Automotive Niche Area

**Welcome to the Automotive Niche Area**

UNISA has initiated the establishment of a new specialised research niche area focusing on the automotive industry in South Africa. This Automotive Niche Area is led by the distinguished Professor Igor Gorlach.

Aim

The primary aim of the Automotive Niche Area is to facilitate sustainable and mutually beneficial collaboration between academia and industry, in line with their strategic goals. The anticipated benefits of the initiative include human capital development, enhancing the competitiveness automotive companies through skill development and the integration of advance technologies in the workplace, and ultimately benefiting the broader community.

Activities

The Automotive Niche Area aim will be achieved through several key tasks, including conducting research, providing training and education, facilitating knowledge transfer, and offering assistance in industry development and problem-solving endeavours. As depicted in the diagram below, the activities within the Automotive Niche Area will encompass industry-based undergraduate and postgraduate projects, as well as research initiatives aimed at the commercialisation of innovative concepts.
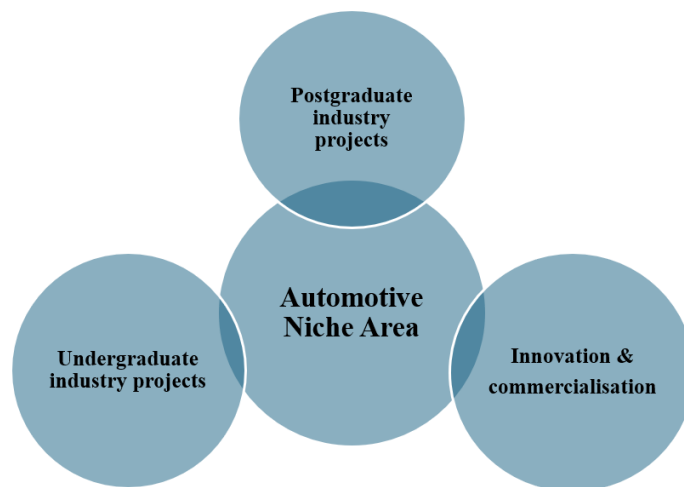
Project Topics

Project topics cover a range of disciplines within Mechanical, Industrial and Mechatronic Engineering, with a focus on real-world applications in automotive manufacturing and car components production. Some projects are based at the Isuzu Motors SA in Gqeberha and component manufacturing companies in the Eastern Cape.

   a) Project Topics related to the current automotive manufacturing sector

1. **Semi-Automated Assembly Operation Optimisation**: Develop algorithms or systems to optimise the assembly operation layout, reduce cycle times and increase throughput.

2. **Smart Manufacturing Systems**: Design and implement IoT-enabled systems for real-time monitoring and control of manufacturing processes in automotive plants, aimed at improving efficiency and reducing downtime.

3. **Energy-Efficient Manufacturing Techniques**: Research and develop energy-efficient manufacturing processes for automotive components, incorporating concepts like regenerative braking systems or waste heat recovery.

4. **Material Handling Optimisation**: Analyse and optimise supply chain management strategies and MRP for material handling operations, considering aspects like lean manufacturing principles, just-in-time inventory, and vendor-managed inventory.

5. **Predictive Maintenance for Machinery**: Develop predictive maintenance algorithms using machine learning techniques to anticipate equipment failures in automotive manufacturing machinery, minimising downtime and maintenance costs.

6. **Human Factors in Automotive Manufacturing**: Investigate ergonomic design principles and human-machine interaction in automotive manufacturing processes to enhance worker safety, comfort, and productivity.

7. **Digital Twin Simulation**: Implement digital twin simulations for automotive manufacturing plants to replicate real-world production processes virtually, allowing for predictive analysis, optimisation, and troubleshooting.

8. **Autonomous Guided Vehicles (AGVs)**: Design and implement AGV systems for material handling and logistics within automotive manufacturing facilities, aiming to streamline material flow and reduce manual labour.

9. **Quality Control Systems**: Develop intelligent quality control systems using machine vision and AI algorithms to inspect automotive components for defects and deviations from specifications, ensuring high product quality.

10. **Additive Manufacturing Applications**: Explore the potential applications of additive manufacturing (3D printing) in automotive component manufacturing, focusing on rapid prototyping, customization, and lightweight part production.

11. **Cybersecurity in Automotive Manufacturing**: Investigate cybersecurity risks and develop strategies to secure interconnected systems and data in automotive manufacturing environments, protecting against cyber threats and ensuring data integrity.

b) *Project Topics related to the transition to Electric Vehicles (EVs) in South Africa*

1. **Regulatory Compliance and Certification**: Investigate regulatory requirements and certification processes for electric vehicles in South Africa, ensuring compliance with safety standards, emissions regulations, and energy efficiency mandates.

2. **Infrastructure Development for EV Charging Stations**: Analyse the current infrastructure landscape in South Africa and propose strategies for the deployment of EV charging stations, considering factors like location optimisation, grid integration, and charging standards compatibility.

3. **Battery Recycling and Second-Life Applications**: Investigate methods for the recycling and repurposing of EV batteries in South Africa, exploring opportunities for second-life applications such as energy storage systems or grid stabilisation solutions.

4. **Localised EV Component Manufacturing**: Evaluate the feasibility of establishing local manufacturing capabilities for key EV components in South Africa, such as battery packs, electric motors, and power electronics, considering factors like supply chain dynamics, labour skills, and economic incentives.

5. **Policy Analysis and Regulatory Frameworks**: Assess existing policies and regulations related to EV adoption in South Africa and propose recommendations for enhancing incentives, standards, and infrastructure investment to accelerate the transition to electric mobility.

6. **Consumer Awareness and Education Campaigns**: Design and implement educational campaigns to raise awareness about the benefits of EVs among consumers in South Africa, addressing concerns related to range anxiety, charging accessibility, and total cost of ownership.

7. **Fleet Electrification Strategies**: Develop strategies for electrifying public transportation fleets, taxi services, and commercial vehicle operations in South Africa, considering factors like route optimization, vehicle procurement, and financial incentives.

8. **Integration of Renewable Energy Sources**: Explore opportunities for integrating renewable energy sources such as solar and wind power into EV charging infrastructure in South Africa, aiming to reduce carbon emissions and enhance energy resilience.

9. **Grid Impact Assessment of EV Adoption**: Conduct a comprehensive analysis of the potential impact of widespread EV adoption on the South African electricity grid, considering factors like demand patterns, load management strategies, and grid stability measures.

10. **EV Battery Swapping Stations**: Evaluate the feasibility and viability of implementing EV battery swapping stations in South Africa as an alternative charging solution, considering technical, economic, and operational aspects.

11. **Smart Grid Technologies for EV Charging**: Investigate smart grid technologies and demand response mechanisms to optimize EV charging load management and grid integration in South Africa, aiming to minimise peak demand and infrastructure costs.

12. **Electric Public Transportation Pilot Programs**: Design and implement pilot programs for electric buses or mini busses in selected cities or regions of South Africa, assessing the feasibility, performance, and socio-economic impacts of electrified public transportation.

13. **Public-Private Partnerships for EV Infrastructure**: Explore opportunities for public-private partnerships (PPPs) to accelerate the deployment of EV charging infrastructure

in South Africa, leveraging private sector investment and expertise while ensuring public accessibility and equity.

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