# Mastering AVI

Part 8: Operation and Maintenance
of Automated Inspection Systems

• First line maintenance concept
• Preventive / Predictive /Corrective maintenance
• Holistic maintenance
• Obsolescence management

Instructor Lead: Romain Veillon / Fernand Koert / Sébastien Koch

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## The goal of Maintenance

1. During building of the URS a risk assessment should have taken place, so FMEA critical functions should have been addressed

2. This must be the bases for maintenance
   - Maintenance is not only checking for wear and greasing
   - The goal is to preserve the mechanical/electrical state of the machine as was during the initial validation.

3. In fact, you preserve the baseline, otherwise you cannot guarantee equality in visual inspection after
- Machine errors
- Breakdown of mechanical parts
- Breakdown of electrical parts
- Worn-out of light sources
- Camera malfunction

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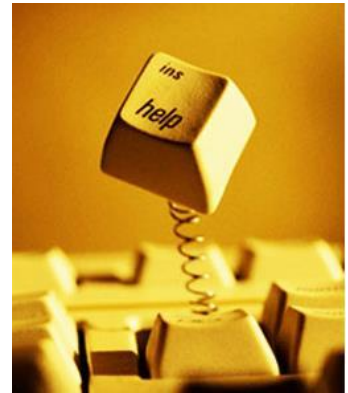
## Tooling

You need tools for a regular check and decision making

1.  Tooling to adjust electrical and mechanical zero point

2.  Calibration tools
    - Focus of depth and aperture of cameras
    - Light intensity light sources. LEDs will loose brightness in time and you need to define when to exchange

3.  Alignment tools
    - To check for unbalanced grippers or vial holders
    - To align star wheels and other transport parts

The mechanical impact on vision is huge

- Not well aligned creates crashes, product spills
- Unbalanced grippers or holders generate false ejects
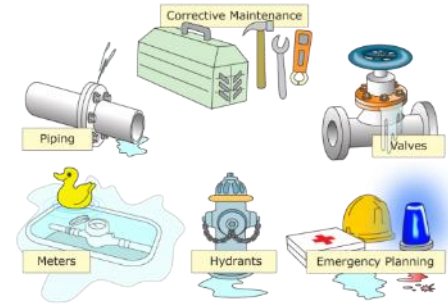
## Types of Maintenance

Corrective maintenance

- You act when something breaks down

- Not completely unavoidable

- Disadvantage: uncontrollable downtime



PM Preventive maintenance

- You act before something breaks down

- You periodically exchange parts

- You analyze and learn. It's a cycle

- An annual schedule of daily, weekly, monthly, quarterly and yearly task to perform

- First Line Maintenance should be part of this

- Disadvantage: you may exchange wear parts to soon and thus extra costs

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PDM Predictive maintenance

- You act when the information gathered signals it's time

- You collect this information during production with minimal production loss

Examples

- Statistically Inline monitoring of the eject rate per gripper

- Statistically Inline monitoring of the LED brightness

Plan

Standard

Execute

Improve

Report

Analyze

Maintenance
Lifecycle
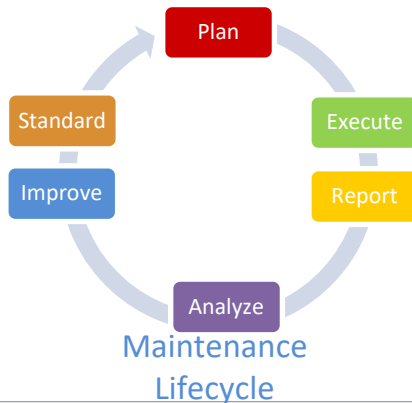
Best Practice

- A combination of PM and PDM

- PM has some PDM elements
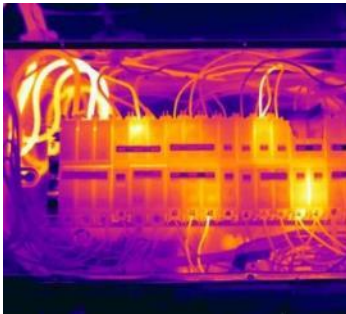
- They form the maintenance lifecycle

## Area of Maintenance

- A multi disciplinal multi departmental combined effort

- Mechanic
- Electric
- Computer(management)
- Vision

Electrical

- Often seen as reliable and neglected
- The quality and reliability of electronics, sensors, PLCs etc. are very high nowadays
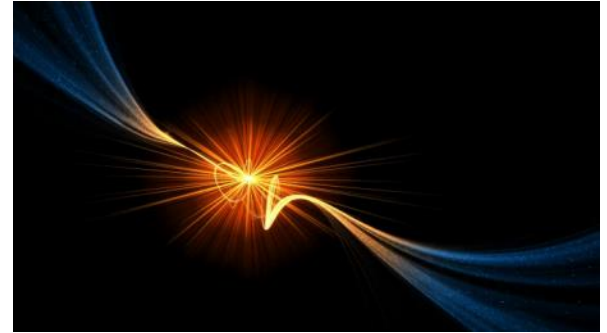


- Wiring is the Achilles

- Infrared measurements in the cabinet gives information
- But only for high current, a few percentage of the whole

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Low current wiring

- Faulty contacts generate sparks

- Very difficult to find

- Brings your AVI in unpredictable state

  - PLC programs rely on sensor and state information
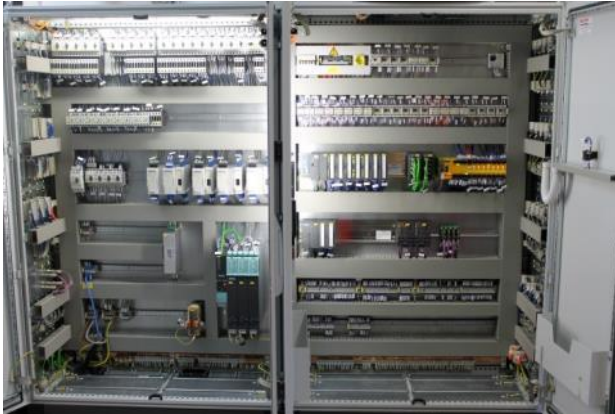




- Not everything in the design is failsafe
  - A sensor should generate an error if malfunctioning
  - or If the cable is broken

- The preventive measure can only be checking the clamps in cabinets and connection boxes annually

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Modern AVI will use Intel processors to communicate with the users and organization

- Very often using the Windows operating system

- Temporary information is stored on the hard drive at huge amount

- Defect images for later usage etc. and often not removed
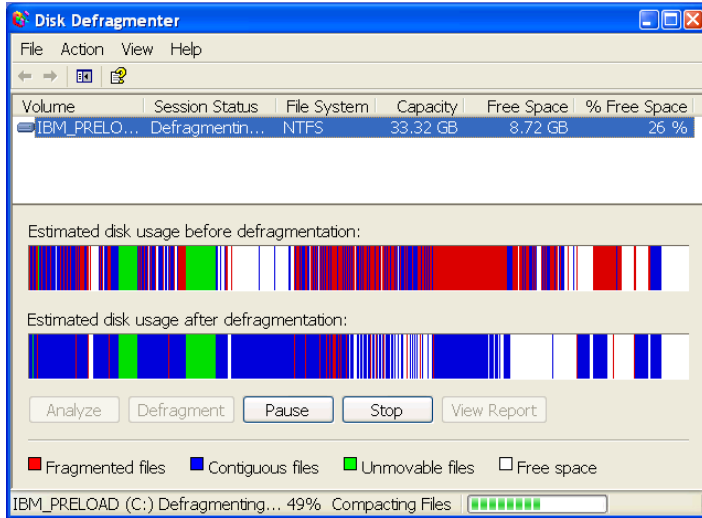


- What's important: frequent back-up

- What's not important: frequent clean-up

- Although the NTFS file system is more stable: Fragmentation will take place and could slow down the overall performance

- In short: don't neglect. It also needs a frequent overhaul

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In short

OF LIMITS

Small unwanted changes will have huge effect

- Camera position, diaphragm, aperture

- Position LEDs, especially front light

- You can DIY, but you need special trained staff

- Depending on machine configuration cleaning is possible

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Maintenance is not just another department it should be embedded

- Create ownership

And not

- I hear a strange sound in my machine

- Well, not my problem



The machine operator stands closes to AVI

- They are the ears and eyes of maintenance

- The first that should signal that something is not in order

- Unexpected machine errors and more frequent

- Involvement by feeling they are owner

- A simple way to achieve this is First Line Maintenance

# First Line Maintenance
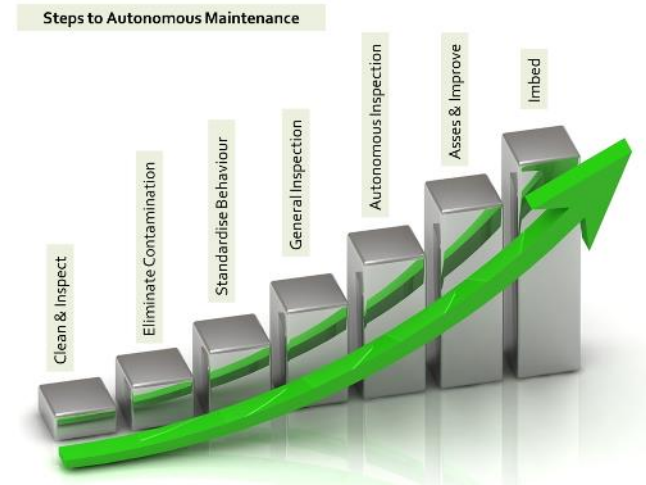
Simple tasks that operators can be thought

- Cleaning and greasing if applicable
- Checking wear and tear parts that are visible
- Exchanging replacement parts like computer filters
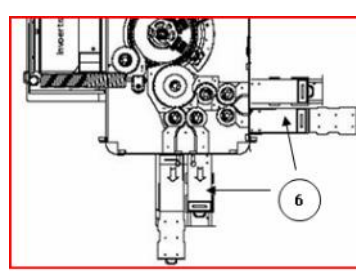- Testing the validated state with one or more test kits

Tasks that are split in
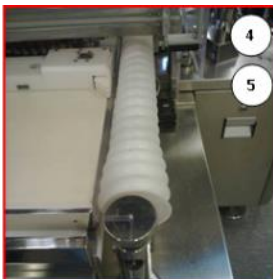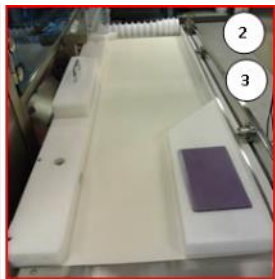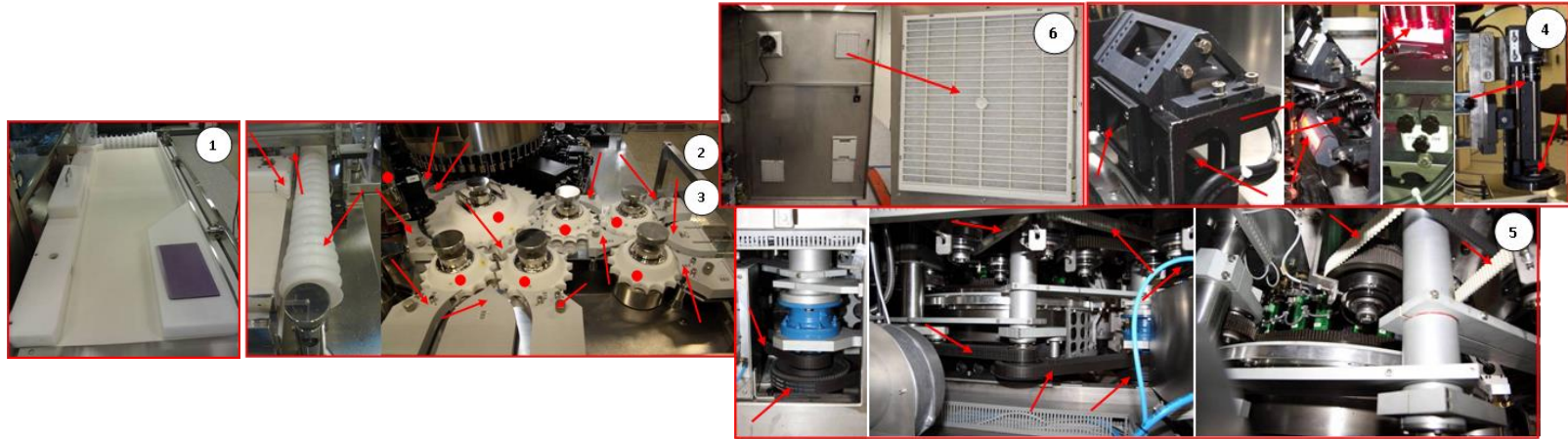
- daily
- weekly
- monthly

By means of

- illustrations
- checklists



**Steps to Autonomous Maintenance**

Clean & Inspect · Eliminate Contamination · Standardise Behaviour · General Inspection · Autonomous Inspection · Asses & Improve · Imbed

| Item No. | Area | Method | Criteria | Frequency | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Per shift | daily | weekly | monthly | Time |
| 1. | General | a. Vacuuming machine , clean with ammonia solution followed by alcohol. Plexiglas only with soap solution!! <br> b. Line tidy and clean <br> c. Replace vacuum cleaner bags. <br> **Combine this with a format change** | *Free from product and dust and everything that does not functional belong* | | | + | | 60 |
| 2. | Intake belt | Clean with alcohol solution | *Free from product, dust and other dirt* | | | + | | 10 |
| 3. | Intake belt | Crease with silicon oil. Rub the belt with a light with silicon oil wetted cloth and rub dry afterwards. | *Dry and smooth. To do every two pallets* | + | | | | 5 |
| 4. | Intake worm | Clean with ammonia solution followed by alcohol. | *Free from product, dust and other dirt* | | + | + | | 5 |
| 5. | Intake worm | Crease with silicon oil. Rub the worm with a light with silicon oil wetted cloth and rub dry afterwards | *Dry and smooth. To do every two pallets* | + | | | | 5 |
| 6. | Outlet trays | Clean with ammonia solution followed by alcohol. | *Free from product, dust and other dirt* | | + | | | 5 |
| 7. | Starwheels and guiding | Clean with ammonia solution followed by alcohol. | *Free from product, dust and other dirt. Formatparts may only returned in the cupboard clean!* | | + | + | | 5 / 15 |

| Item No. | Area | Method | Criteria | Frequency | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Per shift | daily | weekly | monthly | Time |
| 1. | Intake Belt | Check on damages | No tears or fraying | | | + | | 5 |
| 2. | Starwheel and Worm | Visual inspection on damages and dirt on/in the vacuum channels | *No failing pieces of plastic and these channels are open* | | | + | | 10 |
| 3. | Guidances | Visual inspection on damages | *Undamaged and no missing plastic pieces* | | | + | | 2 |
| 4. | Lenses, mirror, prisms | Visual inspection of the surface | No dirt, dust and scratches | | | + | | 5 |
| 5. | Drive | Visual inspection on drive belts, in doubt warn TS | *Drive belts have the right tension and no tears* | | | + | | 5 |
| 6. | Cabinet | Visual inspection on filter. 4 pieces. If necessary, clean | *Free of dirt and dust* | | | + | | 5 |

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# ◀◀ RECAP

**QUIZ**

**You have learnt**
**Maintenance**
- FMEA critical functions are the basis for maintenance
- tools for a regular check and decision making
- Corrective, preventive and predictive maintenance
- The area of maintenance
- What normally is of limits
- Ownership and first line maintenance

**Maintenance**
- What's the goal of maintenance
- Which maintenance methods should preferably be combined
- Why is ownership important