Teaching Factories Competition 2025: Company challenges

Advanced Manufacturing, Green and Sustainable Manufacturing, Digital Transformation in Manufacturing

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Company: K.TEX
Country: Ukraine
Website: https://ktex.com.ua/en/
Industry: Nonwoven textiles & insulation

Reference sector and brief description of the business:

K.Tex is a manufacturer of light industry, one of the leading producers of nonwovens in Ukraine: more than 200 employees, 5 production lines for the production of nonwovens with a total capacity of 4500 tons per year, 3 quilting lines and a sewing department. The company has patents and 10 registered trademarks with functional properties mainly of heat-saving and shape-filling and substrates and coatings with structural, insulating, filtering and protective functions for 5 industries: garment, furniture, construction, agricultural, medical; more than 300 regular customers, consumers of products: manufacturers of clothing, workwear, upholstered furniture, soft toys, home textiles and other products; construction companies and manufacturers of filtering equipment; a reliable partner for more than 20 Ukrainian and foreign suppliers of raw materials. Ukrlegprom representative in the Circular Economy Working Group of the European Association of Textile and Clothing Manufacturers EURATEX.

CHALLENGE #1

Title of challenge: Selection and adaptation of a flame retardant for the manufacture of non-woven hemp building insulation as an ecological and natural alternative to mineral wool.

Topic challenge belongs: Advanced Materials and Manufacturing.

Category of Solver team: Higher Education students (Bachelor's and Master's)

What kind of business impact would you like to achieve by solving the challenge:

The production of environmentally friendly natural building materials is one of the top priorities of our company as a response to market needs. we have held many events to promote hemp insulation to end users. Conclusion: the flammability of this type of insulation is the biggest drawback, along with the classic insulation: stone wool and mineral wool,

and, accordingly, is a barrier to the rapid development of this product line. accordingly, having solved this issue, we expect the sales of ecological insulation to grow tenfold. In addition, an important aspect of the selection of an antiperene is its harmlessness, so as not to spoil the original product.

CHALLENGE #2

Title of challenge: Selection of flame retardants for nonwoven fabrics made of synthetic fiber.

Topic challenge belongs: Advanced Materials and Manufacturing.

Category of Solver team: Higher Education students (Bachelor's and Master's)

What kind of business impact would you like to achieve by solving the challenge:

A separate project of our company is the development of materials based on fibers from textile recycling: heat and noise insulation materials. For the most part, textile recycled materials are PET fibers. For us, fixing antiperenes on synthetic fibers is an unsolved problem that prevents the development of adaptation of these materials to the needs of the construction market.

CHALLENGE #3

Title of challenge: Conducting a study on the life cycle and carbon footprint of nonwoven hemp building insulation

Topic challenge belongs: Advanced Materials and Manufacturing.

Category of Solver team: Higher Education students (Bachelor's and Master's)

What kind of business impact would you like to achieve by solving the challenge:

We constantly receive this request from our foreign partners when they ask us to export our construction products (insulation materials).

Company – GUSHKA WOOL
Country: Ukraine
Website: https://gushka.ua/
Industry: woolen clothing & textiles

Reference sector and brief description of the business:

Nestled in the heart of the Carpathians, in the vibrant region of Kosiv, GUSHKA not only crafts products but also spins a narrative deeply rooted in centuries-old traditions, as rich and textured as the wool they meticulously mold. Founded in 2016, this Ukrainian brand upholds ancient wool crafting traditions, inviting its patrons to experience the profound depth of Ukrainian heritage. Beyond just tradition, GUSHKA specializes in producing woolen clothing, pillows and bedspreads. Each item is sustainably made from 100% pure, eco-friendly wool, sourced directly from Ukrainian sheep that roam the untouched meadows of the Carpathian Mountains.

CHALLENGE #4

Title of challenge: Automated Wool Felting System: Enhancing Traditional Craftsmanship with Controlled Manufacturing Processes.

Topic challenge belongs: Advanced Materials and Manufacturing.

Category of Solver team: Higher Education students (Bachelor's and Master's).

What kind of business impact would you like to achieve by solving the challenge:

Business Impact of Solving This Challenge Our company specializes in traditional weaving, preserving techniques that are over a hundred years old. We rely entirely on manual processes at every stage of production, from raw material preparation to the final product. We purchase wool directly from farmers, which makes quality control difficult. After spinning and weaving, each piece is created significantly larger than the required size. This is because the final step involves felting in water, following a traditional process. Historically, woolen products

were placed in a river, where the natural flow of water and movement caused the fibers to tighten and shrink, making the fabric denser. However, this method presents several challenges: We cannot control the water temperature, flow intensity, or level of friction. Each product spends approximately one day in the water, but due to unpredictable conditions, the final size may vary significantly from the intended measurements. Some products may shrink excessively, leading to defects and financial losses. To preserve the uniqueness of our traditional production while improving quality and consistency, we need an engineering solution that can replicate the natural process of felting in water within a controlled environment. An automated system that mimics the effects of water would allow us to: Ensure precise product dimensions after processing. Reduce defective items, improving profitability. Maintain traditional craftsmanship while enhancing efficiency. We are seeking a technological solution that seamlessly combines heritage weaving techniques with modern manufacturing, ensuring authenticity and high quality.

Company – SIA LD Stels
Country: Latvia
Website: www.ldstels.lv
Industry: cosmetic manufacturing & skincare

Reference sector and brief description of the business:

SIA LD Stels operates in the cosmetic manufacturing, export, and retail sector, specializing in the production of high-quality skincare and body care products. The company focuses on innovative formulations and efficient production processes to deliver premium cosmetic solutions to both domestic and international markets. SIA LD Stels is a leading cosmetic manufacturer and exporter, dedicated to producing high-quality body scrubs, skincare products, and cosmetic formulations. With a strong emphasis on innovation, efficiency, and sustainability, the company continuously seeks to optimize production processes while maintaining the highest industry standards. By integrating advanced manufacturing techniques and adapting to market demands, SIA LD Stels serves both B2B and B2C sectors, offering customized solutions to retailers, wholesalers, and direct consumers.

CHALLENGE #5

Title of challenge: Development of a Universal Packaging Machine for High-Density Scrubs.

Topic challenge belongs: Advanced Manufacturing: Human-Machine Interface, Robotics & Automation.

Category of Solver team: Higher Education students (Bachelor's and Master's).

What kind of business impact would you like to achieve by solving the challenge:

Business Impact of Solving Challenge 1: Development of a Universal Packaging Machine for High-Density Scrubs Solving this challenge will have significant operational, financial,

and strategic benefits for SIA LD Stels and the broader cosmetic manufacturing industry. The key business impacts include: 1. Increased Manufacturing Efficiency & Scalability Automating the packaging process will eliminate manual labor bottlenecks, enabling higher production speeds and consistency. A universal packaging solution will allow for greater scalability, supporting the production of a wider range of scrub formulations without additional manual intervention. 2. Cost Reduction & Improved Profit Margins Lower labor costs by reducing reliance on manual packaging processes. Minimized material waste, ensuring accurate portioning and reducing raw material loss during packaging. Optimized operational efficiency, leading to a better cost-to-output ratio. 3. Competitive Advantage & Market Differentiation A first-of-its-kind universal packaging machine in the cosmetics industry will set SIA LD Stels apart from competitors. The ability to package high-density scrubs efficiently will encourage innovation in product formulations, giving the company a unique market position. Faster production turnaround will enable quicker response to market demands and customization requests. 4. Industry-Wide Impact & Potential Commercialization The solution could be scaled beyond SIA LD Stels, potentially leading to patent opportunities or commercialization of the packaging technology for other cosmetic manufacturers. Collaboration with engineering and automation firms could lead to new business partnerships in manufacturing technology. By implementing a universal packaging machine, SIA LD Stels can achieve a transformational shift in its production capabilities, reducing costs, increasing efficiency, and securing a sustainable competitive advantage in the global

CHALLENGE #6

Title of challenge: AI-Powered Smart Weighing & Tracking System for Error-Free Cosmetic Manufacturing.

Topic challenge belongs: Green & Sustainable Manufacturing: Zero Defect Manufacturing. Digital Transformation in Manufacturing: Smart & Intelligent Manufacturing, Advanced Simulation & Digital Twin Technology.

Category of Solver team: Higher Education students (Bachelor's and Master's).

What kind of business impact would you like to achieve by solving the challenge:

Business Impact of Solving Challenge 2: AI-Powered Smart Weighing & Tracking System for Error-Free Cosmetic Manufacturing Implementing an AI-driven smart weighing and tracking system will bring transformational improvements in operational efficiency, cost reduction, quality control, and sustainability for SIA LD Stels and the broader cosmetic manufacturing industry. The key business impacts include: 1. Achieving Zero-Defect Manufacturing & Quality Assurance Eliminates human error in ingredient measurement, ensuring that every batch meets precise formulation standards. Reduces product defects and inconsistencies, leading to higher customer satisfaction and compliance with industry regulations. Automates validation & traceability, creating a full digital record of ingredient usage, reducing risks of non-compliance. 2. Cost Reduction & Increased Operational Efficiency Minimizes ingredient loss by optimizing weighing precision, leading to significant savings on raw materials. Streamlines workflow, ensuring faster production cycles and increased production output. 3. Integration with Smart & Intelligent Manufacturing Systems AI-powered tracking ensures real-time monitoring and predictive alerts, reducing downtime and inefficiencies. Seamless integration with accounting & ERP systems (such as 1C) for better inventory and batch management. Facilitates data-driven decision-making, enabling better forecasting and optimization of production resources. 4. Advancing Sustainability & Waste Reduction Supports Green Manufacturing by reducing ingredient waste, leading to more sustainable production. Optimized material usage helps in reducing the carbon footprint of manufacturing operations. Helps meet regulatory and corporate sustainability goals, improving brand reputation and compliance with environmental standard 6. Ensuring Full GMP Compliance & Digital Transparency Automated

tracking of ingredient input ensures complete traceability, making it easier to verify what was added, when, and by whom—a key requirement for GMP-certified companies. Reduces the risk of non-compliance issues, batch recalls, and regulatory fines by maintaining an accurate digital record of ingredient handling. Eliminates manual paperwork, replacing physical records with a real-time digital log, making GMP audits faster and more efficient. 7. Comercialization: Potential commercialization of the AI system, allowing other manufacturers to adopt the technology, creating a new revenue stream. Enhanced brand reputation as a leader in digital transformation & sustainable manufacturing. 8. Supporting Green & Sustainable Manufacturing with Paperless Operations Drastically reduces paper usage by digitizing ingredient tracking, batch documentation, and compliance records. Supports sustainability goals by contributing to eco-friendly, paperless production, aligning with global green manufacturing initiatives. Sets a new industry standard for smart, sustainable, and transparent production processes, influencing GMP-certified manufacturers worldwide By integrating AI-driven ingredient tracking with GMP compliance and paperless documentation, this challenge not only enhances manufacturing precision and efficiency but also drives the entire cosmetics industry toward greener, more transparent, and digitally advanced production standarts.

Company – Pannon Business Network Association
Country: Hungary
Website: https://www.pbn.hu/main.php?Lang=EN
Industry: digital innovation & advanced manufacturing.

Reference sector and brief description of the business:

PBN is the collaborative center for applied research, training and advanced manufacturing to catalyse value creation by digitalization as active catalyst of the ecosystem. Linked to industry, academia and citizens, it is facilitating digital, human-centred, resilient and green transformation with focus on business and healthy ageing through its connected divisions. A key distinguishing feature of the Hungarian PBN is its extensive international reach by having realized over 85 international applied research projects with 500+ European partners. am-LAB unit: a digital innovation hub and advanced manufacturing laboratory focuses on digital technologies, robotics, data science, extended reality and 3D technologies. A broad portfolio of connected technological devices is available in the laboratory, with engineering staff enables such in-house development like real-time data visualisation, augmented reality applications, predictive statistics, neural network-based image recognition.

CHALLENGE #7

Title of challenge: Humanoid Robot Walking Development - Implementing Autonomous Walking.

Topic challenge belongs: Advanced Manufacturing: Robotics & Automation.

Category of Solver team: Higher Education students (Bachelor's and Master's).

What kind of business impact would you like to achieve by solving the challenge:

Currently, humanoid robots face substantial limitations in real-world mobility due to discrepancies between simulated models and physical execution. By successfully enabling autonomous walking for the Poppy Humanoid Robot, our company will gain a

competitive edge in robotics. This innovation positions us as a technological leader in humanoid robotics, potentially opening new market opportunities. Mobile robots with advanced locomotion can be used for dynamic industrial automation in logistics, warehouses, and smart factories, reducing dependency on fixed robotic solutions. Achieving autonomous walking is a critical milestone for integrating humanoid robots into Teaching and Learning Factory environments, where they can participate in real-world production systems. A walking robot would be able to navigate dynamic workspaces, interact with human operators, and execute tasks independently, significantly enhancing its role as an intelligent, collaborative system. This capability would open up new possibilities for flexible automation, training applications, and human-robot collaboration in industry 4.0 settings. This challenge will also serve as an opportunity to engage with top engineering talent (students and researchers) through the Teaching Factories Competition, foster collaborations with academic institutions and industrial partners for future co-development projects, and establish our company as a thought leader in humanoid robotics, increasing visibility within the robotics and AI communities.

Company – LLC SPU EURO TECHNO TRADE
Country: Ukraine
Website: https://spu-ett.top/
Industry: indoor farming & sustainable agriculture.

Reference sector and brief description of the business: Reference Sector: AgriTech / Indoor Farming / Sustainable Food Production Brief Business Description: We develop modular, closed-environment greenhouses incorporating hydroponic or aeroponic systems, robotics, and AI. This allows year-round cultivation of crops with minimal water and land usage while remaining unaffected by external conditions. By integrating renewable energy sources, we reduce reliance on external grids. The closed-loop ventilation system precisely controls temperature, humidity, and CO_2 levels, ensuring consistent quality and higher efficiency. Our collaboration with academic partners helps refine our technologies and implement innovative solutions.

CHALLENGE #8

Title of challenge: Robotics for Controlled Agriculture Systems.

Topic challenge belongs: Advanced Manufacturing: Robotics & Automation.

Category of Solver team: Higher Education students (Bachelor's and Master's).

What kind of business impact would you like to achieve by solving the challenge:

Key Business Objectives and Expected Impact 1. Increasing productivity in a controlled environment - Robotic platforms/manipulators perform all key operations in a fully controlled microclimate (sowing, cultivation, harvesting). - Thanks to automation in closed systems (hydroponic or aeroponic), the production cycle becomes continuous and

independent of weather conditions or regional geography. 2. Reducing operational costs and minimizing the human factor - Robots reduce the need for a large workforce, lowering labor costs and mitigating errors associated with human intervention. - Precise and careful dosing of nutrients, as well as automatic control of irrigation or spraying (in the case of aeroponics), improves product quality and extends the service life of equipment. 3. Modularity and scalability - Automated modules can be easily combined or scaled: to increase growing volumes, it's sufficient to add new units already equipped with robots and controllers. - Robotic remote monitoring systems enable the launch of additional greenhouses in different regions while maintaining consistent quality standards. Technical Aspect (Example) - Robotic manipulators with a high degree of freedom for precise operations in densely arranged blocks (hydro-/aeroponic installations). - Automated Guided Vehicles (AGVs) to transport plant trays between different lighting, feeding, or packaging zones. - A closed ventilation system with automatic dampers and filters for circulating purified air.

CHALLENGE #9

Title of challenge: Transforming Agriculture with Advanced AI.

Topic challenge belongs: Digital Transformation in Manufacturing: Artificial Intelligence.

Category of Solver team: Higher Education students (Bachelor's and Master's).

What kind of business impact would you like to achieve by solving the challenge:

Key Business Objectives and Expected Impact 1. Intelligent optimization of microclimate and resources - AI models collect data from sensors (temperature, humidity, carbon dioxide, pH, and other indicators in hydroponic/aeroponic solutions) and regulate lighting, ventilation, and nutrient consumption in real time. - Predictive analytics allows for planning peak energy consumption periods and directing excess energy from alternative sources (solar panels, wind turbines) to storage or other necessary processes. 2. Reducing waste and non-productive losses - By using AI, it is possible to monitor each plant individually: if any signs of nutrient deficiency or disease are detected, the system immediately adjusts the supply of solution and growing conditions. - Targeted resource application (water, fertilizers) lowers costs and reduces environmental impact. 3. Big data analysis and continuous model improvement - Based on feedback (e.g., plant growth efficiency, crop weight and quality), AI models learn and provide more accurate recommendations. - In close collaboration with an academic partner, research can be conducted to develop new algorithms that account for the biological and botanical characteristics of different crops. Technical Aspect (Example) - Neural networks and computer vision: detecting disease symptoms on plant leaves and monitoring uniform growth. - Energy consumption forecasting models: aligning HVAC (Heating, Ventilation, Air Conditioning) operation with generation indicators from solar panels or other alternative sources.

CHALLENGE #10

Title of challenge: Smart Manufacturing for Autonomous Greenhouses.

Topic challenge belongs: Digital Transformation in Manufacturing: Smart & intelligent Manufacturing.

Category of Solver team: Higher Education students (Bachelor's and Master's).

What kind of business impact would you like to achieve by solving the challenge:

Business Objectives and Expected Impact 1. Full integration and autonomy of the production system - All greenhouse units (hydroponic/aeroponic racks, nutrient delivery, lighting, ventilation, energy generation) are connected to a single "smart" control center (MES/IIoT platform). - Such an architecture enables the greenhouse to operate autonomously even in regions with limited resources: when necessary, the system switches to backup power sources or adjusts its consumption schedule. 2. Reducing maintenance time and enhancing reliability - Thanks to smart systems, each greenhouse module "notifies" about its status (for instance, water level, the condition of filters in the ventilation system) and performs diagnostics of its own components. - This reduces the number of emergency shutdowns and improves maintenance planning. 3. Possibility of using digital twins and remote management - A "virtual copy" (digital twin) of the greenhouse is created based on the collected data, allowing various scenarios to be modeled—such as changes in nutrient solutions, lighting levels, or climate parameters. - This speeds up experimentation without posing real risks to living plants. Technical Aspect (Example) - MES (Manufacturing Execution System): aggregates data from robots, sensors, and AI models, creating a unified "mirror" of processes in real time. - IIoT platform and digital twin: processes data through MQTT/OPC UA protocols and dynamically constructs a 3D model/schematic of the greenhouse with real metrics for each module.

Company – Quantum-Systems
Country: Germany
Website: http://quantum-systems.com/
Industry: unmanned aerial systems.

Reference sector and brief description of the business: Quantum-Systems specializes in the development, design, and production of advanced multi-sensor unmanned aerial systems (UAS) that collect aerial intelligence for the professional user. Quantum Systems is more than just a drone manufacturer; we are an aerial data intelligence company that provides multi-sensor data collection products to government agencies and commercial customers. Our electric vertical take-off and landing (eVTOL) systems boast industry-leading endurance, ease of operation, and reliability. With our dual approach – serving both commercial AND defense customers – we are committed to pushing the boundaries of aerial intelligence. This unique position gives us the exclusive advantage of applying commercial development speed to the defense industry. Customers in the public and private sectors alike use versatile UAS from Quantum Systems for defense, security, humanitarian, and geospatial operations.

CHALLENGE #11

Title of challenge: Optical Target ReID for drone.

Topic challenge belongs: Digital Transformation in Manufacturing: Artificial Intelligence.

Category of Solver team: Higher Education students (Bachelor's and Master's).

What kind of business impact would you like to achieve by solving the challenge:

Optical Target ReID for drone

After a tracked object gets out the screen for a certain a amount of time, re-detect the object when it appears again preserving the same assigned ID. Several drones might also be able to know that they are looking at the same object. Stable and efficient Computer Vision

algorithm should Improve usability of the UAVs by providing stable unique IDs to detected targets. Key success criteria is when that same object get identified with same ID no matter the angle, light or time since last time camera saw it.

Company – Istya
Country: France
Website: https://istya.co
Industry: Ai-driven energy optimization & industrial automation

Reference sector and brief description of the business: Istya is a technology company specializing in AI-driven energy optimization, industrial automation, and smart building solutions. The company develops intelligent software, sensors, and IoT-based systems that help manufacturers reduce energy consumption, enhance operational efficiency, and improve sustainability. Istya's expertise spans digital transformation, industrial energy flexibility, and predictive analytics, enabling factories, SMEs, and large-scale industrial sites to optimize HVAC, production line energy use, and facility management. Through its advanced AI models and modular IoT solutions, Istya provides scalable, cost-effective tools for businesses seeking to modernize their manufacturing processes, increase energy efficiency, and meet regulatory sustainability goals.

CHALLENGE #12

Title of challenge: AI for Optimizing Energy Consumption in Industrial Production.

Topic challenge belongs: Digital Transformation in Manufacturing: Artificial Intelligence.

Category of Solver team: Higher Education students (Bachelor's and Master's), Vocational Educational and Training students.

What kind of business impact would you like to achieve by solving the challenge:

The challenge aims to achieve a significant business impact by optimizing energy consumption in industrial production through AI-driven solutions. Energy is one of the largest cost drivers in manufacturing, with processes such as welding, ventilation, and extraction systems consuming high amounts of electricity. These systems often operate inefficiently due to rigid scheduling, lack of real-time adjustments, and the absence of predictive capabilities. By

integrating AI, manufacturers can significantly reduce energy waste, lower operational costs, and improve overall efficiency. A key outcome of this challenge is the reduction of energy costs. AI-based energy management can optimize power usage by adjusting consumption in real-time, reducing peak demand charges, and shifting non-essential loads to periods of lower electricity prices. This not only leads to direct cost savings but also improves financial planning and operational stability for manufacturers. Sustainability and regulatory compliance are also major business drivers. With increasing pressure from European regulations such as the Carbon Border Adjustment Mechanism and the Corporate Sustainability Reporting Directive, manufacturers must adopt solutions that enhance energy efficiency and reduce carbon footprints. AI-driven optimization enables companies to align their operations with environmental regulations by reducing energy waste and facilitating the integration of renewable energy sources into industrial processes. The challenge also addresses the growing need for energy flexibility in manufacturing. AI models can adapt industrial energy consumption to electricity market fluctuations, allowing manufacturers to participate in demand response programs. This provides an opportunity to reduce costs further by adjusting consumption based on real-time grid conditions and energy availability. By leveraging AI, companies can balance their energy demand with the availability of renewable energy, making their operations more resilient to energy market volatility. Beyond energy cost savings, AI-powered energy management improves equipment efficiency and maintenance. Unoptimized energy use can cause excessive stress on industrial machinery, leading to unnecessary wear and tear, increased downtime, and higher maintenance costs. AI-driven predictive maintenance models can analyze energy consumption patterns to identify inefficiencies, optimize energy loads, and prevent failures. This results in longer equipment lifespan, reduced maintenance costs, and fewer unplanned production interruptions. By addressing these challenges, AI-based energy optimization provides a competitive advantage in smart manufacturing. Companies that integrate intelligent energy management systems will enhance their operational efficiency, reduce costs, and improve sustainability performance. This will position them as leaders in energy-conscious manufacturing, helping them stay competitive in an evolving industrial landscape. The market potential for AI-driven energy optimization is significant. The solution developed through this challenge can be applied across multiple industries, including automotive, metallurgy, food processing, and electronics. It is scalable and can be adopted by both large corporations and small and medium-sized enterprises without requiring costly infrastructure changes. By implementing AI-powered energy management, manufacturers can unlock new opportunities for cost savings, operational improvements, and sustainability gains, ultimately driving long-term business growth and competitiveness.

Title of challenge: Low-Cost BMS Lite for Industrial SMEs.

Topic challenge belongs: Digital Transformation in Manufacturing: Internet of Things (IoT).

Category of Solver team: Higher Education students (Bachelor's and Master's), Vocational Educational and Training students.

What kind of business impact would you like to achieve by solving the challenge:

The challenge aims to create a low-cost Building Management System (BMS Lite) tailored for small and medium-sized industrial enterprises (SMEs) that currently lack access to affordable, scalable, and easy-to-deploy energy and facility management solutions. Traditional BMS platforms are expensive, complex to implement, and require significant infrastructure, making them inaccessible to smaller manufacturers. By developing an IoT-based, cost-effective BMS, this challenge seeks to improve energy efficiency, reduce operational costs, and enhance automation capabilities for SMEs. The first major business impact is the reduction of energy costs. Many SMEs operate without an integrated system to monitor and control energy consumption, leading to inefficiencies and high utility expenses. A low-cost BMS Lite would allow companies to track real-time energy use, detect inefficiencies, and automate key functions such as HVAC control, lighting management, and equipment scheduling. By optimizing resource consumption, SMEs can reduce energy waste and lower operational expenses, increasing their profitability and financial stability. Another critical impact is improving sustainability and compliance with regulatory standards. With stricter environmental regulations in Europe, SMEs must adopt solutions that help them monitor and reduce their carbon footprint. A smart BMS can facilitate energy tracking, CO_2 monitoring, and predictive maintenance, enabling businesses to align with corporate sustainability goals, ESG reporting requirements, and European energy efficiency directives. Beyond cost and sustainability, this challenge empowers SMEs with digital transformation capabilities. While large manufacturers have adopted IoT-based automation and smart energy management, many SMEs still rely on manual processes and outdated infrastructure. A plug-and-play BMS solution would allow smaller manufacturers to embrace smart factory concepts, increase automation, and digitize key operational processes. This will enhance their competitiveness, making them more resilient to industry shifts and energy market fluctuations. Additionally, a low-cost BMS Lite supports predictive maintenance and equipment longevity. Many

manufacturing SMEs operate on tight budgets and cannot afford frequent machine breakdowns. By integrating IoT sensors and AI analytics, a BMS Lite can monitor equipment conditions, predict failures, and schedule maintenance proactively, minimizing downtime and extending the life of critical assets. From a market perspective, this challenge has high scalability and adoption potential. SMEs represent a large portion of the industrial sector, yet they are underserved when it comes to affordable automation and energy management solutions. A cost-effective, easy-to-deploy BMS could be rapidly adopted across various industries, including food processing, automotive suppliers, textiles, and general manufacturing. The business model could also evolve into a subscription-based or modular system, providing flexibility for companies to scale their automation capabilities as needed. By addressing these challenges, the BMS Lite for industrial SMEs will enable manufacturers to reduce costs, optimize energy efficiency, increase sustainability, and adopt smart manufacturing technologies. This will allow SMEs to compete with larger players, strengthen their business resilience, and contribute to a more energy-efficient and sustainable industrial ecosystem.

Title of challenge: Modular PCB for Stability & Longevity.

Topic challenge belongs: Advanced Manufacturing: Advanced Materials and Manufacturing.

Category of Solver team: Higher Education students (Bachelor's and Master's), Vocational Educational and Training students.

What kind of business impact would you like to achieve by solving the challenge:

The challenge aims to improve the stability, longevity, and modularity of Printed Circuit Boards (PCBs) used in industrial applications. PCBs are the backbone of modern manufacturing automation, embedded in sensors, controllers, and industrial electronics. However, many PCBs in industrial environments face thermal stress, mechanical wear, and obsolescence, leading to frequent failures, high maintenance costs, and electronic waste. By developing modular and reconfigurable PCB designs, this challenge seeks to enhance durability, repairability, and adaptability, creating a more sustainable and cost-effective approach for manufacturers. One of the most significant business impacts is the reduction of maintenance costs and downtime. In industrial settings, faulty PCBs can lead to unexpected equipment failures, causing costly production stoppages and delays. A modular PCB design allows manufacturers to replace faulty components or upgrade functionalities without replacing the entire board, minimizing repair costs and increasing operational continuity. This leads to higher equipment uptime, better production efficiency, and lower long-term expenses for manufacturers. Another key impact is the extension of product lifecycle and sustainability. Electronic waste is a growing environmental concern, particularly in industrial sectors where obsolete control boards and sensors are frequently discarded. By making PCBs more repairable, upgradable, and modular, manufacturers can extend the lifespan of their electronic components and reduce e-waste, aligning with circular economy principles and European sustainability regulations. This challenge also enhances manufacturing flexibility and customization. Many industrial applications require specialized PCB configurations tailored to specific machinery or automation systems. A modular PCB architecture enables manufacturers to customize and reconfigure boards based on evolving operational needs, rather than investing in entirely new electronic systems. This supports adaptive manufacturing, rapid prototyping, and cost-effective production scaling. In addition to cost savings and sustainability, the challenge strengthens supply chain resilience. The global semiconductor and electronic

component shortages have exposed the vulnerability of manufacturers relying on fixed PCB designs that cannot be easily adapted or sourced from alternative suppliers. By developing a universal, modular PCB platform, industries can diversify component sourcing, reduce dependency on single suppliers, and improve supply chain agility in the face of disruptions. The market potential for modular, high-stability PCBs is substantial. Industrial automation, robotics, IoT, and sensor-based manufacturing systems all rely on PCBs that must operate reliably under harsh conditions. A versatile PCB design with modular capabilities would provide greater value to equipment manufacturers, automation providers, and industrial companies looking for cost-effective, durable, and sustainable solutions. By solving this challenge, manufacturers will benefit from lower maintenance costs, increased production uptime, extended product lifecycle, enhanced sustainability, and improved supply chain flexibility. This will drive greater efficiency, adaptability, and resilience in industrial operations, positioning modular PCB technology as a key enabler of future-ready, smart manufacturing systems.

Company – Iscleanair S.r.l. Benefit Company
Country: Italy
Website: https://www.iscleanair.com/wp/en/
Industry: air pollution abatement & clean air technology.

Reference sector and brief description of the business: Is CLEAN AIR is an innovative advanced technology company, strongly driven by research and development, that has been involved in the development, industrialization and commercialisation of APA (Air Polution Abatement) technology and related clean air services and solutions on a global scale since 2017. APA is the first filter-less solution for the air cleaning and environmental remediation at the surface level. It is a patented, smart, modular and flexible multiservice platform integrated with monitoring features, IoT, based on energy efficiency and circular economy philosophy for a social, ecological and economic sustainability. In recent years APA has been awarded and received multiple recognition for its uniqueness and sustainability since using only water reduces resource consumption and waste. Applied already in many (over 150 installations) industrial and urban settings, is looking at next phase of enhancements of its products.

CHALLENGE #15

Title of challenge: Is CLEAN AIR's Sustainable natural resource management challenge.

Topic challenge belongs: Green & Sustainable Manufacturing: Sustainable Supply Chain Management, Circular Economy. Digital Transformation in Manufacturing: Internet of things (IoT).

Category of Solver team: Higher Education students (Bachelor's and Master's), Vocational Educational and Training students.

What kind of business impact would you like to achieve by solving the challenge:

Our focal intention revolves around attaining an elevated level of control over a prevalent industrial phenomenon or addressing a specific challenge. Our aim is to identify and verify a water-absorbent substance capable of capturing evaporated water from our storage tank during the air cleaning processes, and simultaneously, facilitating a simplified process for transferring the trapped evaporated water back into the tank. An essential criterion for this material is its efficiency in absorbing water vapor while enabling easy conveyance. A distinctive feature will have to be its ability to execute these functions without any consumption of power or electricity. This innovation not only will contributes to resolving the challenge but also increase the sustainability of the purification process and bolsters overall resource management. A profound industrial concept remains at the core of our formidable challenge: the intricate management of resource utilization. Our proposition embodies a substantial challenge that finds its essence at the convergence of resource management, sustainability, and ingenious thinking. Our overarching objective is to unearth the latent possibilities within the air we inhale, thus catalysing a paradigm shift in our perception of water resource utilization. The core of our challenge is based on engineering an instinctive process that effortlessly assimilates the suspended water particles in the air (which are usually measured as Relative Humidity) and seamlessly redirects them into our water storage unit. However, an intriguing facet complicates this pursuit: the emphasis on efficiency merely constitutes one piece of a multidimensional puzzle. In fact, we extend a warm invitation for you to envision a solution that accomplishes this remarkable feat with elegance, al while circumventing any undue strain on our energy resources. The innovation we seek transcends the boundaries of traditional resource management; maintaining an equilibrium into our indoor ecosystems. Furthermore, it is paramount to acknowledge that the materials chosen for absorption must inherently prioritize environmental compatibility. Embedded within the comprehensive scope of our challenge lies the potential to yield a product that not only excels in sustainability but also serves as a vanguard of ecological harmony