**AP4CTE AP Seminar: Building a Dynamic Workforce**
*Research Strategies for Innovating and Problem-solving Across Career Paths*
Module 5

# The collaborative work experience of robotics and human workers in the automobile industry in South Africa

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**Abstract.**
Through the lens of the evolutionary economic theory, this study aimed to investigate what drives the implementation of technologies in the South African automobile industry and to understand the experiences employees have had with the introduction of technologies to the sector with regard to work collaboration, safety, and job satisfaction. Using a qualitative methodology, data were collected through a semi-structured in-depth interview, which induced its information from three automotive companies with a total of 30 participants that were purposively chosen as the sample size. Findings revealed that robots and human employees work efficiently together in the automobile sector. In an attempt to minimize product imperfection due to human inconsistencies and to increase productivity, the automobile industry will adopt more technologies to meet the needs of its customers. Findings further revealed that the human-robot collaborative work experiences are negatively impacting on the job satisfaction and confidence of autoworkers and resulting in underutilized skills of the autoworkers. The recommendation is that it will be best to pair robots with human employees in ways that autoworkers' job satisfaction and job security are not constrained. This research contributes to the ongoing study of human-machine collaborative work in the global manufacturing industry and, for the most part, to the study of labour processes and technical advances in the automotive industry worldwide.

**Keywords:** human-robot collaboration, job satisfaction, productivity, repetitive tasks, the fourth industrial revolution

## Introduction

This study examines the experiences of workers with technology in the automobile industry. In the quest to expand productivity and encourage workers to carry out their work, the automobile industry in South Africa aspires to incorporate innovative automation into their labour practices cleverly (Chigbu and Nekhwevha 2020). The support of robots is beneficial in many situations in the car manufacturing sector, and different functional capacities are evolving where automatons will be needed to support humans in the labour market. Findings by Calitz, Poisat, and Cullen (2003) highlight that South African industries have been aware of the international production developments regarding the implementation of robot-human worker collaboration and its potential outcome on the African workforce. Having robots that perform some work in the assembly line increases precision, productivity, and safety in the automobile industry. As the auto industry expands, the technology-human interface becomes the best attributes of successful implementation in the sector.

It is essential to explore and describe what deter-mines the introduction of robotics in the South African car industry, taking safety, job satisfaction, and experiences of workers with industrial robots into consideration. This study contributes to the literature on technological-economic evolution and the usefulness of robot technologies when considering human-robot collaboration, higher productivity, worker's workplace safety, consistent quality products, and

the satisfaction and dissatisfaction from the human-robot interface. This study should be of value to automobile manufacturing entrepreneurs, autoworkers, and the industrial sector policymakers.

**Problem statement**

The human-robot interface has been an advantage to the industrial sector. For years, the motor sector has teamed robotics and workers together in the car plants for various reasons that benefit both the autoworkers and management of automobile companies. While human-robot collaboration reduces repetitive tasks for human workers and lessens the nervous tension in human workers triggered by ergonomics, this collaboration also increases productivity. It ensures higher quality for the management of the car companies. The complexity of the car industry, especially when combined with different vehicle models, assumes this sector utilizes innovation to react strongly to the ever-changing business climate and remain viable in the international motor world (Chigbu and Nekhwevha 2020).

The reason for the constant adoption of robotics in the automobile sector and the collaborative experience of workers and these technologies in South Africa has been researched internationally. However, there is a dearth of research in this area in South Africa with a particular focus on the motor sector. For instance, Gombolay et al. (2015) looked at the decision-making authority, team efficiency, and human worker satisfaction in mixed human-robot teams in the United States of America. Such work in South Africa was written by Calitz, Poisat, and Cullen (2003), which focused on the use of collaborative robots in manufacturing. Further, according to Chigbu and Nekhwevha (2020), South Africa's auto-mobile industry makes more use of technologies and robotics. Hence, due to the insufficient quantity of research in the automobile sector coupled with the high usage of collaborative robotics in the industry, it was required to investigate what drives the implementation of technologies in the South African automobile industry. It was also critical to understand the experiences employees have had with the introduction of technologies in the sector with respect to cooperation, workers' wellbeing, and work satisfaction.

**Literature review**

This section covers an in-depth literature review on the dynamic experiences between today's technology and the human workers in the automobile industry. In this section, an understanding of how human workers and manufacturing technology as a total system are integrated into different situations was ascertained. The benefits and its social, physical, and emotional strain faced on the process of this teamwork were also identified.

*Reasons behind technological adoption*

Karabegović (2016) averred that the automotive industry is the world's leading installer of robotics, provided that international competition in the job market requires continuous development and transformation of manufacturing processes in the motor industry. Every manufacturing process could not be conceived without robotics today. Calitz, Poisat, and Cullen (2003) revealed that it is crucial to identify what the consumers are searching for and take this knowledge and advantage to outcompete counterparts. Considering the time taken to paint a vehicle by a human being, the use of automated robots is economical and extremely effective. The quantity of paint dispersed is spread equally along with the vehicle with robots fitted with a flowmeter, which reduces waste material (Vulavala and Ulmer 2014). Over the years, millions of dollars have been saved by the usage of robotics in the car manufacturing industry. Car

companies have increased their production lines in twofold by setting up different robots in place of humans in the factory. The motivation is that since robots do not go on sick leaves or vacations, using robots in this sense saves money for the adopter. Organizations also save more money as technology does not need insurance or health benefits. Robots can perform the same task continuously without breaks (Ibid).

New forms of these technologies adopted each year are far more advanced than their prototypes (Arntz, Gregory, and Zierahn 2016). Modern industrial technologies offer multiple advantages, and their capabilities are increasing with time, at extraordinary speed, driven by technologies developing at an exponential rate (Deloitte 2018). The robots nowadays can also investigate their work along with assembling a car, eliminating labourer interference (Vulavala and Ulmer 2014). Some time ago, the sales of technologies decreased but recently increased because the automobile companies are reinvesting in newer technologies, advanced facilities, and refurbishing the production sites (Struijk 2011) – this investment will continue. Amid this innovation, the automotive industry in South Africa 'cannot stand still' but must take advantage of this development (Department of Trade and Industry [DTI] 2018). These numerous productive contributions of technologies to any automobile company forces their adoption (Rasiah 2011; Barnes, Black, and Monaco 2018). Form another angle, the reason behind these technological adoptions in the car industry is to establish human-machine collaboration in order to boost productivity.

*Human-robot interface*

The manufacturing industries, for decades, have assimilated robotic technology into the workforce to improve proficiency and lessen both the workload for and stress on workers in the workplace. In South Africa, a study conducted by Calitz, Poisat, and Cullen (2003) found that the robot-human collaborationfor SouthAfricanand African businesses is a feasible choice. These scholars implied that South Africa is a developing nation. Thus, any innovation progressions must be favourable to drive financial development, improve work accuracy, enable labourers to work more astutely, and upgrade human work execution. Furthermore, they expressed that human-robot teamwork, by and large, does not supplant human skills. They also found that this 'collaboration' helps workers in ordinary and routine activities.

The South African car industry is by far the most evolved in the deployment of robotic machinery, which has enabled a significant intensification of production in multi-product processes (Barchiesi 1998). For Deonarain (2019), the collaboration between humans and machines is vital to ensure the benefits of digitization and to increase skills development and capacity building. This makes the assembly line the rightful work setting to apply the assistance of robots, given that multi car parts and unpredictable market demands characterize the sector. This application and support would improve consistent quality during the production process and lessen the nervous tension in human workers triggered by ergonomics (Gleeson et al. 2013). The facilitation of combining humans and robots to be involved in the execution of work in the factories is essential for the successful realization of hybrid assembly structures (Consiglio, Seliger, and Weinert 2007).

For Struijk (2011), up to 1000 articulated robotics can be used in modern car factories, with only 5000 workers, a ratio of 1–5! In the car factories, spot welding, arc welding, and handling of the car body and parts are the main functions of these robots. Earlier, increasingly sophisticated applications, such as underbody sealing and laser welding, were developed using

articulated robots and, more often than not, vision systems. Therefore, firms have become more competitive (Black and Hasson 2012), but South Africa is falling behind leaders in technology (World Bank 2017). Based on this, the South African Department of Trade and Industry has recognized the importance of human-robot interface in the auto industry and has called for greater incorporation of technology and increased adaptation to technological change as the global market requires constant innovation and creativity to flow with the trend of the Fourth Industrial Revolution (4IR)(DTI 2018). One of the reasons behind this is to enable workers and robots to execute the different tasks assigned to them more effectively to accelerate productivity.

*Human-robots division of labour*

Newer technologies appear to create a new division of labour in which employees carry out duties that aid complex technological tasks (Autor 2013; Acemoglu and Restrepo 2017; Saborowski and Kollak 2015). Part acquisition is one of the main aims of automaton intervention (Gleeson et al. 2013), although the operation of these tasks often requires qualities that only human workers can offer, for now, such as a high degree of physical handiness, detailed visual and concrete observation, and the capability to reach into spaces that are tightly confined. In this case, the handling of parts is best completed by human workers. Gleeson et al. (2013) further explicated that, on the one hand, in terms of the operation of parts, robots execute the task of tightening bolts properly, guaranteeing firm rotation and preventing physical stress on the human worker.

On the other hand, human worker ability is most suitable for tasks such as connecting electrical manoeuvres in cars. Robots can complete tasks such welding and painting in isolation and without the guidance from human workers. Cars are usually sealed by robots; still, some car parts need manual sealing in order to establish quality around doors and inside the automobiles (Fredriksson et al. 2001). In the task performed in the assembly line, machines in orderly form provide the right parts to a human worker to heighten the performance of the worker. In contrast, the human worker executes all the assemblage (Gleeson et al. 2013). Also, the actual welding assembly consists mainly of handling and fastening the components, and the actual welding is just one of many tasks. Therefore, a cooperative welding cell in which human and robot interaction is the most suitable solution for a complete productive performance in the car plant. Workers are responsible for managing the welded components and direct the robot employee to fulfil the welding job (Antonelli et al. 2013).

*Reduction of repetitive tasks for human workers*

Technologies guarantee higher repeatability than manual execution (Antonelli et al. 2013). It is proven that the combination of workers and robots is favourable to manage the growing challenge of meeting the shifting demands of the quantity and diversity of products to be manufactured. Such challenges and procedures must be met with high precision and repeatability, which is hard to achieve at a consistent level with human workers. The reality is that workers tend to spend more than 50%of their working day repeating the same movements, which increases musculoskeletal disorders on different parts of the worker's body (Fredriksson et al. 2001). Due to the accumulated effects of repetitive tasks on human workers' health, complex operations in the manufacturing process make robots an obvious choice for the automotive industry (Vulavala and Ulmer 2014). This is because of robot capabilities (Unhelkar, Siu, and Shah 2014) and human work-related safety issues (Monaco, Bell, and Nyamwena 2019).

*Collaborating for job safety*

Vulavala and Ulmer (2014) asserted that due to the high efficiency of robots, human errors and self-afflicted harm and accidents could be eliminated by allowing robots to complete precarious tasks, such as lifting heavy loads (Haddadin, Albu-Schäffer, and Hirzinger 2008; Singh and Sellappan 2013; Calitz, Poisat, and Cullen 2003; Monaco, Bell, and Nyamwena 2019). In manufacturing, robots complement human capabilities in the process of teamwork and aid strenuous tasks and work next to humans safely without injuring them (Weistroffer et al. 2014). However, extremely close vicinity between robots and humans could lead to other safety concerns for the employees, such as accident should a worker bump into a stationery or a mobile robot (Vulavala and Ulmer 2014). For instance, brain injury, chest impacts, and facial bone fractures could occur if robots and workers collided with each other at speeds (Haddadin, Albu-Schäffer, and Hirzinger 2008). System failures are another safety concern that may result in injury, or loss of containment of toxic, flammable materials resulting in significant harm to the work environment.

For a safe human-robot interface to be guaranteed on the assembly floor, constant and clever monitoring activity that offers the arrangement with necessary information regarding workers and machine localization and hazardous areas must be carefully considered (Moniz 2013).

*Co-working to overcome human inconsistency in the automobile industry*

In an inconsistent setting, human errors are the consequence of human variability. This variability may be due to external phenomena such as interferences, excessive job requirements, users' inability, psycho-social variables, organizational features, human-machine malfunctions, or poor system adaptation (Mital and Pennathur 2004). Automated instruments do not experience anxiety or time pressure and are not influenced by these factors that significantly impinge on human performance. Because humans have beliefs, motivations, emotions, sense of responsibility, and need to be socially accepted, these factors affect their performance, according to Joe et al. (2015). The interface between the human-robot must be effective for the human operator to communicate most efficiently with the machinery. An effective interface lessens human mistakes, and prevents uncertainty and expensive inefficiency (Mital and Pennathur 2004). There is no doubt that social factors can affect human team efficiency and human-robot cooperation. Thus, to optimize team efficiency, people's behavioural, computational capacities, and social variables affecting team-work need to be considered thoroughly (Joe et al. 2015).

*High and low job satisfaction and human-robot teamwork*

The automation in the workplace is most likely set to increase, bringing with it a multitude of issues related to boredom (Cummings, Gao, and Thornburg 2016). Boredom has been linked to task performance, and with ongoing task automation, work-related boredom will grow into more pressing matters related to worker motivation (Cummings, Gao, and Thornburg 2016). For Calitz, Poisat, and Cullen (2003), the effect of technology on employee's motivation could be a considerable challenge. Effective communication, for instance, was recognized as a significant factor in how well people and machines work together (Joe et al. 2015). Communication between humans and machines does not flow naturally as it does between individuals, as the human-computer interface is comparatively slow and often disruptive. When the amount of automation is high, communication and other interactions between human and

automated agents may be very restricted. Workers hardly interact with one another while working with robots except during scheduled work breaks (Lewchuk and Robertson 1997).

Further, Gombolay et al. (2015)affirmed that a significant number of workers would establish that the higher the authority over activities and the more mind-boggling the innovation, the higher the job fulfilment. Consequently, an employee may feel that his or her skill is being undervalued when controlled by an automated system. Thus, despite the fact that computerized systems efficiently increase activity, removing control from human specialists may alienate them from utilizing their skills. Indeed, for individual employees, job satisfaction is more attached to a personalized concept of a 'good day's work for a reasonable day's salary' than to any chance of increasing one's position in problem-solving or decision-making (Vidal 2007).

**Theoretical framework**

This study employed the Evolutionary Economics Theory (EET), focusing on its contribution to technological adoption and entrepreneurship/business, such as that of the automobile sector. Schumpeter, in 1947 introduced the perspective of economic evolution as the process of labour that takes advantage of innovation to manufacture new and old models of things to display a flexible measure to reorganize the business resources intentionally (Rahmeyer 2013). Economic evolution theory emphasizes productivity increase and economic growth (Freeman 1982; Schumpeter 1947). The main influence on economic growth and rate is the continual adoption of technology to teamwork with human workers. The auto labour market has witnessed the radical transformation of work due to increasing levels of workplace automation and effective human-robot collaboration designed to boost its competitive edge.

To link this study to EET, the approach of evolutionary economics dwells on the connection between the economic growth of any business or organization, such as car manufacturing companies, and technological adoption. The automobile manufacturing entrepreneurs aim to interface and transmute their motor plants with human-machine teamwork to spur economic growth and ascertain a reasonable return on investment. The business strategy to adopt technologies to work alongside autoworkers in the motor plants is a radical structural transformation that unlocks economic activities and invigorates auto-mobile manufacturing business opportunities that are unique. Implementing technologies in the automobile plant establish the expected opportunities whereby workers and robot work collaboration makes the jobs more comfortable and faster. It also increases cost-effectiveness, ensures a higher quality of cars, increases productivity, and maximizes profit for management.

This manufacturing method is usually gradual and incremental – meaning that in future more technology adoption to collaborate with autoworkers will be implemented. The reason is to quickly manufacture the services that will permit car manufacturing entrepreneurs to stake their position in the ever-changing, competitive automobile system, at the forefront or fall behind as followers. Despite the collaborative advantages, there will be losers on the side of the workers regarding skills under-utilization, job dissatisfaction, and low self-confidence due to task domination by the robots in the process of teamwork.

The usefulness of EET in this study is that it elucidates the necessity to transform the automobile workplace for the economic growth of the company through the human-robot interface. However, Schumpeterians, as far back as 1947, dominated the theory of economic evolution economic and business-related debate. At present, this theory remains useful in highlighting the constructive outcome of technological progress and techno-economic processes

in the auto companies. The neo-evolutionary Schumpeterians such as Moreau (2004), Rahmeyer (2013), and Nooteboom (2014) have focused attention on understanding the role that entrepreneurs play in promoting technological adoption and economic growth, as well as the destructive effects on workers that accompanies such innovation. Having explained the theoretical framework, the article next provides the methodology adopted in this study.

**Research methodology**

Using a qualitative, interpretive methodology, data were collected through a semi-structured, in-depth interview. This phenomenological study extracted data and information regarding the motivation behind robot-human teamwork, collaborative experiences, work safety, and the job satisfaction experienced by this joint effort. The study population consisted of three car companies in the automobile sector in South Africa. Each car company's population comprises 7378, 5000, and 3300 workers, respectively making a total population of 15,678. The study purposively sampled 28 plant floor employees and two managers and collected data until the study was completed in terms of data saturation. Further, the sample size of thirty participants in qualitative research is sufficient and acceptable in studies of this type, based on empirical evidence from prior research.

The managers and workers were selected because of their service and experiences in car companies in South Africa. The study also relied on a desktop analysis of human-robot interface and experiences published in peer-reviewed journals. The phenomenological approach was utilized to focus on the experiences of the auto workers with robotics in the motor sector. The reason was to interpret the consistency of their responses on why technologies are adopted in the automobile sector and on their collaborative relationship with technologies in the plant. Informed consent from the participating managers and workers was obtained prior to the interviews and they participated in the study voluntarily. The researchers ensured credible data by recording all interviews and transcribing them verbatim within a short time after data collection. Thematic and content analyses were employed to structure arguments from the gathered information. The researchers compressed the mass quotations from the participants to reduce the data size. Hence, two or more quotes represent the perspectives of all the respondents. The next section presents the findings of this study.

**Research results and discussion**

This study details the experiences of South African automobile workers with regard to the introduction of technology in the workplace, considering the collaborative safety and job satisfaction issues. It also outlines the reasons why organizations adopt sophisticated technologies. The interpretation and the discussion of the findings were supported with secondary empirical data combined with the evolutionary economic theoretical framework.

*Why automobiles organizations understudy adopt sophisticated technologies*

Most companies adopt technology because it offers more advantages than human workers in delivering quality goods effectively. For instance, technology is free from retirement considerations, lunch breaks, medical aid, injury, does not grumble about the workload, performs more dangerous tasks, and works round the clock at a faster pace and reduces production costs. This shows that the capabilities of technologies are alluring and necessitate their adoption. Still, these values of technology, as opposed to humans, are detrimental to human existence and

human functions in society. To gain a better understanding of the reason behind technology adoption in the motor sector, it was necessary to grasp it from management's perspective. According to the two managers interviewed in this study, the reason why the motor industry in South Africa adopts technologies:

> The reason is quite simple, is to be globally competitive, if we did not adopt these technologies, we would basically close the plant, and it will be 3,000 jobs lost to be quite honest with you. The rest of the world is moving towards these technologies. You can produce faster, quicker, more accurate, greater safety issues going on for the workers and bigger volume and the plants set are able to join bigger volume at the right quantity cost and quality, and all the ones will be more successfully, so if you are sitting with a low volume plant and not just embracing technology, you cannot compete on a global platform, so it is actually a business imperative for us to do that.

and

> We consider cost-avoidance in business. In this sense, I meant quality consistency to avoid repetition with more time and materials and to look at the fact that work goes on to translate into greater output with the robot in place even when a worker is on break or shift.

The findings show that technology is being used every day and will continue to be used in the future as it produces cars in a faster and safer manner. Robots enhance the output of these costly assembly lines by ensuring that production activities proceed at a steady speed with minimal machine idle time. In term of productivity, technologies are more accurate and detailed, and produce high-quality work. With constant speed and repeatability, these machines can produce a greater quantity at consistent quality within a short timeframe than human workers. In addition, robots are adopted to ensure car assembly plants can remain globally competitive. These findings are in line with the studies by Rüßmann et al. (2014) and Unhelkar, Siu, and Shah (2014), who states that improved productivity has been attributed to technological growth and adoption.

The findings of this study are also consistent with what has been found in the previous study, where Deloitte (2018) established that South African managers indicated that they are adopting and investing in advanced technologies. The reason is because of the capabilities of technologies in harnessing and driving smart manufacturing and also to drive new business models. From the view of economic evolution theory, auto management is searching and selecting financial decisions that will boost its competitive edge in the labour market. The selection procedure is externally influenced by conditions such as the quantity and demand of cars, how other competitors perform, which controls the speed of the organization to expand its com-petition and opportunities. The position of EET is that competition in the labour market in the process of the technological path is central, given the fact that it structures the company's growth.

This study also revealed that management emphasized that these machines provide safety for the workers as old methods of doing things were harmful to people. It is essential to employ these collaborative technologies to 'enable the workforce to be more efficient' in such an environment (Deloitte 2018) and to avoid performing a repetitive job in the industry, which has been found to increase the musculoskeletal disorders of workers (Fredriksson et al. 2001; Antonelli et al. 2013; Gleeson et al. 2013). It has been stressed that humans and robots working together will lessen worker overload, eliminate human errors, and cut expensive incompetence (Mital and Pennathur 2004). These human errors and inconsistencies can be attributed to humans' emotions and sense of responsibility (Joe et al. 2015). By eliminating human inconsistencies, the amount of wasted material will be minimal, which saves money for the company. The capabilities of these

machines are very high (Singh and Sellappan, 2013). Therefore, from the above accounts, technology is a necessity when it comes to performing certain complex tasks in the organization and makes work easier for workers.

Technology is being implemented continuously; hence, it was necessary to explore the experiences of South African workers with regard to the introduction of technology in the workplace, from their point of view.

*Collaborative experience, safety, repetition, and job satisfaction*

The following discussion is based on the interview questions regarding the experiences of workers while working with robotics. It explores collaboration, safety, repetition of work, and job satisfaction. In terms of collaboration, the researcher wanted to understand whether the employees work well with machines. It must be recognized that as much as these machines are being introduced, they cannot work unattended. In terms of collaboration and safety, all the participants unanimously said:

> Working as a team with robots makes things a little bit easier. We and the robots must work together for safety reasons. We do a lot of tasks repeatedly, so the robots help when it comes to that. Still, you do not want to be too close to them because they can injure you, and it can be very unsafe if the procedures are not followed, but you do not want to compete with them because we see them as strong rivals, we just have to work along and with them.

and

> It can be very dangerous working with robots. Some processes are in place that one needs to follow to be safe, but when you are on duty, and you are in a hurry to get the work going, sometimes it is easy to forget the procedures that you have to follow. It can be very unsafe if the procedures are not followed. Also, there is a challenge of equipment failures, which is very unsafe if you don't have the relevant training to deal with them.

and

> From a safety perspective, they are in robot cells, and we don't enter there. We work outside the cage. Robots go a long way in doing some jobs that could strain workers due to the nature of jobs in this company, which involves repetitive tasks. The thing is that when the robots are in operation, you have to restrict your closeness around them. We work pretty well with them.

It can be observed from the participants' responses that workers worked well with the robots as the machines do most of the repetitive jobs, which makes their job easier and more work is done. Therefore, there is a need for the facilitation of combining humans and robots to be involved in the execution of work in the factories, which is essential for the successful realization of mixed-assembly structures. However, as much as workers enjoy working with robots, there is still a fear of them taking over jobs because technologies are here to stay and can do an even better job than humans.

In addition, the findings showed that machines could be dangerous as they are not always easily predictable. The majority of the participants felt that these machines are not very safe. Sometimes, they are not comfortable working with them as they might get injured and, most importantly: 'machines are usually unsafe if you do not follow procedures.' Unhelkar, Siu, and Shah (2014) made the same findings with workers in one assembly plant who felt unsafe with their experience with robot assistants due to the sudden functional changes in the robots. Further, if a robot is mobile and can move fast, human workers can sustain various injuries if they collide with the machine (Haddadin, Albu-Schäffer, and Hirzinger 2008). Such robots should, therefore, operate safely in the vicinity of people without endangering them (Weistroffer et al. 2014). So,

there should be a sign indicating the position of such machines and hazard zones (Moniz 2013). Hence, there is a need for trust to be established between the machines and the workers so that the technology may function to standard specification and perform 100% as expected.

> When it comes to job satisfaction, all the autoworkers echoed that:
> Robots take away the physical work on the workers because the robot does not get tired. This reduces the work of humans, but this affects the worker's satisfaction because it makes them feel lazy in the shop. I want to use all my skills as I work and not a fraction of it. Again, we are threatened that almost of the task we are performing at present can be done by robots which will further reduce what I do in the plant. I can say that this affects my job satisfaction. There are things as workers you wish you did in or on the car that will boost my confidence in my skills and smile at what and what I did to make the car. This feeling increases my job satisfaction as a hard worker. Sometimes, it occurs to me that it is my competitor and rival and possibly have more chances of staying in the company than me.

Findings in this section pointed out that workers are experiencing a lack of job satisfaction when it comes to working with technology as they felt that, one day, they would be replaced by these machines, which are performing most of the tasks. Workers feel that their skills are not being utilized fully, and sometimes, they are left with less challenging work as machines do most work for them because technologies are programmed to work in perfection.

Regarding workers urging management for more challenging responsibilities, Vidal (2007) found that in factories where structural organizational change and workplace restructuring, such as human-robot collaboration, has occurred, worker frustration and stress were high. In South Africa, NAAMSA (2019) pointed out that human-robot collaboration and technological transition in the automotive industry significantly reduces workers' competence and human capital, and creates redundancies of some employees (Calitz, Poisat, and Cullen 2003; Hlatshwayo 2017). For Calitz, Poisat, and Cullen (2003), the major challenge encountered by employees working with robotics is the effect on work-place morale, job security, and depression because of the fear of redundancy and job termination, and fear of the unknown. As noted by Cummings, Gao, and Thorn-burg (2016), a list of frustration-related problems results from the human-machine interface and the advent of workplace automation.

## Conclusion

Automation has increased productivity, production efficiencies, and safety in car companies, but has also threatened the job satisfaction of workers. Driving and maintaining innovation progress is a central issue for auto-assembly plant managers in general. The complexity of the car industry, especially when combined with different vehicle models, requires that the automobile sector utilizes human-robot teamwork to respond strongly to the ever-changing business climate and to remain viable in the international motor world. This means that the continued development of robotics and its allocation to other roles is a necessity to ensure the competitiveness of South African auto companies in the worldwide automotive sector. This strategic move suggests that South Africa's motor businesses are developing a creative solution in the form of a human-robot interface to maximize long-term payoff capabilities.

The use of human adaptability combined with the precision of industrial robots is intended to improve the safe operation and high volume of vehicles in the plant. More-over, automation in the auto sector has made things easier for employees by relieving the need for manufacturing workers to execute mundane tasks manually that risk their wellbeing. While employees were relieved of the burden of repetitive work, the sense of meaningful work had

been drained from them, which reduces their job satisfaction. Therefore, workers yearn for greater workplace challenges to improve their self-confidence. It is vital to restructure automotive plants around collective automation that combines the strength and efficiency of industrial robotics with human imagination and innovation, to boost the economy of industrial factories. It is however vital to pair robots with human workers in ways that do not trample on the job satisfaction and job security of autoworkers.

Further studies are necessary to ascertain how factory workers can maintain their job satisfaction as manufacturers continue to grasp human-robot collaborative opportunities to transform their production processes fundamentally. This study contributes to the existing literature on human-machine collaborative work in the global industrial sector, primarily in the sphere of the labour process and technological evolution in the auto-mobile sector both worldwide and in South Africa. Although this study focused on only three motor companies, its results are transferable to other local and inter-national automobile companies not covered in this study.

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