

DRONE



STEAM

DRONES@STEAM

Fostering digital Transformation in VET schools
and creating new job prospects in the labour market

Project Result No: 2

**Activity 4: DRONES@STEAM JOB-SPECIFIC SCENARIOS
FOR CODING A DRONE**

**Scenario 1: Mechanical Manufacturing Workshop Inspection
and Maintenance**

Lead partner(s): PIT, RDPSEA



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CONTEXT

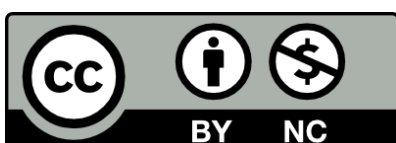
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<https://dronesteam.eu/>

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- ECAM-EPMI (ECAM) - France
- Cyprus Computer Society (CCS) - Cyprus
- Politeknika Ikastegia Txorierri S. Coop (PIT) – Spain
- National Center for Scientific Research “Demokritos” (NCSR) - Greece
- A & A Emphasys Interactive Solutions Ltd (EMP) – Cyprus
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Contents

Cross-Curricular Scenario 1: Mechanical Manufacturing Workshop Inspection and Maintenance	4
1 Introduction	4
2 The need.....	4
2.1 Key terms.....	5
3 Objectives and Expected Learning outcomes	5
4 Prerequisites	5
5 Cross-curricular interactions	6
6 Implementation steps	6
6.1 Time distribution	6
6.2 Step 1: Description of the problem (1 hour).....	6
6.3 Step 2: Search for proposals (2 hours).....	6
6.4 Step 3: Development of the Maintenance plan (4 hours)	7
6.5 Step 4: Testing the Maintenance Plan (3 hours).....	7
6.6 Step 6: Presentation of the Maintenance Plan to the workshop teachers (1/2 hour) ..	7
7 Reflection, Feedback and scenario evaluation	8
8 Scenario expansion	9
References.....	10

Cross-Curricular Scenario 1: Mechanical Manufacturing Workshop Inspection and Maintenance

1 Introduction

Using drones for maintenance tasks in industrial applications has numerous advantages. They can improve safety by inspecting difficult or dangerous areas, increase efficiency by quickly gathering data and save costs by reducing the need for specialized equipment and performing maintenance tasks more quickly. Drones can also provide accurate data and imagery, catch maintenance issues early on and be deployed flexibly with different sensors and cameras.



2 The need

The mechanical manufacturing workshop at our VET school has been experiencing difficulties in keeping up with maintenance tasks for its complex machinery and equipment. Frequent maintenance is essential to ensure that the machinery operates at peak efficiency, but the workshop teachers and students are struggling to meet the workload. The maintenance tasks often involve climbing ladders or scaffolding to reach the machinery, which poses significant safety risks.

Fortunately, some of the students who are enrolled in an Intelligent Fabrication advanced course, which includes Intelligent Metrology, have identified an opportunity to use technology to improve the maintenance process. After observing the equipment and the maintenance process, they propose using a drone equipped with a camera to inspect the machinery and gather data.

Although some of the workshop teachers are initially sceptical of the idea, the students will work on their idea to present a detailed plan for using the drone to perform routine inspections and maintenance tasks. With the drone's camera capturing detailed images and video of the machinery, the staff would be able to identify any potential issues before they become serious problems, enabling more efficient and effective maintenance.

By working on this plan, the students will have the opportunity to apply their knowledge and skills to a real-world problem that could serve as an invaluable learning experience. Additionally, the plan provides a solution to the workshop's maintenance challenges, benefiting both the students and the staff.

2.1 Key terms

Drones Programming | Drones Piloting | Industrial Maintenance | Inspection | Efficient, Effective Maintenance | Mechanical Manufacturing Workshop | VET School | Real-World Problem | Learning experience

3 Objectives and Expected Learning outcomes

- Creation of a detailed plan for using technology to improve the maintenance process in the mechanical manufacturing workshop
- Collaborate with workshop teachers to implement the plan and address the workshop's maintenance challenges
- Identify and address safety risks associated with maintenance tasks in the workshop
- Improved problem-solving and critical thinking skills through developing a detailed plan
- Improved collaboration and communication skills through working with workshop teachers
- Improved awareness of safety risks associated with maintenance tasks in a workshop setting
- Increased confidence in applying knowledge and skills to real-world problems
- Improved understanding of the importance of efficient and effective maintenance in a workshop environment.
- Stimulate the interest of students in drone technology.

4 Prerequisites

- Knowledge of the pre-mentioned guided lesson plans in Drones
- Knowledge on the workshop machinery
- Basic IT knowledge

5 Cross-curricular interactions

This challenge-based scenario provides the opportunity for teachers and students from different areas of vocational education to get involved. For example, areas such as **Manufacturing Design** have a direct connection, since students should be able to design and 3D print spare parts: frame, propeller protectors and remote-control holder.

The **IT** sector can also be involved in the script, helping with the processing of the data collected through the various inputs from the drone. They could even design a software application to act as a human-drone interface.

Students from different sectors of vocational education can work in groups of 2 - 4 persons. The way of interaction in this scenario is direct, promoting cooperation and exchange of information between the involved groups.

6 Implementation steps

To help you in this process, we provide you with some steps you can follow to carry out your project. The parentheses refer to the estimated time that may be required in each implementation phase, focusing on the programming and piloting of the educational drone.

6.1 Time distribution

The duration of this open-ended challenge-based scenario can vary depending on the depth of approach by students and teachers. Taking 2-4 hours per week, it will probably take 4-6 weeks before the presentation takes place.

6.2 Step 1: Description of the problem (1 hour)

- Through group discussion, the students should reflect on why maintenance is essential for complex machinery and equipment and how it affects the efficiency of the workshop. They should also consider the consequences of not performing maintenance tasks regularly.
- Identify the challenges faced by the workshop so that the students can reflect on the difficulties faced by the workshop staff in keeping up with maintenance tasks.

6.3 Step 2: Search for proposals (2 hours)

- Brainstorming session together with the workshop teachers to identify the most common problems and the maintenance challenges faced by the staff.
- Research of the manufacturer's technical data and the machine usage to set the frequency of preventive maintenance tasks.
- Discussion on the advantages of using technology to improve the maintenance process, with a focus on using a drone equipped with a camera and different sensors for inspections.
- Identification of the key elements to be included in a maintenance plan.

6.4 Step 3: Development of the Maintenance plan (4 hours)

- Recording and mapping of the mechanical workshop. Definition of the routes to follow to inspect each machine.
- Programming the drone with the selected routes.
- Drafting of the proposal. Working in groups, the students will draft the maintenance plan including the following sections:
 - Checklists for each critical piece of equipment and machinery to ensure that all maintenance tasks are carried out systematically and thoroughly.
 - Corrective maintenance tasks: the procedures to be followed for repair tasks.
 - Preventive maintenance tasks: such as lubrication, cleaning, and replacement of parts, to prevent any potential issues from developing.
 - Predictive maintenance tasks: these involve using the data gathered by the drone to identify potential issues before they occur.
 - Safety procedures to minimize the risks associated with maintenance activities (using safety harnesses, ropes, or nets).
 - Data analysis procedures: The plan should specify how the data collected during inspections will be analyzed, including the identification of trends and patterns that could indicate potential issues.
 - Reporting procedures for any maintenance activities.
 - Budget and resources required for implementing the maintenance plan.

6.5 Step 4: Testing the Maintenance Plan (3 hours)

- Follow the process outlined in the maintenance plan to fly the drone through the workshop and collect information on the current state of the various machines.
- Complete the necessary documentation in the maintenance plan, including checklists, reports on breakdowns, and materials used.
- Analysis of the images captured on each machine looking for performance indicators to detect any abnormal patterns that could indicate an issue.
- Dumping of data into databases that will generate records and trends.

6.6 Step 6: Presentation of the Maintenance Plan to the workshop teachers (1/2 hour)

- The Maintenance Plan is presented to the mechanic workshop teachers, including an overview of the problem, the proposed solution using a drone equipped with a camera, and the different types of maintenance tasks included in the plan.
- The students will demonstrate the use of the drone to inspect the machinery and explain how the data collected will be used to identify potential issues and trends.
- The presentation will also include a joint assessment of the plan by the students and the workshop teachers, to ensure that the plan meets the requirements of the workshop and addresses the maintenance challenges they face.
- Based on the information gathered during the joint presentation and evaluation, the plan will be modified and improved accordingly. This may involve incorporating additional features, such as new sensors, into the drone to measure factors like overheating and vibrations.

7 Reflection, Feedback and scenario evaluation

To get valuable feedback on this scenario, we can implement a brief questionnaire, the answers to which will be a topic of discussion with students. The final evaluation must be correlated to the degree of student satisfaction with the results of the project, in combination with their initial assessments.

Indicative Questionnaire

1. In which team did you participate?
 - Team-1
 - Team-2
 - Team-3
 - Team-4

2. Do you think that this scenario enhanced your knowledge and skills?
 - Definitely
 - In most cases
 - Not sure
 - Not at all

3. Do you think that this scenario met your personal motivations/criteria?
 - Definitely
 - In most cases
 - Not sure
 - Not at all

4. Was there enough time to fulfil your goals?
 - Yes
 - No, I needed more time

5. What problems did you face and how did you overcome them?

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6. What did you like most?

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7. What did you like least?

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8. What would you suggest for the optimisation of the scenario and the process of its implementation?

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9. What would you like to be your next goal?

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8 Scenario expansion

This educational scenario can easily be the basis for expanding the educational process, as it is oriented towards principles and techniques that promote the dynamic development of the students.

Extrapolation of the Maintenance Plan to School Maintenance: the students, teachers and school staff could explore the possibility of extrapolating the plan to other areas of the school that require maintenance: plumbing and electrical issues, malfunctioning HVAC systems and damages to building structures. The use of a drone equipped with a camera can allow for the inspection of hard-to-reach areas and the captured data can help identify potential issues before they become serious problems. This approach can help reduce the risk of accidents and costly repairs and it can save time and resources by streamlining the maintenance process.

Integration of AI: The students could propose the integration of artificial intelligence algorithms to analyze the data collected by the drone and identify potential issues automatically. This would reduce the workload for the staff and increase the accuracy of the inspections.

Collaboration with industry: The students could collaborate with industry partners to develop a more comprehensive maintenance plan and gain insights into the latest technologies and techniques for equipment maintenance.

Maintenance training: The students could develop a training program for the workshop staff to teach them how to use the drone and interpret the data collected. This would ensure that the staff is fully equipped to carry out the maintenance plan effectively.

References

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