences	Frequency	Negative experiences	Frequency
Increased productivity	27	Fear and anxiety	16
Improved quality of work	25	Lack of motivation	13
Better developed employees	21	Reluctance for training	11
Decreased downtime	19	Increased absenteeism	8
Increased motivation levels	14	Loss of vision	8
Expansion of professional prospects	14	Unreasonable expectations	7
Progressive mindset	8	Increased sensitivity	6
Reduced reworks	5	Resistant to change	5

TABLE 7: Ten main competencies needed for collaboration with robots on a production system.

Themes	Response frequency
Engineering skills	30
Collaboration	30
Computer literacy	30
Troubleshooting skills	27
Communication	26
Swift decision-making	23
Reliability	22
Critical thinking	21
Adaptability	20
Time management	19

TABLE 8: Additional competencies vital in Industry 4.0.

Themes	Response frequency
Creativity	18
Knowledge of the production system	18
Diversity management	18
Ethical behaviour	17
Coding	16
Flexibility	16
Emotional intelligence	13
Quality controlling skills	12
Logical reasoning	11
Negotiation skills	11
Moral judgement	9
Sympathy	9
Leadership skills	8
Change management	6

In addition, the following were mentioned: knowledge of the production system, diversity management, coding, flexibility and emotional intelligence, as well as quality controlling skills, logical reasoning, negotiation skills, moral judgement and empathy.

Contrary to the previous three industrial revolutions where most emphasis was placed on technical skills, with Industry 4.0 the gap between hard and soft skills is bridged with a hybrid skill set required by employees to remain employable (Calitz et al., 2017; Kearney, 2017; Schwab, 2018).

Theme 4: Industry 4.0 talent strategies

The overall observation about responses to talent management (Table 9) is that organisations must adopt a variety of strategies to ensure that they do not only repurpose their existing talent but also attract and retain the desired Industry 4.0 talent. The participants mentioned apprenticeships (30), an effective orientation programme (24) and succession planning (22) as the most effective means to effectively manage Industry 4.0 talent. One participant explained: 'This is why I want to sit with our training manager to suggest a new curriculum for our apprenticeships where we start them in this technological mindset'.

Another participant added: 'When we recruit employees into the business, we have a full orientation programme running to take and identify critical skills and integrate it into the business'.

Notably, it emerged that organisations in the automotive sector had adopted an integrated approach to talent management to manage talent effectively. Components of an integrated talent management approach as highlighted in the interviews include training centres, effective performance management processes, on-the-job training and behavioural incentives for employees. Bursaries, collaboration with educational institutions, purposeful employment, the development of a talent pipeline and specialist remuneration were also mentioned. The literature study also indicated that in contemporary times with the continuing 'war for talent', organisations need to adopt an integrated and flexible approach to effectively manage talent (Bersin, Lamoureux, Mallon, Laurano, & Harris, 2010; Bussin, 2014).

TABLE 9: Strategies used to repurpose talent in Industry 4.0 robotic organisations.

Themes	Response frequency
Apprenticeships	30
Effective orientation programme	24
Succession planning	22
Training centres	21
Performance management	18
On-the-job training	17
Employee behavioural incentives	15
Bursaries	14
Collaboration with academia	12
Purposeful employment	12
Talent pipeline	12
International programme	8
Specialists remuneration	2

In this study, it was found that organisations in the automotive industry needed resources to provide broad-based training to both low-level and specialised employees. It was also revealed that collaboration between organisations, industries and educational institutions was vital to nurture the existing and future talent. In Industry 4.0, talent management should focus on recruiting suitable people, orientating them into organisational process and retaining them through proper acknowledgement of their efforts, which will require an effective performance management intervention. Table 9 presents the main themes identified with regard to talent strategies and the number of responses related to each.

It became evident that a total talent strategy supported by a formal policy on employee development from entry-level specialist level was required, based on a thorough needs analysis and one that enables employees to adapt to a fast-paced environment.

Practical implications

The rapid adoption of Industry 4.0 technologies such as robots in the automotive industry leads to the emergence of new job categories that requires an endless alignment of employees' competencies to organisational needs. The purposeful and effective management of human resources is therefore vital to the attainment of organisational strategy, effectiveness and efficiency. These results from the current study suggest that organisations in the automotive industry should develop and implement an integrated and well-structured talent management system.

Human Resources practitioners, operational managers and engineers should work together to identify the specific needs and challenges related to the supply of human resources. The upskilling and reskilling, especially of employees performing manual labour, such as artisans and material handlers, should continuously be done and are the responsibilities of operational leaders as well as HR departments. Employees need to understand the impact of Industry 4.0 on their jobs and should be provided with a suitable alternative career path to increase their motivation for training and personal development. It is evident that new job categories emerge and organisations should not only focus on technical skills but also on conceptual, human and personal skills to equip employees to adopt a systemic perspective and enable them to work effectively in a collaborative environment, trouble shoot and solve problems. The results are relevant to the automotive sector as a whole and specifically to human resource management units, engineers and operational leaders, who collectively are responsible for the recruitment and development of talent that will meet the future needs of South African organisations.

To ensure a future pipeline of adequate talent for the automotive industry, organisations should collaborate with educational institutions and other organisations both nationally and internationally to develop and nurture Industry 4.0 talent.

The preceding recommendations have an impact on the attraction, engaging and retention of Industry 4.0 talent. A talent strategy should attract, engage and retain talent. If this does not happen, the strategy is not effective. An effective Industry 4.0 talent strategy should be underpinned by fundamental talent management practices that support the idea of retaining valuable employees within automotive organisations.

Limitations and recommendations

A sample size of 30 participants may be identified as a limitation towards getting broader views on the subject investigated. However, the study design minimised the possible effect of small sample size by purposefully selecting participants regarded as experts in the field and focus of the study.

Although there might be variations in how Industry 4.0 impacts various sub-sectors in the automotive industry, the study did not focus on a specific automotive industry sub-sector in South Africa. Many new job categories, competencies and talent strategies may be considered generic in the new world of work.

It would be useful to conduct a similar study in international organisations and compare the results with those found in this study that was focused on the South African automotive industry.

Conclusion

Industry 4.0 is impacting the world on various levels and affecting the emergence of various job categories. This requires organisations to possess talented employees with the correct set of hybrid skills to meet Industry 4.0 demands. Talented employees with the required skills or the potential to develop certain competencies can add value to the organisation and contribute to overall organisational competitiveness. With the worldwide war for talent in Industry 4.0, a collaborative approach is needed, encompassing an integrated approach to attract, develop and retain these employees.

However, the results of this study revealed that the automotive industry, as the largest contributor to the country's gross domestic product, has not fully adopted Industry 4.0 technologies. Therefore, to effectively leapfrog into Industry 4.0, the automotive industry needs to proactively implement the technologies associated with Industry 4.0. Of further importance is the fact that the automotive industry needs to develop an Industry 4.0 talent pipeline through collaboration. The results of this study indicated that in a predominant labour market, automotive organisations cannot ignore the importance of competency management through effective talent management that strategically incorporates talent attraction, development and retention.

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Competing interests

The authors have declared that no competing interests exist.

Authors' contributions

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

Ethical considerations

In compliance with Nelson Mandela University's ethical clearance process, participation was voluntary, and no participants were persuaded or paid to participate (clearance no. H19-BES-HRM-010.). This was achieved by providing the prospective participants with an informed consent document, which they had to complete and sign before participating in the interview.

The research overview, expectations from the participants as well as the handling and use of the data collected were stated in the informed consent document. Participants were offered the opportunity to withdraw from the study at any given stage during the interview should they wish so. The researcher adhered to the statements contained in the informed consent document at all stages of the study.

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Data availability

Data sharing is not applicable to this article because no new data were created or analysed in this study.

Disclaimer

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