AUSTRALIAN DEFENCE FORCE

Considerations for EO manufactured by novel technology to enable effective in-service management

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History behind topic

- Topic originated as an Australian TQ to MSIAC
  - *Novel Manufacturing technologies; what needs to be considered to ensure that when items go into service they can be managed effectively?*
  - *Given the somewhat disruptive nature of these technologies, what do they mean for some of our traditional stock management philosophies?*
- There is no simple solution, novel things are novel…

Presentation scope

- Novel manufacturing technologies: what and why?
- What's the problem?
- Key in-service management aspects
  - The intent
  - The issue
  - Possibilities
- Potential opportunities
- What can you do?

Intent of this presentation

- Leave with a baseline understanding of the issues
- Look for solutions or improvements
- Whilst revisiting the basics, look for opportunities to improve current in-service management

Novel EO Manufacturing Technologies

- What are they?
  - Any new manufacturing process to produce EM, assembly, or AUR
  - May be a new technology, or exploited from another industry
- Why?
- Current examples
  - RAM (either EM or mix-in-case)
  - Continuous-flow chemistry
  - Additive manufacturing

What is the problem?

- Historically, manufacturing technology evolved slowly, management methods could evolve
- Recent significant increase in novel processes, and current climate will likely drive this to continue
- Disruptive nature: traditional management may not be relevant in some cases
- Novel processes are things we need to get after, but we need to understand the issues

In-Service Management

- Good in-service management stems from good introduction to service
- Key aspects:
  - Qualification
  - First Article Test
  - Commissioning/re-commissioning production lines
  - Lotting & batching
  - ISS & MHM
  - Management responses to incidents

Qualification

Two types - Material and Final/Type Qualification

For Material Qualification, you need to identify:

- characteristics of the material, including after possible degradation due to ageing and the service environment

What does this have to do with novel processes?

Qualification

The process can change the properties, thus the failure modes

- E.g. RAM vs conventional mixing:
  - No high-shear forces (larger particles)
  - Faster mix (less time for chemical reactions)

The trigger for re-qualifying (what makes it a ‘new’ material)

‘Where there is a change to… the manufacturing process... it should not be assumed that the original judgement remains valid; partial or whole requalification may be required’ - STANAG 4170

First Article Test

- Purpose: test to ensure that a manufactured product meets contracted specifications
- For novel processes, do we still need it?
- Yes, but should focus on production reliability.

Commissioning / Re-commissioning Production Lines

- Purpose: Testing, following an extended cessation of production, that a previously furnished item meets the contracted specifications
- Trigger: ‘extended cessation of production’…
- What is the nature of the novel process? Is each instance of it ‘independently reliable’?

Lotting

- Definitions vary between NATO/US/UK
- Intent
  - Group items produced under common conditions, and therefore expected to have common performance & safety characteristics
  - Provide traceability of its origin(s), aiding investigation if required
- Trigger: varies…

Lotting

U.S. – MIL-STD-1168 (Lot Numbering)

- Lot identifies ‘homogeneous’ material, which is said to exist when it has been produced
  - by **one manufacturing** activity
  - In one unchanged processed
  - Under **stable conditions** of production
  - IAW the same drawings and specs
- Trigger guidance:
  - Administrative (time or quantity based)
  - Technical (Interruption >90 days, cessation of homogeneity)
  - Separated in the best interests of the Government…

Lotting (…and Batching)

U.K. – DEF-STAN 13-96-1168 (Lotting & Batching)

- *A discrete quantity of ammunition or components that is:*
  - *as homogeneous **as possible,** and*
  - *under **similar** conditions **may** be expected to give uniform performance*
- Lotting component: Lots
- Governing component: Batches
- Secondary governing component: Sub-batches

Lotting

How should we do it for novel manufacturing processes?

- It depends
- Example: RAM
  - mix-in-case, 1 item = 1 Lot?
  - 1 batch to fill multiple items = 1 Lot?
  - Future continuous RAM, ingredients from common batches = 1 Lot?
- Example: Continuous Flow
  - Production within an ‘envelope’ = 1 Lot?
    - Could items produced under different instances of the same envelope be combined into 1 Lot?

In-Service Surveillance

- Intent: AOP-62 (ISS of Munitions – General Guidance)
  - *'Provide information required to ensure that munitions remain safe, reliable and perform correctly throughout the period of their intended life'*
- How, and with what information?
  - Program informed by qualification and S3 testing
  - Failure mode must be known, and need measurable degradation
- Impact for novel processes
  - <u>What are the new failure modes?</u>
  - Likely increased initial testing, with potential to reduce over time

Munition Health Management

- Intent: AOP-4488 (NATO MHM Handbook)
  - ‘An intelligent process to capture and analyse data regarding real exposure of munitions to lifecycle threats in order to optimize the assessment of their remaining safe life with a view to achieving improved safety, reduced cost and sustained capability’

- Relevant?
  - Always

Looking forward

- Should we be driven by definition, or intent?
- What is the impact of the novel process?
- Can we deal with certain risks by assigning short lives with a view to extend following adequate ISS?
- Can data should we capture to enable future analysis?

Potential opportunities

- ‘Big data’
  - Record everything we can
  - Inform smart decisions
  - Risk less

- Dynamic Lotting
  - Data-driven re-assigning

What can you do?

- **Be curious**
- Understand your novel process
- Understand the intent of in-service management aspects
- Understand the impact of your novel process
- Discuss it with others who will have a different perspective

Talk to the friendly DOS team

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Questions ?