OPTIMISING BEARING PRODUCTION THROUGH DYNAMIC AUTOMATION

CHALLENGE OWNER

The Challenge Owner is a German-based global automotive and industrial supplier, specialising in the manufacturing of high-precision components and systems for engine, transmission, and chassis applications, as well as rolling and plain bearing solutions. With nearly 4,000 authorised sales partners worldwide, the company leverages local market insights to develop innovative products and solutions for the automotive and industrial sectors. It pioneers motion technology, striving to make mobility and industrial processes more efficient, intelligent, and sustainable.

This sector-wide challenge is supported by the Advanced Remanufacturing and Technology Centre (ARTC), as part of the **A*STAR Advanced Manufacturing Startup Challenge 2024**, focused on the theme of "Artificial Intelligence in Manufacturing". ARTC is led by the Agency for Science, Technology and Research (A*STAR), in partnership with Nanyang Technological University Singapore. ARTC's expertise in advanced manufacturing and remanufacturing accelerates the transfer of innovation from applied research to industrial applications and solutions, building capabilities through collaboration with their industry members. A*STAR aims to catalyse startup challenge winners to co-innovate and co-deploy advanced manufacturing solutions through ARTC's consortium.

To Note: Participants should approach this challenge with the intent to utilise A*STAR's intellectual property to resolve the problem statement and give due consideration to license, post-challenge.

CONTEXT

The Challenge Owner's core product and service offerings include components and systems for vehicles with internal combustion engines, hybrid, and electric drivetrains. The company produces precision products that help reduce fuel consumption and emissions while enhancing driving comfort and vehicle dynamics. Its portfolio encompasses valve-lash adjustment elements, variable valve train systems, chain and belt drives, and bearing supports for engine shafts. In the transmission sector, the company develops innovative components for various transmission types, including automated manual, double-clutch, and continuously variable transmissions.

Their operational model features a complex production environment with ten lines, each staffed by operators handling three primary tasks: material transfer (bin-picking), assembly, and measurement. The plant runs 24/7 in three shifts and is highly labour-intensive, with operators often having to manage multiple lines. Operators also use manual pallet jacks to transfer parts from crates to their respective production lines.

The Challenge Owner faces challenges such as:

- Labour inefficiency. Lack of manpower and resources to manage multiple lines.
- Safety. Operators may undertake repetitive heavy lifting tasks.
- Precision and speed. Assembly and measurement processes need to be completed in an accurate and timely manner.

The Challenge Owner is open to exploring the potential of collaborative robots (cobots), dual-arm lighter robot systems, vision systems, and artificial intelligence The ideal solution should reduce manpower requirements, increase safety, improve precision, and enhance overall efficiency.

PROBLEM STATEMENT

How might we develop a dynamic automation solution that integrates with existing production lines to perform multiple tasks efficiently with a high level of precision, while enhancing worker productivity and safety?

WHAT ARE WE LOOKING FOR?

The Challenge Owner seeks a versatile solution that can efficiently perform multiple tasks within their production environment, addressing current challenges while optimising operations within existing constraints.

The solution should meet the following criteria:

- Intelligent identification. The solution should accurately identify and detect shiny & oily parts, distinguishing damaged, rogue, or foreign materials. It must ensure complete emptying of bins without leaving any parts behind.
- Versatility and precise manipulation. The solution must be capable of handling around 10 different components within each plant and adapt to changing part specifications on an annual basis. It should demonstrate accurate pick and place functionality, ensuring correct orientation of parts during placement.
- Dual-arm utilisation and collaboration. The solution should facilitate point-to-point transfer between robots, coordinate operation of left and right arms, perform dual-arm functionality with mobile manipulation, integrate with existing warehouse management systems, and enable effective human-robot collaboration.
- Dynamic prioritisation. The solution should be able to prioritise tasks in non-sequential assembly lines and implement first-in-first-out sequencing when necessary.

OVERALL PERFORMANCE REQUIREMENTS

- Safety. The solution must prioritise safety to minimise injury risk, especially in tight spaces where robots and operators work closely together.
- Efficiency. The system should significantly reduce cycle time to decrease production downtime and enhance operational efficiency.
- Accuracy. The system should demonstrate high accuracy in identifying around 10 component types including those with metallic, shiny, or greasy surfaces, and accurately differentiate between various sizes and inner/outer components with designated orientations
- Flexible. The solution should use flexible code for quick adjustments to production needs, handle complex tasks efficiently, and optimise execution time by balancing the need for thorough processing with rapid cycle times.

There are no geographical restrictions for problem solvers applying to this challenge. However, those seeking to utilize A*STAR's funding for technology development must register or have an existing private limited company in Singapore. Additionally, they should consider expanding within the Asia Pacific region (e.g., Vietnam, Korea, India, China) to enable potential collaborations.

METRICS OF SUCCESS

The solution should aim to have the following desired outcomes:

- Success rate. The solution must achieve a 90% success rate in fully clearing bins, aiming to match or closely approach the current manual/traditional automation success rate of 100%.
- Reduction in time taken. The solution should increase productivity by reducing cycle time and require minimal reconfiguring or reprogramming time. Currently, it takes the operators around 8 hours to complete 6 lines.

- Component identification range. Accurately identify and evaluate a wide range of parts, components, and products.

POSSIBLE USE CASES

1. Dynamic physical adaptation. Sarah, a production supervisor, finds an urgent order for a specific bearing type upon arriving at the plant. She uses the new automation system to quickly reprioritise the production schedule. The mobile manipulators immediately adjust and adapt physically to focus on the new bearing type. An hour later, Sarah inputs another urgent request for a different bearing type, and the system recalculates and adapts for the latest request. The mobile manipulators seamlessly transition between tasks, maintaining overall productivity. This real-time physical adaptation enhances the plant's responsiveness to customer needs and market demands.

2. Precision material handling in challenging conditions. In another part of the plant, the dynamic automation solution tackles the challenging task of handling small, metallic, and greasy bearing components. Its advanced vision technology and sensitive grippers accurately identify and categorise each item, distinguishing between sizes from tiny inner rings to larger outer rings, despite their similar sheen. The solution maintains high accuracy in material transfer, separating defective parts for quality control. The plant manager observes a significant drop in handling errors and an increase in defect detection, leading to better product quality, reduced waste, and cost savings.

WHAT'S IN IT FOR YOU

- SGD50,000 of prize money for each winner of this challenge (see Award Model)
- SGD150,000 A*STAR funding for technology development*
- 2-year ARTC Consortium Membership
- 1 shortlisted problem solver to be fast tracked to ESG's SLINGSHOT Top 50 and can look forward to a SGD20,000 Startup SG Grant
- Access to IMDA's PIXEL corporate innovation hub and complimentary innovation consultancies (e.g. Design Thinking, Digital Storytelling) for the prototype development and commercialisation
- Opportunity to commercialise solution for deployment and adoption by ARTC members

**To access the A*STAR funding for technology development problem solvers must register / have registered a private limited company in Singapore to utilize the funding.*

EVALUATION CRITERIA

The evaluation process shall take place over two stages. Proposals shall be evaluated based on the evaluation criteria set out for the first stage. Thereafter, shortlisted proposals shall be subjected to a second stage evaluation in the form of an interview / pitch, and the scoring shall be based on a re-defined assessment criteria for the selection of the challenge finalist(s).

Solution Fit (30%)	Relevance: To what extent does the proposed solution address the problem statement effectively?
Solution Readiness (30%)	Maturity: How ready is the proposed solution to go to the market? Scalability: Is there any evidence to suggest capacity to scale?

Solution Advantage (20%)	Quality of Innovation: Is the solution cost effective and truly innovative? Does it make use of new technologies in the market, and can it potentially generate new IP?
Company Profile (20%)	Business Traction: Does the product have user and revenue traction? Team Experience: Do the team members possess strong scientific/technical background?

AWARD MODEL

30% of the prize money will be awarded to each selected finalist at the start of the POC/prototype development process. The remaining 70% will be awarded after completion of the POC/prototype solution, based on milestones agreed between Challenge Owner(s) and the solver. Prize money will be inclusive of any applicable taxes and duties that any of the parties may incur.

Note that a finalist who is selected to undertake the prototype development process will be required to:

- Enter into an agreement with Challenge Owner(s) that will include more detailed conditions pertaining to the prototype development;
- Complete an application form with IMDA that will require more financial and other related documents for potential co-funding support.

DEADLINE

All submissions must be made by **13 Sep 2024, 1600 hours (SGT/GMT +8)**. Challenge Owner(s) and IMDA may extend the deadline of the submission at their discretion. Late submissions on the OIP, or submissions via GeBIZ, will not be considered.