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Research Project Brief: Smart Manufacturing Applications in High-Precision Assembly Industries

Title

Investigating Industry 4.0 Technologies for Optimizing Assembly Processes and Quality Control in Advanced Manufacturing

Topic

An in-depth study of smart manufacturing technologies and their applications in high-precision assembly industries, with implications for EV battery pack production

About

LG Energy Solution, Inc., is a wholly-owned subsidiary of LG. As the first company to supply mass-produced EV batteries globally, it primarily works with major U.S. automakers to facilitate the EV transition. The company's Holland location, established in 2010, brings sustainable automotive energy to West Michigan.

Your research will be guided by Rishabh Saxena, Process Engineer at LG. Mr. Saxena has demonstrated expertise in process improvement, quality control, and manufacturing optimization in EV battery production.

Background

Mr. Saxena's work involves improving various aspects of high-precision assembly, including:

- Reducing rework and defects in complex assemblies
- Optimizing welding processes and equipment maintenance
- Implementing automated quality checks
- Enhancing cooling system designs and torque processes
- Improving first-time-through rates and overall yield
- Reducing quality non-conformities and corrective action timelines

This research project aims to explore how smart manufacturing and Industry 4.0 principles can be applied to these areas, drawing insights from various high-precision manufacturing industries.

Goals and Methodology:

- Investigate cutting-edge smart manufacturing technologies applicable to high-precision assembly processes across multiple industries.
- Analyze the implementation and effectiveness of Industry 4.0 principles in quality control and defect reduction in advanced manufacturing settings.
- Explore data-driven approaches to process optimization and predictive maintenance in complex assembly operations.
- Examine the potential of AI and machine learning in enhancing manufacturing efficiency and product quality.
- Assess the scalability and adaptability of smart manufacturing solutions across different industrial sectors.

- Conduct a comprehensive literature review of smart manufacturing applications in various industries
- Analyze case studies from aerospace, medical device manufacturing, and other high-precision sectors
- Perform comparative analyses of Industry 4.0 technologies and their potential applications
- If possible, conduct interviews with industry experts or attend relevant conferences/webinars

Note: Due to the sensitive nature of Mr. Saxena's role, you will not receive any internal data. Students are expected to rely on publicly available information, academic resources, industry reports, and potential interviews with outside parties to inform their research.

Expected Deliverables

1. Comprehensive Research Report: • In-depth analysis of smart manufacturing technologies applicable to high-precision assembly • Comparative study of Industry 4.0 implementations across different manufacturing sectors • Assessment of potential applications and challenges in the context of EV battery production
2. Technology Implementation Framework: • Proposed framework for evaluating and implementing smart manufacturing technologies in assembly processes • Risk assessment and mitigation strategies for technology adoption
3. Industry Trend Analysis: • Report on emerging trends in smart manufacturing and their potential impact on high-precision assembly industries • Future outlook and recommendations for staying ahead of technological advancements
4. Presentation of Findings: • Executive summary of key research findings and their implications for advanced manufacturing

Scheduling:

Mr. Saxena will work with you in a remote format. Ideally, he will be available for a project kickoff meeting, then a bi-weekly checkpoint and more formal presentations according to the course schedule (including the final presentation).

PowerPoint can work for ongoing presentations and final deliverables.