LEARNINGS AND REFLECTIONS FROM PAST PROJECTS

AOSA/SCST Advanced Technology Forum
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Introduction

Implementing technologies is very exciting and can also be very frustrating.

In our lab, we have an automated planting line, x-ray machines and imagers for testing and sample preparation.

Some of these are built in-house and some are “off the shelf” technologies.

Understanding Lab Needs for a New Technology

- <u>Prior to beginning to shop for technologies and providers there is some needed self reflection prior to ensure a successful outcome</u>
- What is the problem the technology is going to solve?
- What is the targeted outcome?
  - Labor reduction/support
  - Elimination of ergonomic concerns
  - Better traceability, automated data collection
  - Increased sample volume
  - Increased efficiency
  - Cost savings
- Is your current process already as efficient/lean as it can be?
  - Do not try to automate an inefficient process
  - Over the course of the project, the inefficient process will improve, and your justification for automating will vanish
- What are the requirements from the lab of the technology?
  - Timing- time savings minimums
    - Time per test targets
  - Budget
  - Capability
  - Reduction of subjectivity
  - Is the target function associated with regulatory testing?
    - Are there additional associated requirements
  - Very important: all requirements are specific, measurable, and have a tolerance (+/-). No requirement is going to be guaranteed to happen or not happen. You can only be assured that it will be very unlikely to fail (think bell curve, is your requirement assured to 3σ = 99.7% chance to pass? Every further standard deviation of assurance means a more expensive solution. To cope, think about how detectable an error is downstream of the process to mitigate a failure).
- If this task is automated, are the processes upstream and downstream fast enough to support it?
  - Exercise a LEAN VSM (Value Stream Map) to fully understand your process bottlenecks and verify your needs
- Safety Requirements?
  - CE certified if you're in Europe
  - ANSI B11.0, B11.19, RIA15.06 if you're in the USA

Our Experience:
Automated Planting Line

- Use for planting corn germination tests
  - Internal testing and regulatory testing

Important Items:

- Number of seeds – 400
  - How do you know you planted 400?
- Media preparation consistency
- Pure seed planted- ensure seeds greater than ½ the original size criteria met
- Data required by the business:
  - Date of receiving
  - Date of planting
  - Forecasted date of evaluation

- Traceability of all important information
  - Media lot IDs
  - Tray IDs
  - Cart IDs
  - Room IDs
  - Incubation times

- When does the machine flag for over/under planting?
  - What happens if this occurs? Operator intervention procedure?

- Preplanning allowed for successful audit by the USDA

Unexpected questions

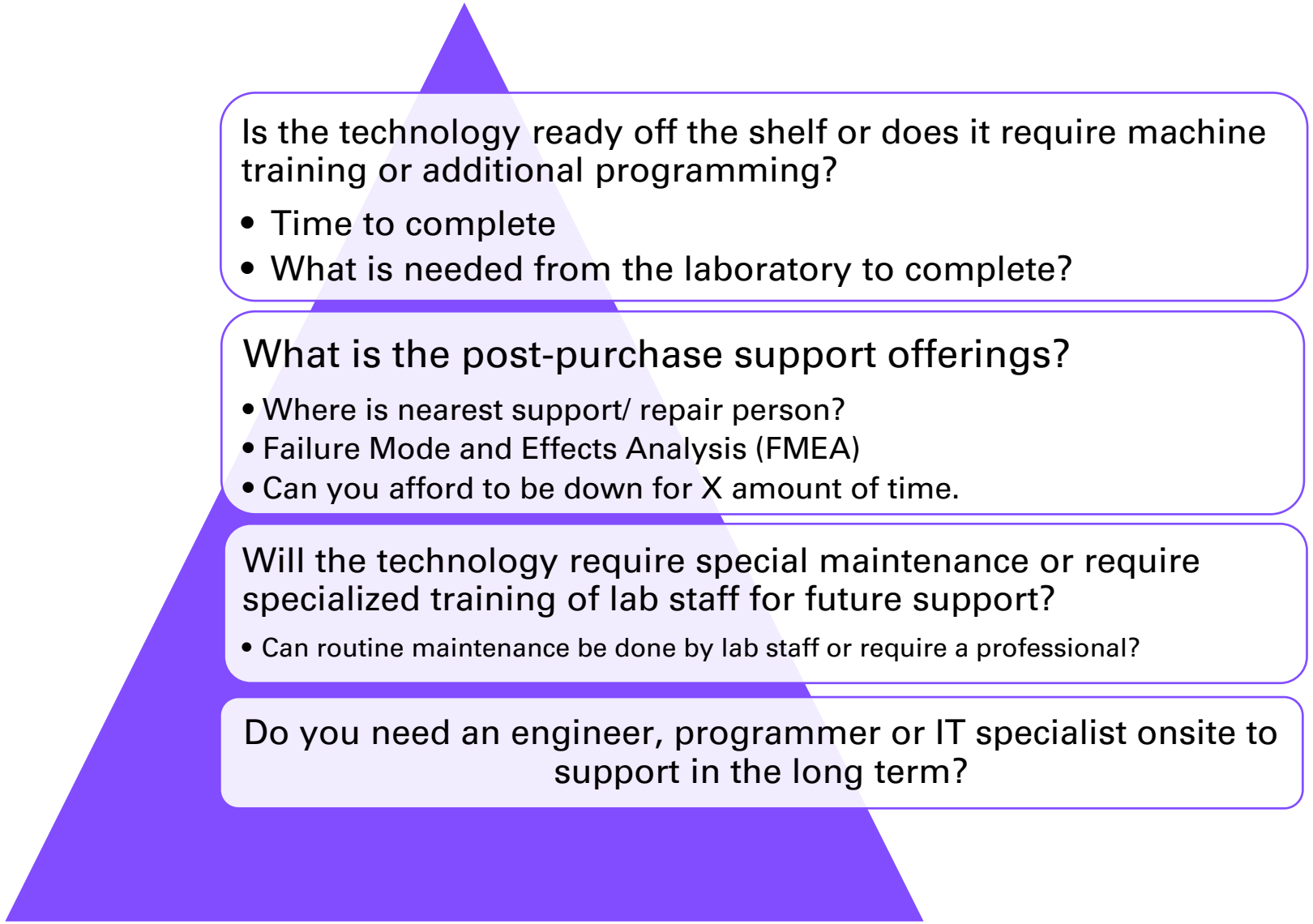
- <u>Some unexpected questions from engineers as the line was being developed:</u>

- What is the threshold?
  - Allowed over/ under
    - Water
    - # of seeds
    - Media temperatures

- Probable steps in the process to be prepared for
  - Upstream sample submission process
  - Upstream scheduling process
  - Downstream cart inventory identification

- Factory Acceptance Testing
- User Acceptance Testing

Selection Considerations



Is the technology ready off the shelf or does it require machine training or additional programming?

- Time to complete
- What is needed from the laboratory to complete?

What is the post-purchase support offerings?

- Where is nearest support/ repair person?
- Failure Mode and Effects Analysis (FMEA)
- Can you afford to be down for X amount of time.

Will the technology require special maintenance or require specialized training of lab staff for future support?

- Can routine maintenance be done by lab staff or require a professional?

Do you need an engineer, programmer or IT specialist onsite to support in the long term?

Example:
Your seed identifying technology finds a seed it can't identify.

What does it do?

- Identify gaps in the technology
- Ensure mitigating steps are in place
- LEAN: A3 Problem solving – problem, analysis, corrective actions, action plan

- In our line of business of testing naturally occurring elements, there is a lot of inherent variation.
- Achieving 100% development for all scenarios is difficult, expensive and realistically unlikely at this time.

This may be established through a culture of continuous improvement, driven by problem solving.

Implementation considerations

- Outputs
  - Usable format for data flow, is it efficient or usable
  - Where does it go?
    - Local storage or cloud
      - How to decide this: how fast does it have to go? Can you depend on your internet connection?
  - Is the new system compatible with your current data system?
  - How to bridge the systems?
    - Local upload of an excel format?
    - APIs, gateways?

Learning Example:

Data output as a PDF

- Needed a way to pull out the data into an excel or usable format to manage a large number of samples without having to record results on paper.
- Lesson learned: need upfront requirement that a database is used to capture data (SQL).
  - In our line of work, data capture is the most important element! Invest in it, don't let people handle data when you can avoid it. Let predictable automated processes (that cannot mistype a key) do the data handling for you.

Validation Plan

Study to ensure seed general appearance by imaging was far more repeatable than human ratings

- The strategy for validation depends on what the technology

- Is there any documented recommendations from any organization?

At this time there is not clear validation requirements or guidelines by any organization

This is likely to be established in the next few years

Studies are likely to vary greatly depending on the technology and topic/ test

In the case of the APL- we referenced the ISTA planting protocol to ensure the machine was not selecting seed by size or shape

Studies should ensure that they are statistically sound and an appropriate number of samples are used to ensure robustness of data

The study is designed to verify the technology supports the reliable and repeatable results and the expected outcomes

We did it! What's next?

- Nice thing about automation: it will reliably make the same mistakes, over and over, and will never change until acted upon.
- Operational Efficiency (OEE%)
  - Availability % - how often is the equipment running and not broken down
  - Performance % - if it's not stopped, how fast is it going compared to what it was designed for?
  - Quality % - defect-free output
  - OEE = Availability x Performance x Quality
    - World Class: 85%
    - APL today: 50%
- There is a chance you might miss your target but it won't be a total loss. Automated data collection solutions monitoring performance will allow you to identify improvement opportunities and quantify performance improvements.

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THANK YOU

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