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Effect of Automation and Digitization on Occupational Stress in Automobile Industry

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ABSTRACT

The automotive sector is changing as a result of disruption caused by industrial automation and digital technology. Companies can adopt the most recent business prospects linked to industry 4.0 in their organization, including those that deal with autonomous driving, automated manufacturing lines, the auto supply chain, big data, the Internet of Things, quality management, the environment, etc. The degree to which people are satisfied with their jobs plays a significant role in this process because workplace stress is a common source of it, particularly for those working on production lines. Numerous studies on job conditions and satisfaction using conventional methods have been done, but they differ from digitalized industries due to a variety of factors, such as job security and a lack of technological knowledge and training, educational requirements, robotization, supervision, anxiety, etc. Stress management techniques are more effective for highly educated and younger people. This study addresses the issue of job stress among engineers and technical workers in the Telangana automobile industry as a result of automation and digitization. One way that ANOVA is used to examine the stress factors responsible for the drop in level of job satisfaction is through the use of a structured questionnaire on a sample of 100 engineers and operators to study the factors affecting job stress in the automobile sector. According to the conclusion, technical operators are more likely to operate in a traditional workplace and less likely to adopt an advanced work environment, and they also report feeling more pressured and unsatisfied with their jobs. In order to improve productivity and competitiveness, which in turn improves services and job satisfaction, it is also necessary to implement suitable training programmes and digital technology adaptation strategies.

HIGHLIGHTS

- Automation factors will have impact on employee stress.
- ANOVA is used to examine the stress factors.
- Demograohical factors are also considered for Stress analysis.
- Top and low level employees working conditions are considered.

Keywords: ANOVA, Digitization, Automation, Job Stress, Robotisation

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In the production of automobiles, digitization is essential. The automotive suppliers are under enormous pressure to adjust to the shifting preferences and requirements, while remaining operational and profitable, as a result of a rise in consumer demand for value-added automobiles. Digitization in the automobile industry has helped businesses become more competitive while laying a solid platform for future growth in a manufacturing environment that is always changing. Every area of the automobile manufacturing value chain, from product innovation to sales and services, is being transformed by digital manufacturing technologies. A connection between a company's management and operations and customers is being made possible by the rapid expansion of data analytics and an increase in the utilization of the digital connections that is allowed by AI and IoT. The industrial production is evolving toward a world of smart connectivity powered by highly disruptive technologies as predictive analytics and cloud computing take off. Businesses must prepare for transformational shifts in order to stay ahead of their rivals and look beyond simply owning technologies (Harish Thyagarajan *et al.*). Stress is a complicated concept. Due to shifting societal needs and life style requirements, it has grown in importance. One's adaptive response to an external condition that results in physical, mental, and behavioral changes is called stress. Numerous definitions and meanings of stress make it evident that there is a connection between a person's mental condition and the actions that cause him to become distracted from his work. Stress can be brought on by a number of things in the automobile business, including job insecurity, flexibility with new technologies, robotization of the workplace, AI involvement, a lack of training, worry, oversight, and monitoring. Lack of technology affinities, an upbeat outlook, the stressful early stages of digitalization, and difficulties keeping up with advancements (Carlos Llopis-Albert *et al.*). The automobile industry is one of the most important and productive sectors in the country, providing opportunities for people to gain new skills and work in a monoculture environment. However, it has been discovered that due to a lack of job satisfaction and technological adaptation, people tend to start their own businesses or choose alternative jobs that are more familiar to them. This problem inspired the conduct of this study, as the majority of earlier studies used standard techniques and only examined the effects of work stress on humans based on their physical characteristics. By concentrating on technical operators and engineers working in the fully automated and digitalized automobile industry, this study will aid in the discovery of solutions. Others are only capable of performing well when they are exposed to a degree of stress that stimulates and energizes them to put out their best efforts. Some people manage stress and function extremely well in any kind of situation that affects their personal or environmental well-being (G. Sureshkrishna *et al.*).

LITERATURE REVIEW

Including Carlos Llopis-Albert *et al.* Studies on how digitalization contributes to autonomous driving, mobility as a service, big data influence on automobile buying, and the increased expansion of electrical vehicles in substitution of conventional vehicles as a result of environmental policies. For this, a study has been undertaken that demonstrates unique quality applications in digital transformation in European countries. It demonstrates effective production growth and lower operating costs with significant financial gains (Carlos Llopis-Albert *et al.* G. Sureshkrishna *et al.*) looked explored the relationship between job satisfaction and stress at work among engineers in India's automotive industries. A systematic questionnaire was developed for this purpose and administered to 200 engineers as a sample. The results indicate that demographic factors are to blame for stress, which has led to a reduction in job satisfaction. It has also been demonstrated that employees who reported higher levels of stress were less content with their jobs, more likely to quit, and less inclined to change the working environment (G. Sureshkrishna *et al.*). The amount of happiness that employees have with their jobs and the organization as a whole is one of the most crucial characteristics of employees working in an organization, according to research by J. Rengamani *et al.* on the factors influencing occupational stress among engineers. Stress at work is the main element that affects how satisfied you are with your job. Workplace stress will undoubtedly have an

impact on job satisfaction, particularly for individuals who serve as production engineers for vehicle manufacturers. Additionally, a disgruntled production engineer has a propensity to move employment, which will increase attrition rates. Production engineers who work with vehicle manufacturers experience more psychological than physical stress (J. Rengamani *et al.*).

Pfaffinger, Katharina F *et al.* explains The expansion of digital technologies has an impact on how we communicate, work, and live. Digitalization presents potential, but it also carries risks and might have un favorable effects like worry. In order to research the psychological causes of digitalization anxiety, he conducted 26 interviews. And discovered that the megatrend of digitalization arouses concerns not just about personal or organizational changes but also about broader societal issues. In order to improve people's feelings and experiences connected to digitalization, they provide treatments that could assist organizations, teams, and individuals in coping with the causes of digitalization anxiety(Katharina F. Pfafnger *et al.*).

R. Ramamoorthy *et al.* noted numerous physical and psychological signs of stress differ depending on the circumstances surrounding each person. Deterioration of physical health and depression are two examples. One of the secrets to leading a happy and successful life in contemporary society is the process of stress management. The organization should support and promote taking on positions that help individuals balance work and family. Stress in the automotive sector is mostly caused by excessive job pressure and work-life imbalance. When it comes to an organization's performance, employee productivity is the most important component (R. Ramamoorthy *et al.*).

PERCEPTION AND BENEFITS OF DIGITIZATION/AUTOMATION

Digital Perception and Importance of Digitization

The expense of the complexity associated with supply chain and raw material acquisition can now be successfully absorbed by automated and standardised digital operations. Digital technologies are currently being used by industry leaders in the automotive sector to create value. Although technological change will continue to occur, one must be ready for it as soon as it does. (Harish Thyagarajan *et al.*) being operationally excellent This digitalization is made possible by numerous new technologies, including process mining and deep learning. Deep learning algorithms, task mining, mining for processes, and robotic process automation are some of these technologies (RPA). Manufacturers and service providers face stiff competition in the market, and they must adjust to swiftly shifting consumer needs. Similar to other industries, the need for digital transformation is unavoidable in order to satisfy customer requests and enhance customer experiences, increase market position, and outperform competitors (Cemdilmegani *et al.*). This calls for a shift in perspective and a reorganised business strategy. It is usually wise to start by introducing new offerings to your customers. It takes a lot of time and effort to introduce new technology to the new environment because management and engineers must be very aware of it and its effects on the business model. Improved training and awareness could provide engineers and management more confidence to avoid axiety.

The Main Challenges of Digital Transformation in the Automotive Industry

(a) Our capacity to create savings is severely hampered by the major challenges of cost and quality management in the supply chain. As a result, businesses are progressively switching to "just in time" (JIT) operations, which have the potential to control costs and significantly enhance all supply chain activities. The use of digital solutions improves data transportation between multiple departments and systems while reducing human errors, which are frequently made during quality control. The quality of the products and associated prices are also impacted by this. Companies may dramatically minimise production delays and increase operational efficiency with proper monitoring, including the use of digital solutions.

(b) Environment and regulation is another challenge. Manufacturers and customers are becoming increasingly aware of issues related to environmental sustainability.

Additionally, when buyers make purchase decisions, "environmental responsibility" is receiving more and more attention. Each industrial process's environmental impact is being significantly reduced by the digitalization and automation of the data management, supply chain, and shipping operations. The increasing pressure from regulators throughout the world to lower or eliminate traffic, lessen the climate effect of the automotive industry, improve user safety, and make transportation safer and more sustainable is another important issue. Companies in the industry are working hard to create connected, intelligent solutions in order to address these difficulties. The world's automakers are already planning and implementing more sustainable ideas (J. Rengamani *et al.*).

(**c)** Staying Ahead of the Market and Competitors is the third obstacle, where In response to the pandemic problem, numerous businesses in the automobile and other industries have started to undergo significant digital transformation. Such a change gives a chance to get access to more lucrative investment opportunities, especially for large car manufacturers. However, the accelerated shift to digital necessitates the reform of supplier and partner-related activities. The latter will need to keep up with this shift in order to stay competitive. Digitization gives partners the chance to combine systems and data, increase overall effectiveness, and maintain a presence in the market and gain an advantage over rivals (Girisha, M.C. *et al.*).

Benefits of Digitization and Automation in Industry

In terms of execution and results, as well as the commitment necessary to spend resources in the process, digital transformation of business processes takes time. Undoubtedly, the automotive sector has to adopt a more significant digital transformation that is centred on enterprise data management and precise analytics in order to extract value from data and enhance business operations overall (Carlos Llopis-Albert *et al.*). With better, data-driven operations across the entire company and all departments, including manufacturing, the entire supply chain, marketing, sales, and after market, the automobile industry is addressing the difficulties of digitalization in this digital era (Magnest *et al.*). To take advantage of new market opportunities, businesses must gradually and smoothly adapt their cultures and methods of thinking (Girisha, M.C. *et al.*). The main advantages of turning an automotive business digital include supply chain optimization, the ability to enter and grow in new markets, the ability to compete effectively, and the ability to increase productivity and quality management while lowering operational costs to enhance customer experience and service (Cemdilmegani *et al.*).

Few Digital Transformation Trends in Automobile Sector

Intelligent Vehicles with Data Security and Protection, Improved Manufacturing and Connected Supply Chain with Advanced Algorithm and AI, Real-time Predictive Maintenance with IoT and Sensor Technologies, Building Multi-modal Integrated Transportation System with Mobility-as-A-Service, Intelligent Vehicles with Data Security and Protection, and Reduced Accidents with Autonomous Driving (Pandey *et al.*).

METHODOLOGY

A survey of well-rounded production engineers working in the automotive sector in the state of Telengana was undertaken. On 100 production engineers and technical operators working in different workshops in the automobile sector, a typical questionnaire was given (G. Sureshkrishna *et al.*). The workers in the automobile business who are regarded as production engineers and operators. The sample size for this study is 100 people who operate on the shop floor in various automotive sectors. The Cochran formula, which is $\alpha = K/K\text{-}1[1\text{-}s^2y/s^2x]$ with a 5% threshold of significance, was used to determine the sample size.

By Using stratified random sampling, the sample responses were collected. A five-point scale (Likert scale) from 1 (Strongly disagree) to 5 was used to quantify the job stress of production engineers in the automotive industry (Strongly agree). A pilot research was used to test the structured questionnaire before it was changed

depending on the findings. The updated questionnaire was then distributed to 100 respondents who worked on the factory floor of automobile businesses in and around Telangana. For the purpose of the study, 100 sample respondents were chosen, and incomplete surveys were discarded. The constructs of the stress factors (stressors), such as physical stressors, psychosocial stressors, social stressors, high job demands, and high management tasks, make up the conceptual model. The stress concerns mentioned above are confronted by the production engineers who operate in the completely automated and digitalized vehicle industry.

SURVEY ANALYSIS

The demographic factors (Table 1) of the study specify that 75 percent of the respondents are male and 25 percent of female production engineers and operators, and 10 percent of the age of the respondents fall under the age category of 18-25 years, 40 percent of the age of the respondents fall under the age category of 25-35 years, 20 percent of the age of the respondents fall under the age category of 35-50 years, 20 percent of the age of the respondents fall under the age category of 50-60 years, 10 percent of the age of the respondents fall under the age category of 60-65 years. Additionally, in terms of ability 30 percent of respondents have certifications that are equivalent to diplomas, 30 percent have certifications that are equivalent to B.Tech degrees, 30 percent have certifications that are equivalent to PG/MBA degrees, and 10 percent have certifications that are equivalent to research degrees. In addition to work history Thirty percent of respondents have experience ranging from 0 to 5 years, thirty percent have experience ranging from 5 to 10 years, twenty percent have experience ranging from 10 to 15 years, ten percent have experience ranging from 15 to 20 years, and ten percent have experience spanning more than 20 years. Twenty percent of respondents work on heavy machinery, forty percent work on moderate machinery, thirty percent work on light machinery, ten percent work on computers, and sixty percent of respondents work from 0 to 6 hours, thirty percent work from 6 to 9 hours, and ten percent work from 9 hours and beyond.

Table 1: Demographic Factors

Sl. No.	Demographic Factors	Frequency	Percentage
	GENDER		
1	Male	75	75
2	Female	25	25
	AGE		
3	18-25	10	10
4	25-35	40	40
5	35-50	20	20
6	50-60	20	20
7	60-65	10	10
	QUALIFICATION		
8	Diploma	30	30
9	B.Tech	30	30
10	PG/MBA	30	30
11	Others	10	10
	EXPERIENCE		
12	0-5	30	30
13	5-10	30	30
14	10-15	20	20
15	15-20	10	10
16	20 PLUS	10	10
	WORK EQUIPMENT		
17	Heavy Machines	20	20
18	Moderate Machinery	40	40
19	Light Machinery	30	30
20	Computers	10	10
	WORK HOURS		
21	Below 6hrs	60	60
22	06-09	30	30
23	Above 09	10	10

According to the survey, the Cronbach's alpha values for mental oppression, job insecurity, lack of technological affinity, involvement of artificial intelligence, lack of predictability or control of the work process, lack of software knowledge, training, performance monitoring and feedback, and anxiety are all relatively high, with alpha values of 0.90, 0.89, 0.79, 0.89, 0.80, 0.89, 0.89, 0.89, 0.92, and 0.90, respectively. The results of the questionnaire survey on the stress at work experienced by production engineers in the automobile sectors

demonstrate that none of the stress components had a p-value greater than 0.05 (Table 2).

Table 2: Significance of Mean Values of Individual Stress Factors

Sl. No.	Stressors	Cronbach α	t	p
1	Robotisation work conditions	0.90	2.01	0.005
2	Mental oppressiveness	0.89	2.46	0.004
3	Job insecurity	0.79	2.33	0.016
4	Lack of technological affinity	0.89	2.46	0.022
5	Artificial intelligence involvement	0.80	1.88	0.004
6	Lack of predictability/ control of the work process	0.89	1.68	0.019
7	Lack of software knowledge/ Training	0.79	2.05	0.009
8	Performance monitoring and feedback /High responsibility	0.92	2.03	0.002
9	Social relations/Anxiety	0.90	2.31	0.013

With further research, it can be deduced that the components based on physical factors, psychosocial factors, social factors, technical demand, and managerial duties likewise have reasonably high Cronbach's alpha values, with respective alpha values of 0.91, 0.79, 0.89, 0.85, and 0.91.

Table 3: One way ANOVA

Sl. No.	Stress Factors	F-Values	p-values
	Physical Stressors		
1	Sudden changes in enterprise	4.01	0.003
2	Work routines controlled by machines	3.91	0.011
3	Technical problems/ Vulnerability to hacker attacks	3.70	0.012
4	Ventilation in work place	3.80	0.009
5	Attitude optimistic or pessimistic	3.50	0.010
	Psychosocial Stressors		
6	Corporate culture/ Internal pressure to understand new developments	4.50	0.002
7	Electrical Shutdowns	4.53	0.005
8	Irregular working times/ Lack of time for training	4.51	0.015
9	Lack of technological affinity	3.90	0.015
	Social Stressors		
10	Lack of Interaction/ Lack of predictability	4.90	0.012
11	Conflicts between peers/ Social exclusion	4.85	0.020
12	Stressful initial phase of digitalization/Isolation	4.55	0.025
13	Job insecurity	4.90	0.015
14	Challenge to keep up with developments	4.55	0.023
	Technical Demand		
15	Time pressure, hectic activities / Loss of individual control	3.90	0.002
16	Dependency on technology	4.98	0.005
17	Enterprise Scale/High Production	4.65	0.007
18	Communication and Decision making	4.30	0.009
19	Mechanical artificial intelligence involvement/Robotisation of humans	3.95	0.005
20	Lack of software knowledge/Training	3.50	0.018
	Management Tasks		
21	Quick implementation of new technologies	4.60	0.020
22	Constant availability /High responsibility	4.90	0.010

One-way Analysis of Variance was used to assess the respondent's data and test the hypotheses. All of the p-values for the stress factors are less than 0.05, according to the results shown in Table 3. This shows that the mean values of the stress components varied significantly from one another. The physical pressures, such as abrupt changes in the business, machine-controlled work routines, technical issues/vulnerability to hacker attacks, workplace ventilation, positive or negative outlook. The production engineers would actually experience considerable stress due to the psychosocial stressors such Corporate Culture/Internal Pressure to Understand New Developments, Electrical Shutdowns, Irregular Working Times/Lack of Time for Training, Lack of Technological Affinity. The effects of job stress will eventually result in weariness and job burnout, which are thought to be extremely dangerous on the assembly lines of vehicle manufacturers. Since even the smallest error by an employee could result in the creation of auto parts that are defective, the entire

batch would have to be discarded, costing the company money. The pressures in society lacking interaction, being unpredictable, Peer conflict and social isolation initial digitalization phase that is stressful, isolation, and job insecurity The replies will be able to disconnect from the traditional social life thanks to the challenge of keeping up with advances, but it will also put them under a lot of stress. The productivity in the industry will be directly impacted by technical factors such as time constraints, hectic activities/loss of individual control, dependence on technology, enterprise scale/ high production, communication and decision making, mechanical artificial intelligence involvement, lack of software knowledge and training (J. Rengamani *et al.*).

CONCLUSION

The automobile sector is undergoing a rapid worldwide landscape shift as a result of digital transformation. The factors and actions that the players believe are necessary to support the digitization process are presented in this work, and questions about how effectively it will affect the processes of production, sales, and connectivity with the user or customer are raised as a result. When preparing for and deploying new digital technologies, organisations should take their employees' concerns very seriously. Based on our findings, we suggest various measures to stop or lessen digitalization anxiety and to further enhance employees' attitudes toward digitalization. A satisfying work environment makes employees feel devoted to their jobs because it gives them a sense of satisfaction. To motivate employees to strive toward reaching the organization's goal, the top management should take an active part in addressing employee needs and putting an emphasis on employee welfare. To be productive in the current competitive world, a healthy balance between work and life must be preserved. Work-life balance can only improve an employee's satisfaction and morale. Comparative studies may be the main focus of future research in order to generalise the results. A number of issues related to the stress that production engineers experience at work may be to blame for the tension that they feel. The stress at work may be psychological, emotional, social, or work-related. A number of stress-related factors, including job security, a lack of technical aptitude, the use of mechanical artificial intelligence, dependence on technology, the stressful initial phase of digitalization, work routines controlled by machines, and others, may have an impact on production engineers. lack of awareness and training time, Since production engineers may handle physical stress considerably better than mental stress, the majority of stress factors may be psychological in character.

According to the report, production engineers in completely automated vehicle factories frequently deal with demanding work schedules, constant supervision, nervousness, managing delicate equipment and large machinery, and a lack of knowledge of cutting-edge technology. The production engineer's ability to perform at work, their level of awareness due to sophisticated machinery, and their capacity for problem-solving and decision-making can all be negatively impacted by job stress. Production engineers who are worried about losing their jobs to robot replacements may exhibit low morale at work, which will have an impact on production. Production engineers' job happiness will be directly impacted by how stressed out they are at work. By giving production engineers and operators the proper training about the methods and technology used, job stress in automated and digitised industries can be prevented and decreased. Later, offering competent support for a period of time may lower stress and enhance morale. There are a few additional variables as well, such as highlighting the advantages of digitalization and helping staff members become accustomed to new technologies and reduce anxiety.

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