

Robotics at Work in Precision Agriculture: Effective Operations, Useful Outcomes



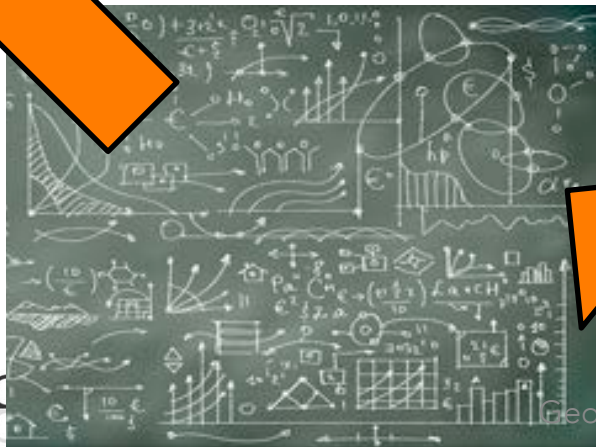
Garuda Robotics: Robotic solutions + Drone services Focused on SEA, based in Singapore



Agenda

- Share experiences
 - What have we done?
 - What have we learned?
- Workflows driven by frameworks
 - Data
 - Analytics
- Effective technological adoption
 - Real data + Real science = Real results

End-to-end Solutions





Analytics and Insights

- Automated analysis of captured images and videos to generate actionable insights
- Computer vision, machine learning techniques





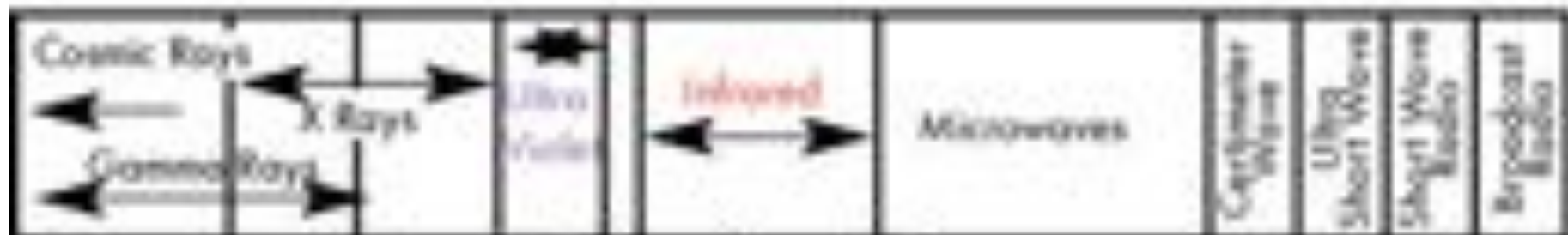
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Agriculture

- Crops of interest
 - Palm, sugarcane, rice
- Palm customer complaints
 - Labor problems
 - Extreme weather patterns
 - Depressed commodity prices
- Yields!
- Robotics technology adoption in early days
- Decision making at macro and micro levels must be based on solid data and analysis

LIGHT SPECTRUM



Wavelength (microns)

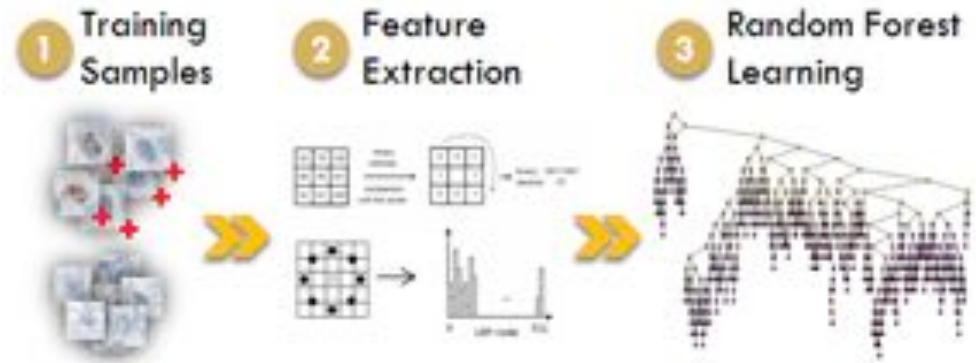
0.4 0.7 2.0 4.0 1000



Tree Counting



Positive training set



Negative training set



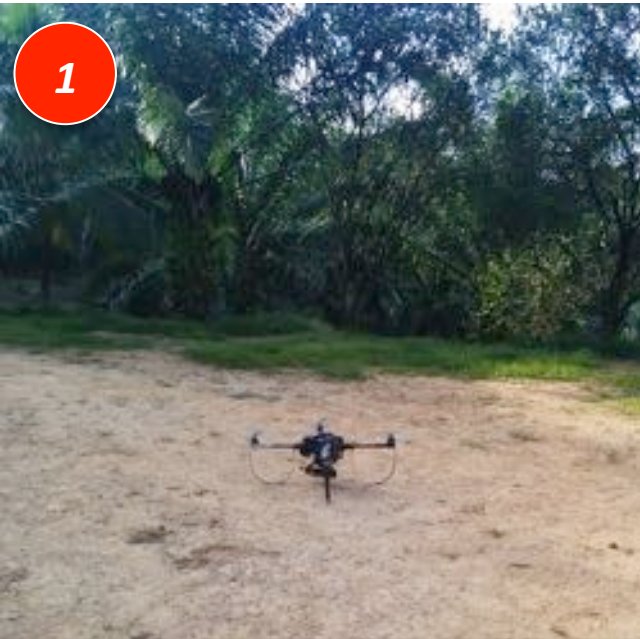
What Have We Learned?

- Running operations at scale is not trivial
- Quality of data is critical
 - Garbage in, garbage out
- Plenty of unsubstantiated theories floating around

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Our Data And Analytics Workflow



**Data Acquisition /
Generation**

**Data Storage /
Transportation**

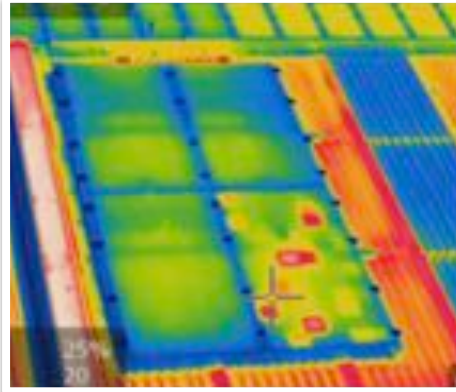
**Data Analytics /
Presentation**

Analytics Framework



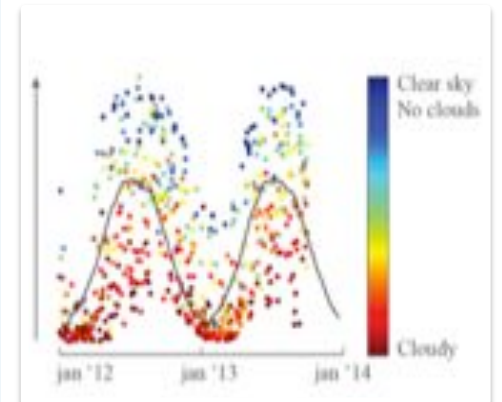
Descriptive Analytics

+



Predictive Analytics

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Prescriptive Analytics



Descriptive Analytics



Example: Telco Tower Inspection

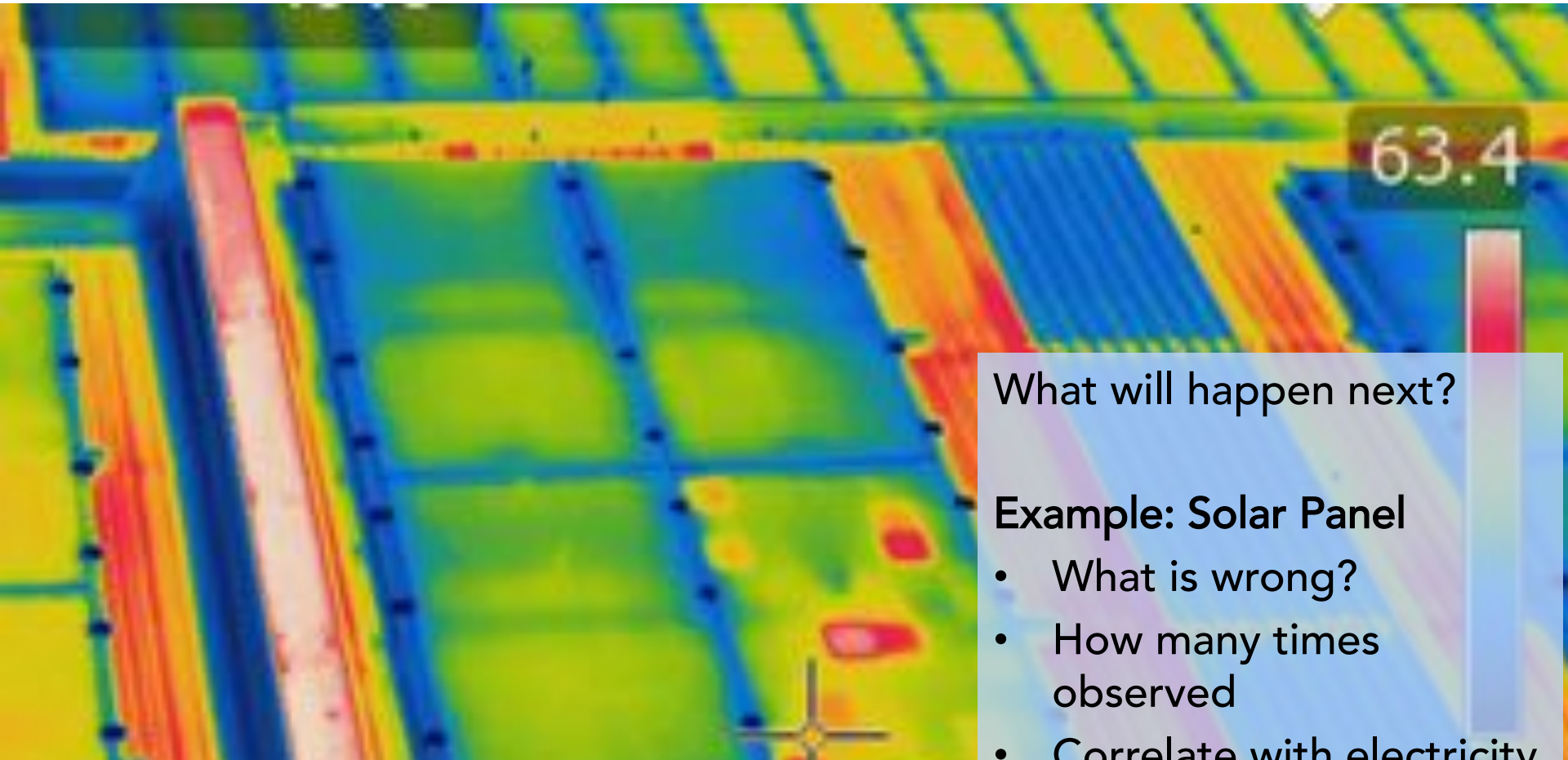
- Is the antenna still slanted at 2.8 degrees from vertical?
- Any disconnected wires, bird nest, damage from harsh weather?



Example: Flare Stack Inspection

- Is the structural integrity of the flare stack holding up?
- Is the flare stack operating at normal temperature?

Predictive Analytics



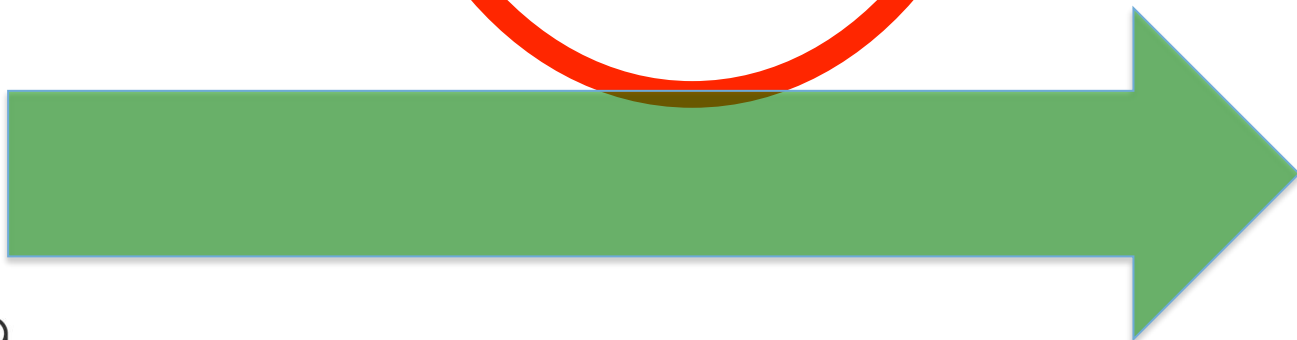
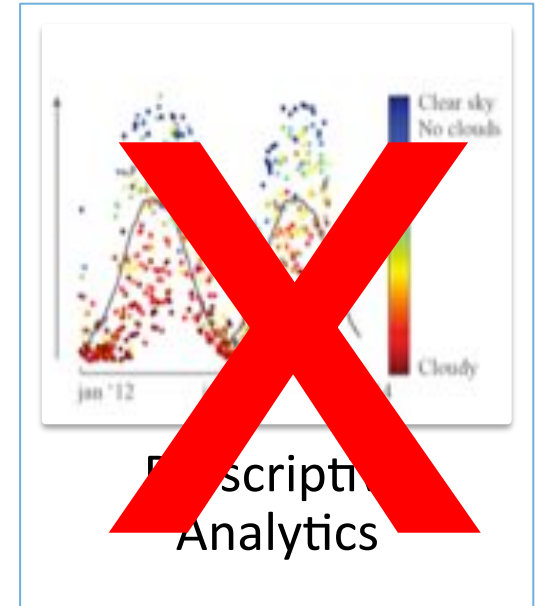
Analytics Framework



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Operationalize robotics technology effectively: Use the right framework

Validation (of hypotheses)



Integration (of datasets)



Modeling (of systems)

Prediction (of trends)



Recommendation (of interventions)

In Summary

- Drones will be very useful in agriculture
- But effective operationalization will require
 - Real problems
 - Large datasets from the ground
 - Scientifically grounded predictive models
 - Tight cycle of testing and iteration of prescriptive analytics

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Thank You!