Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period:\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Project Packet: Designing a Better Airplane Surveillance System

Part I: Identify

**Driving Question:** How can you improve and validate a surveillance system to track airplanes?

On March 8, 2014, the Malaysia Airlines flight 370 went missing over the South China Sea. Could an improved surveillance system have prevented this issue? Your team are radar engineers who will propose an updated surveillance system in order to mitigate issues like the lost MH 370 flight and present your solution to a country in the region. Given a limited budget and information about your country, you will determine how many new towers to place as well as which sites to improve. You will also need to create a method to validate the success of your solution or model your solution using technology.

For your chosen region, you will present:

* An accurate map with improved surveillance system
* A list of all radar towers, existing and improved, and their locations, ranges, and equations
* An explanation for why your solution was the best possible (validate your solution!)

Because our customer is across the ocean, you will need to present your solution through a video.

**Assigned Region:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Budget:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Costs of Materials:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **S-band**  60 NM  \_\_\_\_\_\_ | **L-band**  160 NM  \_\_\_\_\_\_ | **L-band**  220 NM  \_\_\_\_\_\_ |
| Airport (Terminal Control Area [TCA]) | $6M | $7.5M  ($3M cost to upgrade) | -- |
| Land (not a major airport) | $8.5M | $10.5M  ($4M cost to upgrade) | -- |
| Sea (buoy-based) | -- | $18M | -- |
| Air (blimp/balloon) | -- | -- | $25.5M |

**Key Decisions in Mapping:**

Make sure you discuss these questions with your group before you start mapping, so that you are consistent in writing your equations of circles.

1. What units will you use? (circle one) Nautical miles / Statute (normal) miles / Kilometers

*Considerations: all of the radar ranges are in nautical miles, but the existing reference marks on your maps are in miles or kilometers.*

1. Where will you place your x- and y-axes on your map?

Part 2: Describe

1. Add a coordinate plane on your map based on the units and axes agreed upon by your team.
2. Identify all existing radar sites on the map. If the center of the circle is within your map area, include it.
3. In the table below, list their location, coordinates, range (radius in units of your choice), and equation.

**List of Existing Radar Sites:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Location (City)** | **Coordinates of Site** | **Range (\_\_\_)** | **Equation of Circle** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

**Questions to Consider about the Existing System:**

1. What areas of the map are already well-covered?
2. What areas of the map need the most improvement?
3. How will your team determine how good your solution is (a.k.a. validate your solution)? List the criteria you will use to measure and assess your solution. You should have at least 3 and up to 5.
   1. Criteria #1 (required):
   2. Criteria #2 (required):
   3. Criteria #3 (required):
   4. Criteria #4:
   5. Criteria #5:

Part 3: Generate

1. **Generate Concepts** - Each teammate creates a solution on their individual map.
   1. Decide which towers you want to improve or add. Draw these on your map.
   2. Use appropriate tools to draw your circles as accurately as possible.
   3. Keep track of the costs of each tower. Make sure your solution is within budget.
2. **Select a Concept** 
   1. Each person explains their solution and their thought process. While each person is explaining, the team writes down notes about each solution below.
      1. Solution #1 Comments:
      2. Solution #2 Comments:
      3. Solution #3 Comments:
   2. Based on the metrics decided upon by your team, rank each solution (1 = best). Add notes to help you track why you gave each solution a certain rank. Are there specific choices you liked about a particular solution? Can you mix and match solutions?

|  |  |  |  |
| --- | --- | --- | --- |
|  | Solution #1  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Solution #2  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Solution #3  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Criteria #1:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  |
| Criteria #2:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  |
| Criteria #3:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  |
| Criteria #4:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  |
| Criteria #5:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  |

* 1. Finally, write down a list of all the radar sites you want to improve or add based on the solutions your teammates designed.

|  |  |
| --- | --- |
| Locations to be Improved (and Range) | Locations to be Added (and Range) |
|  |  |

Part 4: Embody

1. On your final map, draw your improved surveillance system. Your solution can be one of your teammates’ or a combination of solutions you saw. Make sure the map is accurate and precise.
2. Track your list of radar sites and costs in the table below.

**List of Improved Radar Sites: (only include sites that you either improved or added)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **New or Improved?** | **Location (City)** | **Coordinates of Site** | **Range (\_\_\_)** | **Equation of Circle** | **Cost** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

**Total Cost:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Remaining Budget:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Part 5: Finalize

Create a video explaining your solution. Your video should include:

* What is the challenge?
* What did the existing system look like?
* What is your solution? Show the map and cost.
* Explain your solution. Why did you choose to improve or add sites? What was your reasoning?
* Explain why your solution is better than the original using the criteria your team selected.