

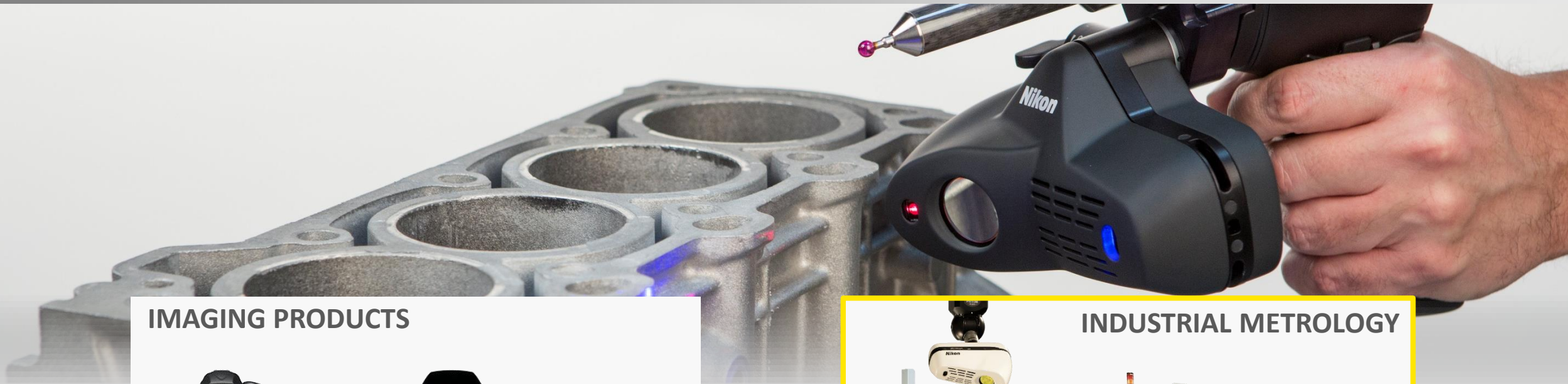
## Automation of CT Imaging Chris Price

IBFEM-4i Event, Swansea

# Introduction to Nikon Metrology



- **Founded in 1917**
- **25,000 employees worldwide**
- **Nikon Metrology**  
Industrial Metrology Division  
HQ in Leuven, Belgium



## IMAGING PRODUCTS



## INDUSTRIAL METROLOGY



## SEMICONDUCTOR / LITHOGRAPHY SYSTEMS



## HEALTHCARE

1986 founding of X-Tek Systems

2009 X-Tek becomes part of Nikon

2019 over 3,000 X-ray/CT systems installed

**TARGET LOCK:**  
*IMPORTANT: Read Before Use*  
Lock Must be disengaged Before Target can be Rotated.

**To Unlock Target:**

- Remove shield, turn key clockwise until it becomes free.
- Insert key into target until it mates with lock.
- Turn key 1 turn counter clockwise.
- Rotate target to new position.

**To Re-Lock Target:**

- With key engaged in lock, turn key clockwise and tighten.
- Pull key out of lock as far as possible.
- Turn key counter clockwise until it tightens. Refit shield.

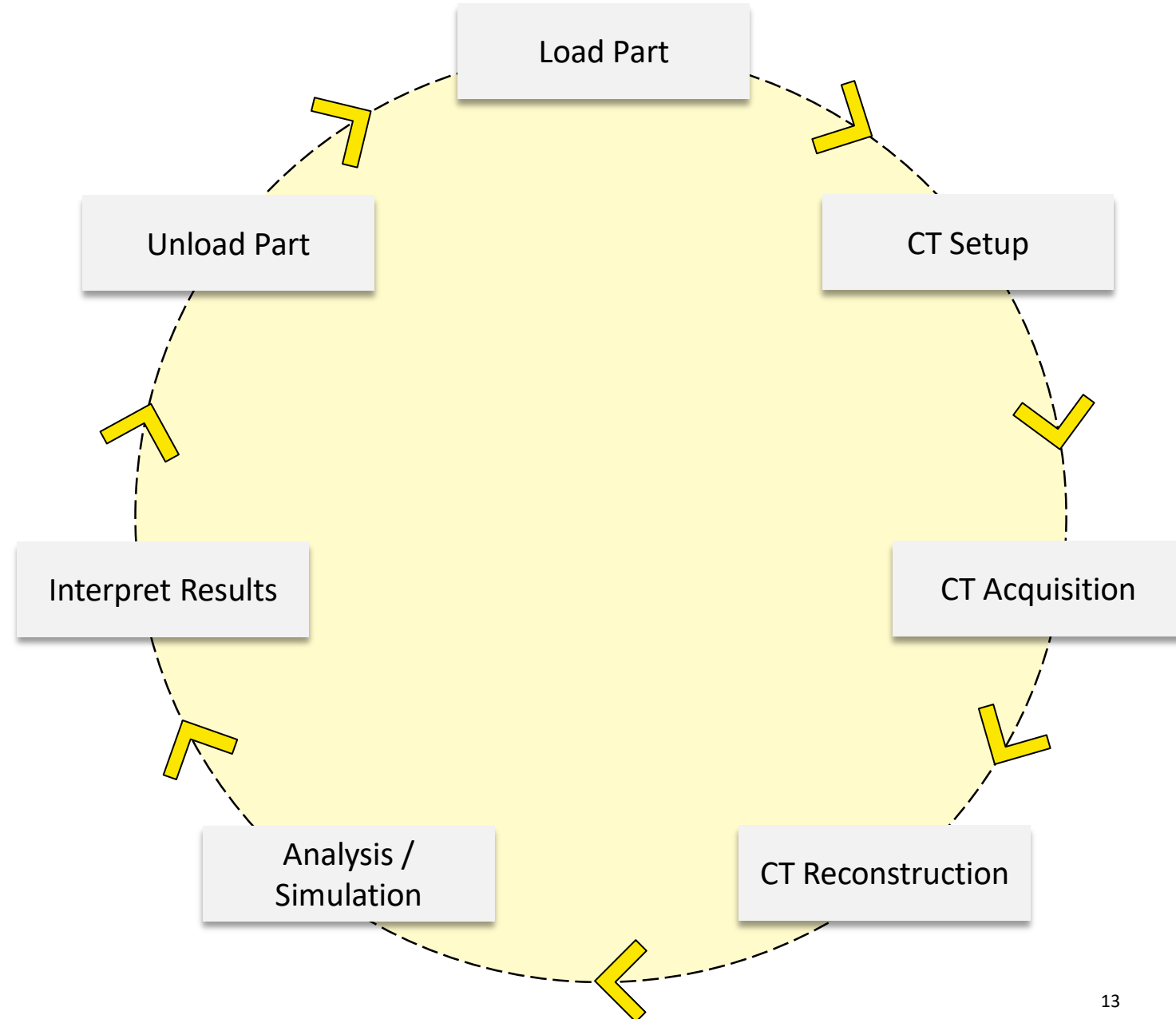
**IMPORTANT:**  
Target module will not function correctly if target is not locked, or if the key is left mated with the lock.

PERIODIC T-RADIATION  
CHECK REQUIRED

Over 30 years design & manufacture

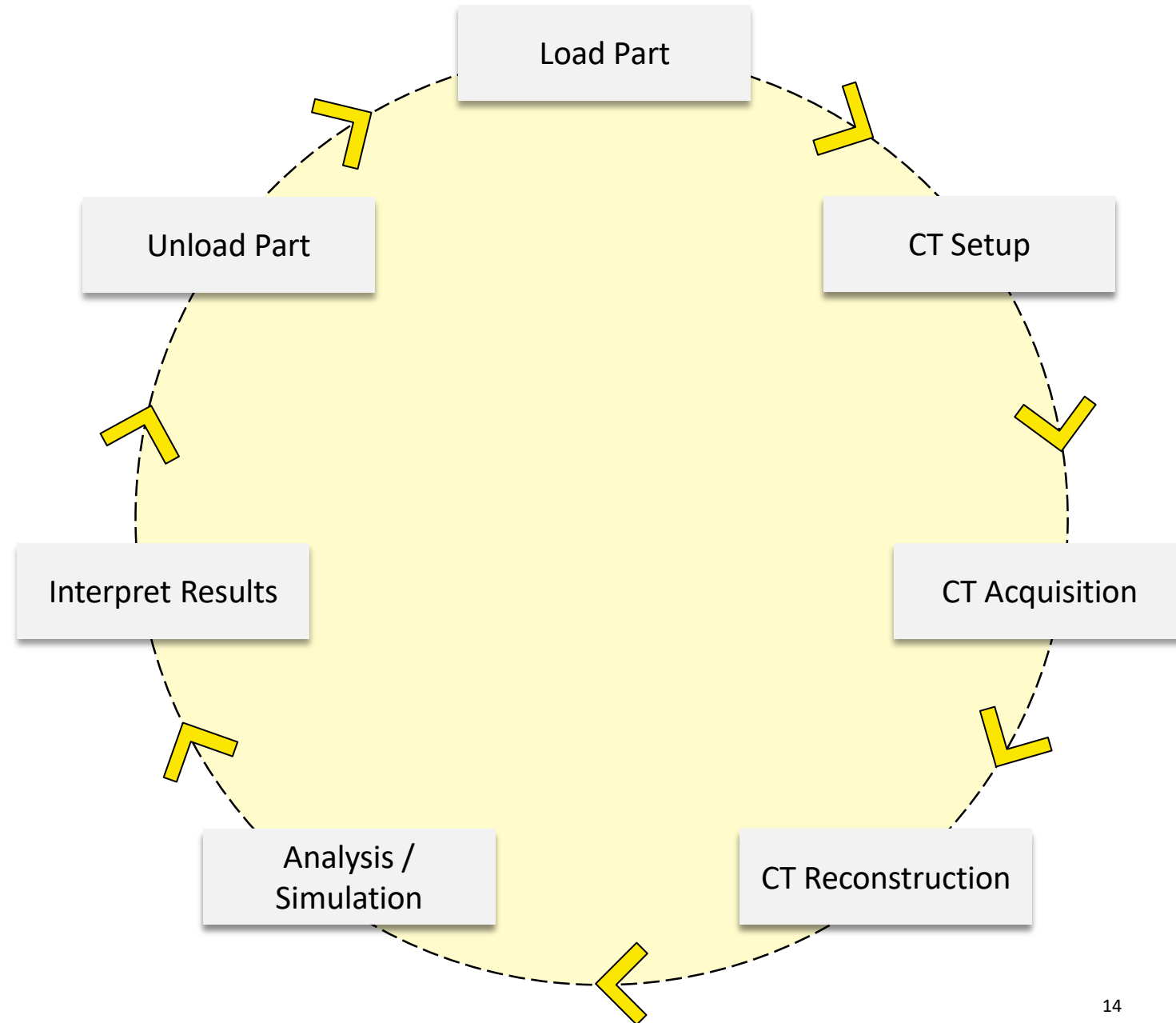
# The CT Scan Process

- Multiple steps, performed by an operator sequentially
- Great for research and low-volume inspection, but inefficient for production and high-volume work
- The more steps we can automate, the more efficient it is



Inspect-X software provides inbuilt automation tools:

- CT Profiles save scan parameters per sample
  - No scan setup required
- CT reconstruction parameters saved to CT profiles
  - Automatic reconstruction
- Volume Graphics macros linked to CT profiles
  - Automatic analysis





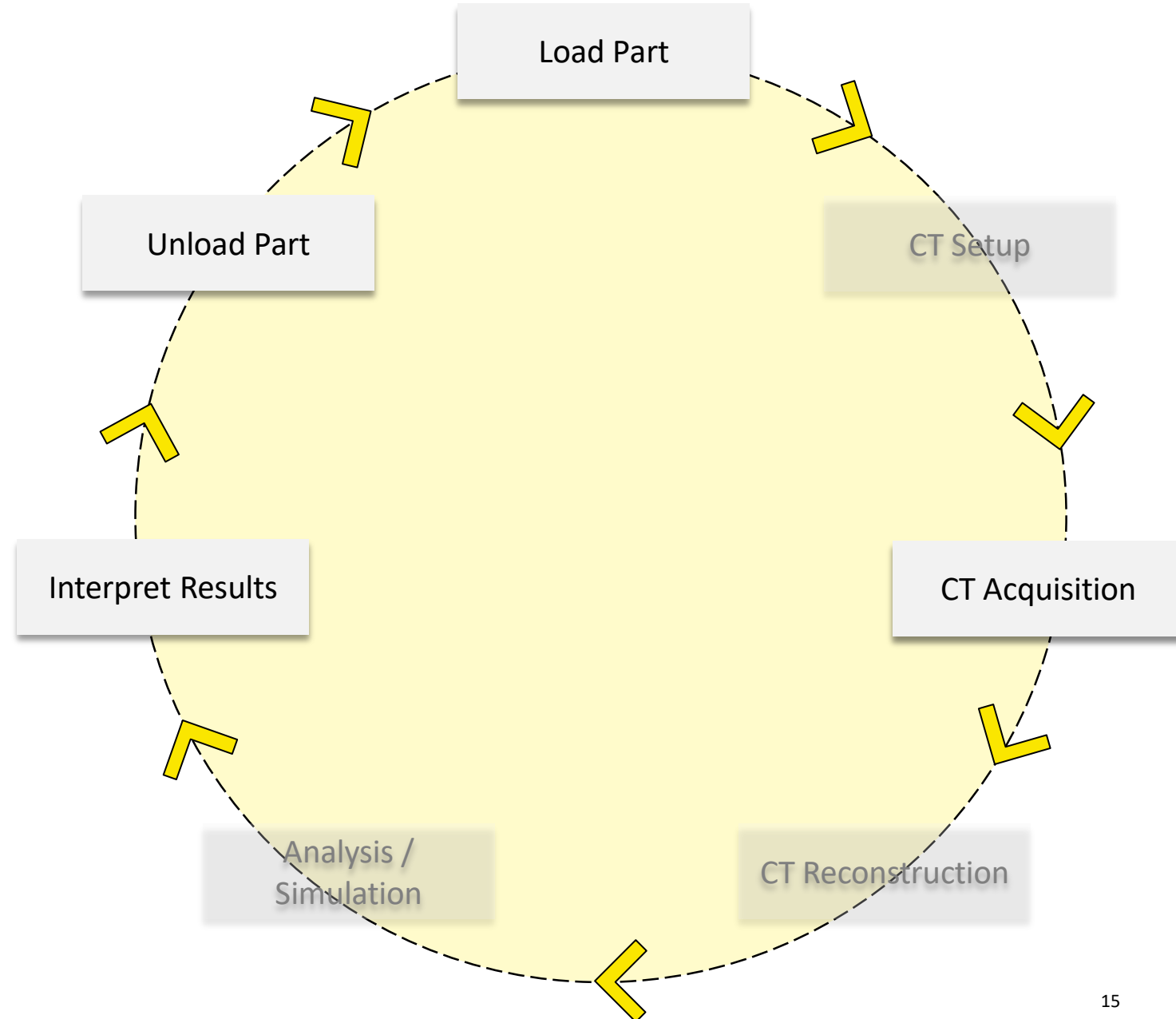
Inspect-X also includes GUI-based Programs:

- Set of CT scans added to a batch
  - Automated acquisition

The only remaining operator tasks:

- Loading and unloading parts
- Interpreting results

**How can we automate this further?**



# Inspect-X IPC Interface

All Nikon Metrology X-ray systems use Inspect-X.  
This includes the Inspect-X **IPC interface**.

The Inspect-X IPC interface:

- Provides two-way communication between Inspect-X and custom applications
- Presents both high-level and low-level access to the X-ray system

## IPC Communication Channels

Application

Inspection  
Inspection 2D  
CT 3D Scan  
CT 2D Scan

X-rays  
Manipulator  
Image Processing

## IPC Communication Channels

### *High-level control*

Allows InspectX to take care of controlling complex functions.

- “Run a 3DCT scan with this profile”
- “Run this inspection program”

Application

Inspection  
Inspection 2D  
CT 3D Scan  
CT 2D Scan

X-rays  
Manipulator  
Image Processing

## ***Low-level control***

Allows full control of each subsystem.

- “Set X-rays to 430kV 100 $\mu$ A”
- “Move Y-axis to 350mm”
- “Set exposure to 500ms”
- “Acquire 4 frames and save image”

## IPC Communication Channels

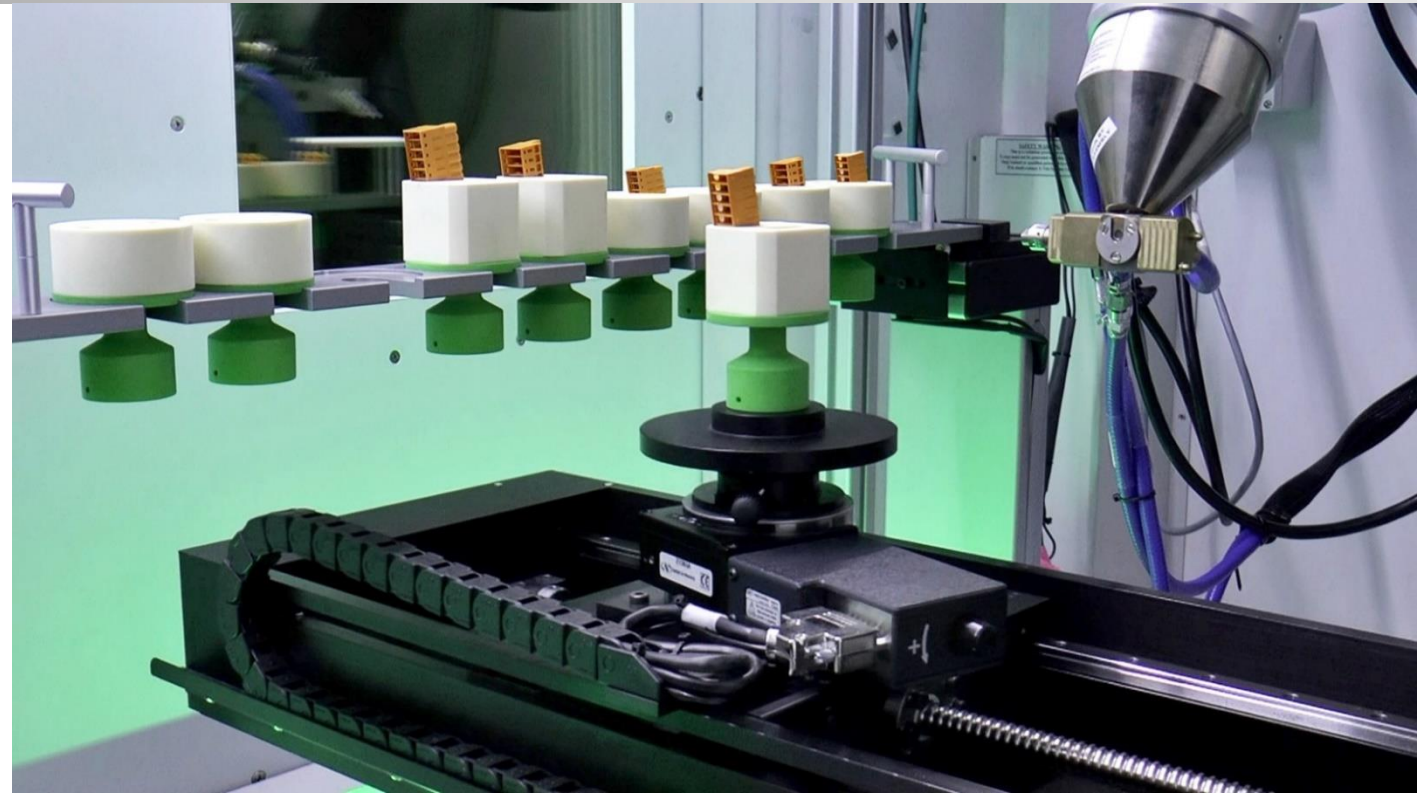
Application

Inspection  
Inspection 2D  
CT 3D Scan  
CT 2D Scan

X-rays  
Manipulator  
Image Processing

# IPC Interface Application: Autoloader

1. Racks are filled with samples at loading station
2. One or more racks are placed into the system by the operator
3. Each sample is scanned in turn, with scan and analysis conditions determined from identifying information



- Allows sample loading/unloading to be parallelised with scanning for high-throughput environments
- Allows zero-intervention batches for samples requiring long scan times

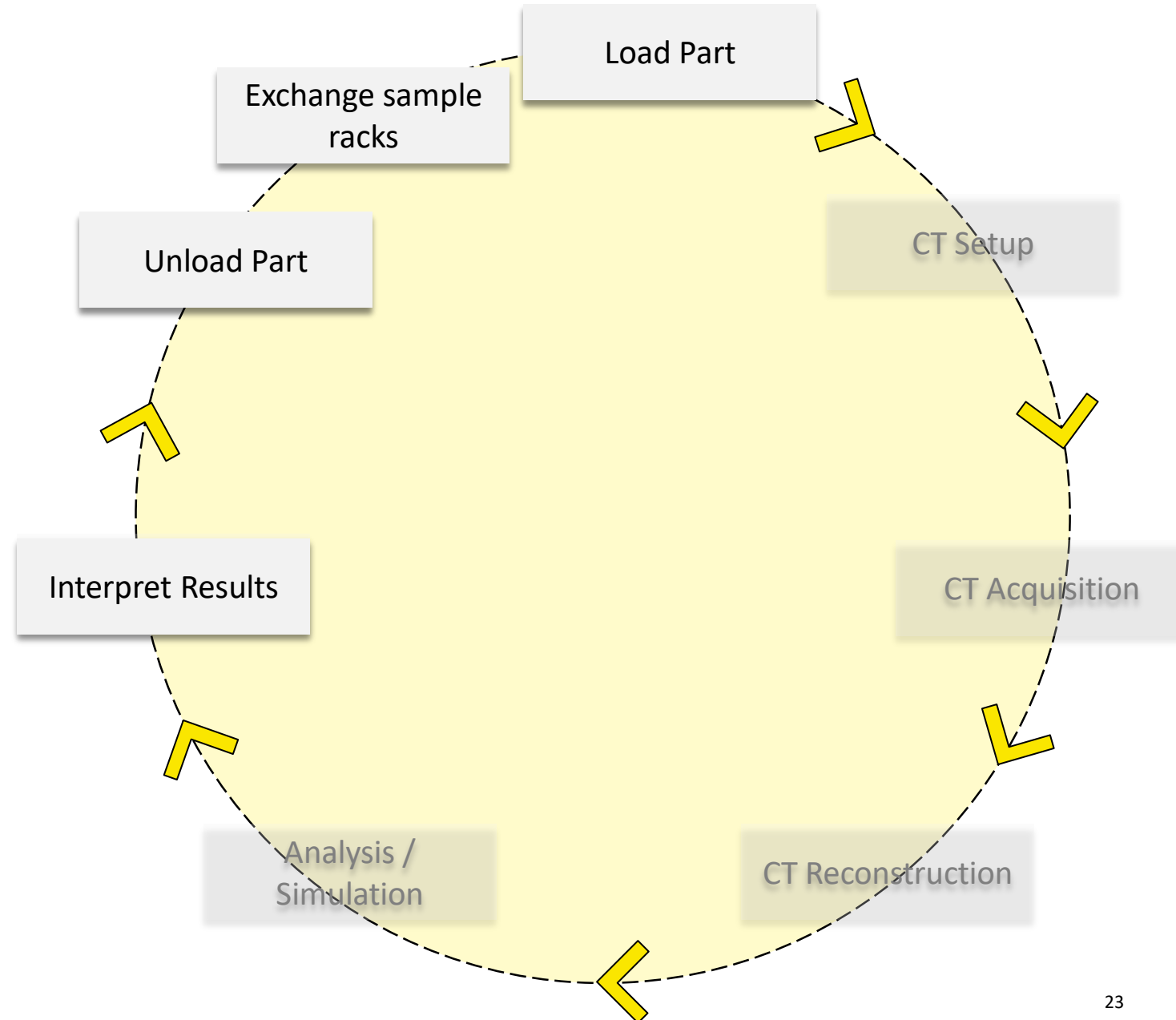






- Per-part load and unload actions are combined to a rack exchange
- Operator interaction is significantly reduced to a minimum
- Interpretation of results can be done in parallel with scanning or offline

**The only operator step that remains is to exchange sample racks**



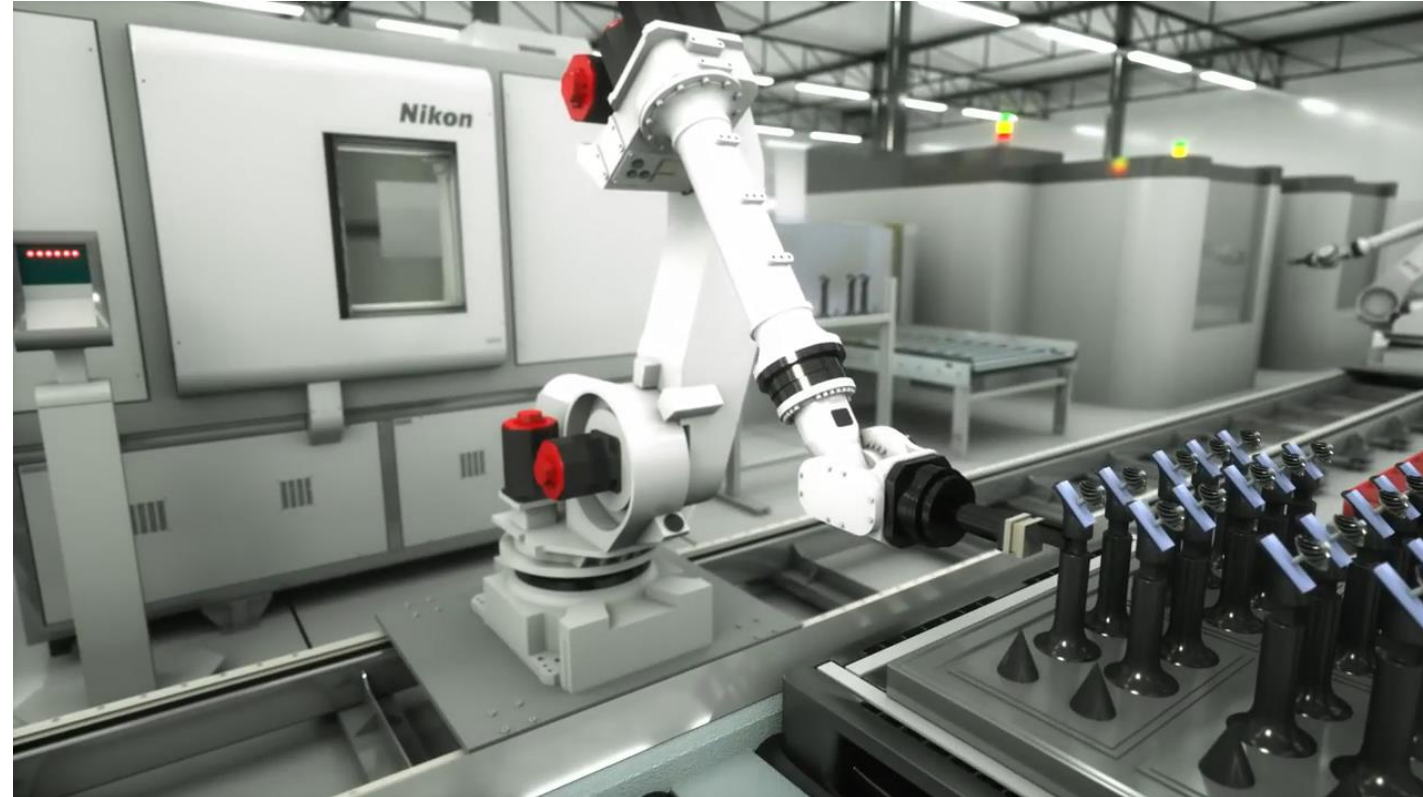
# IPC Interface Application: Robot-loading

Applications written for the Inspect-X IPC interface can interact with third party systems.

This includes:

- Robot arms
- Barcode/RFID scanners
- Production processes

➤ Integration with other automated processes



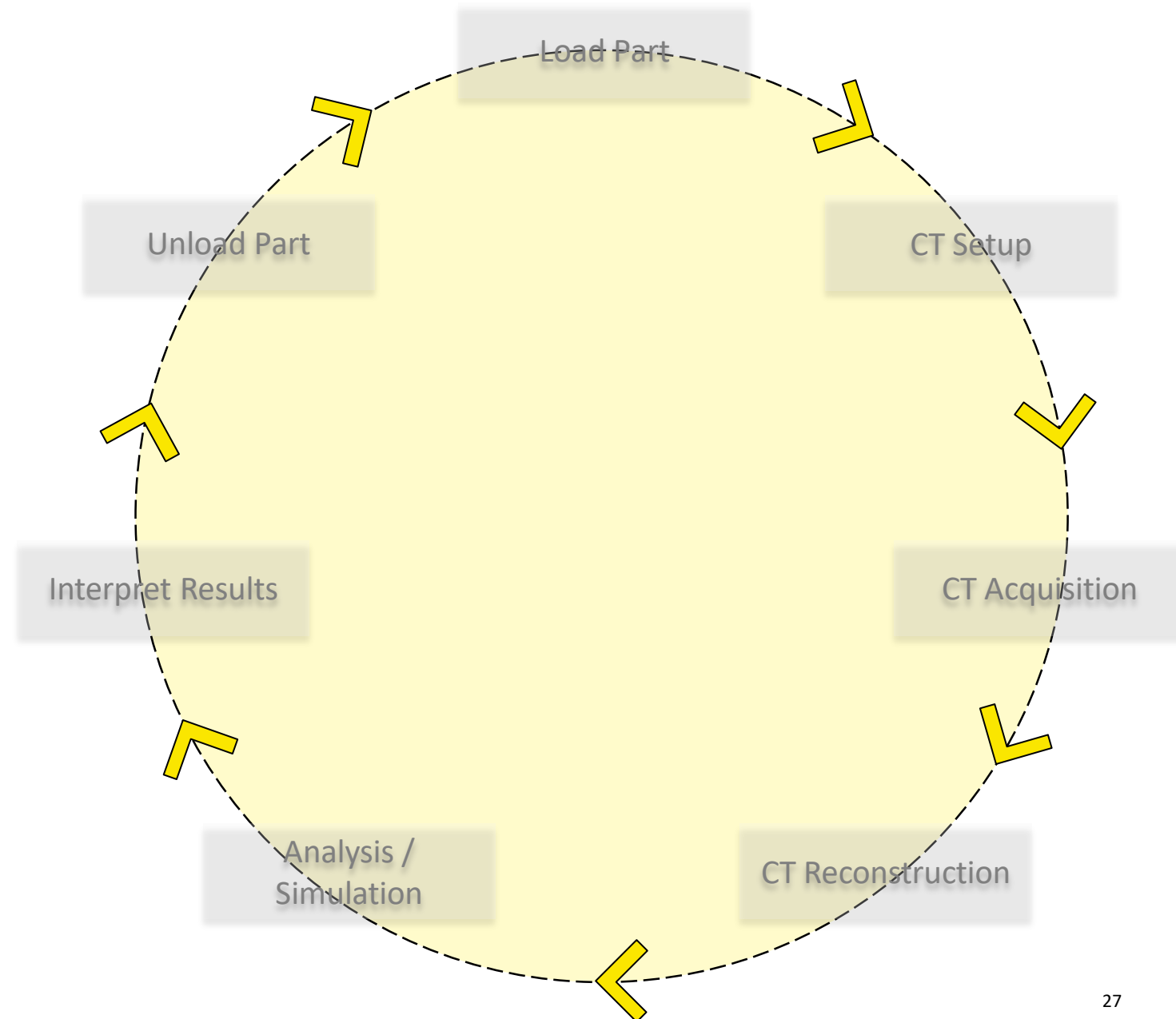


**IN-LINE QUALITY CONTROL  
WITH AUTOMATED CT INSPECTION**

# Automating the CT Scan Process: Fully Robotised

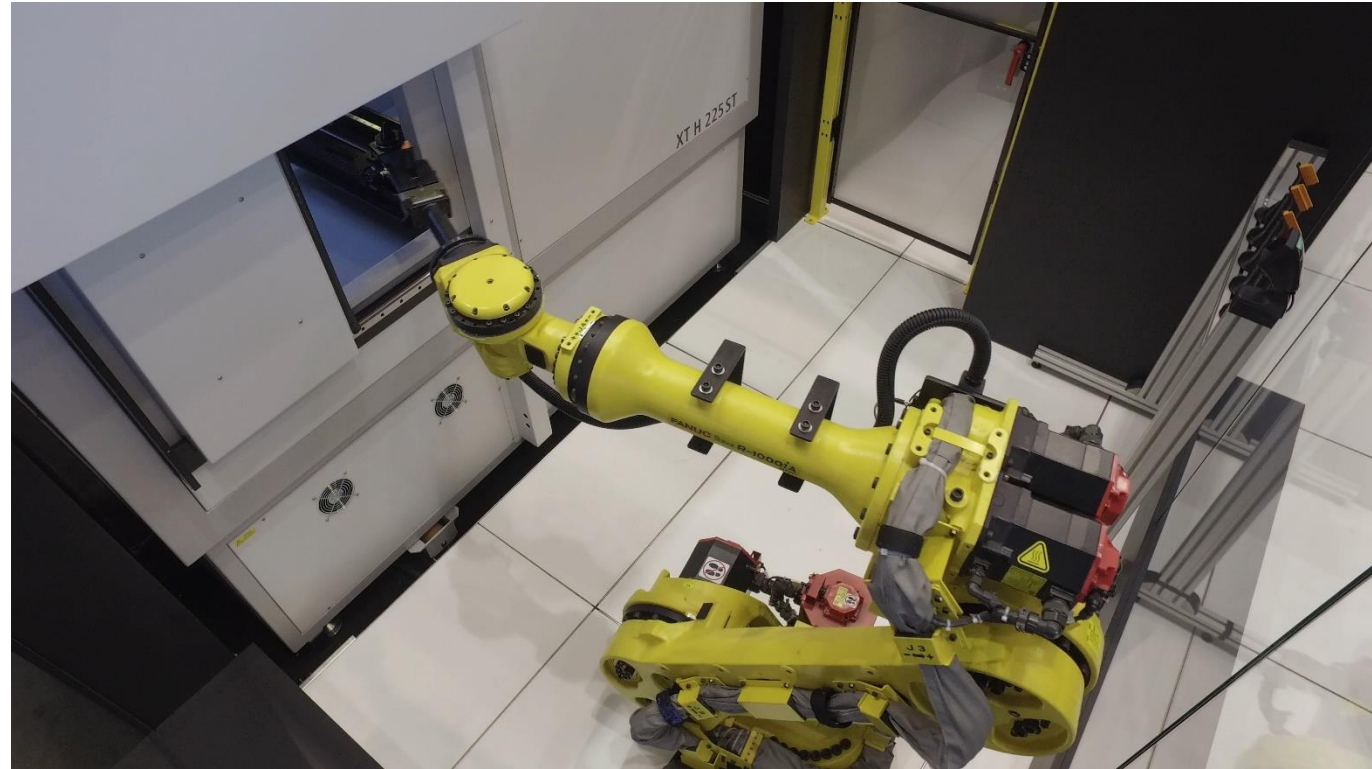


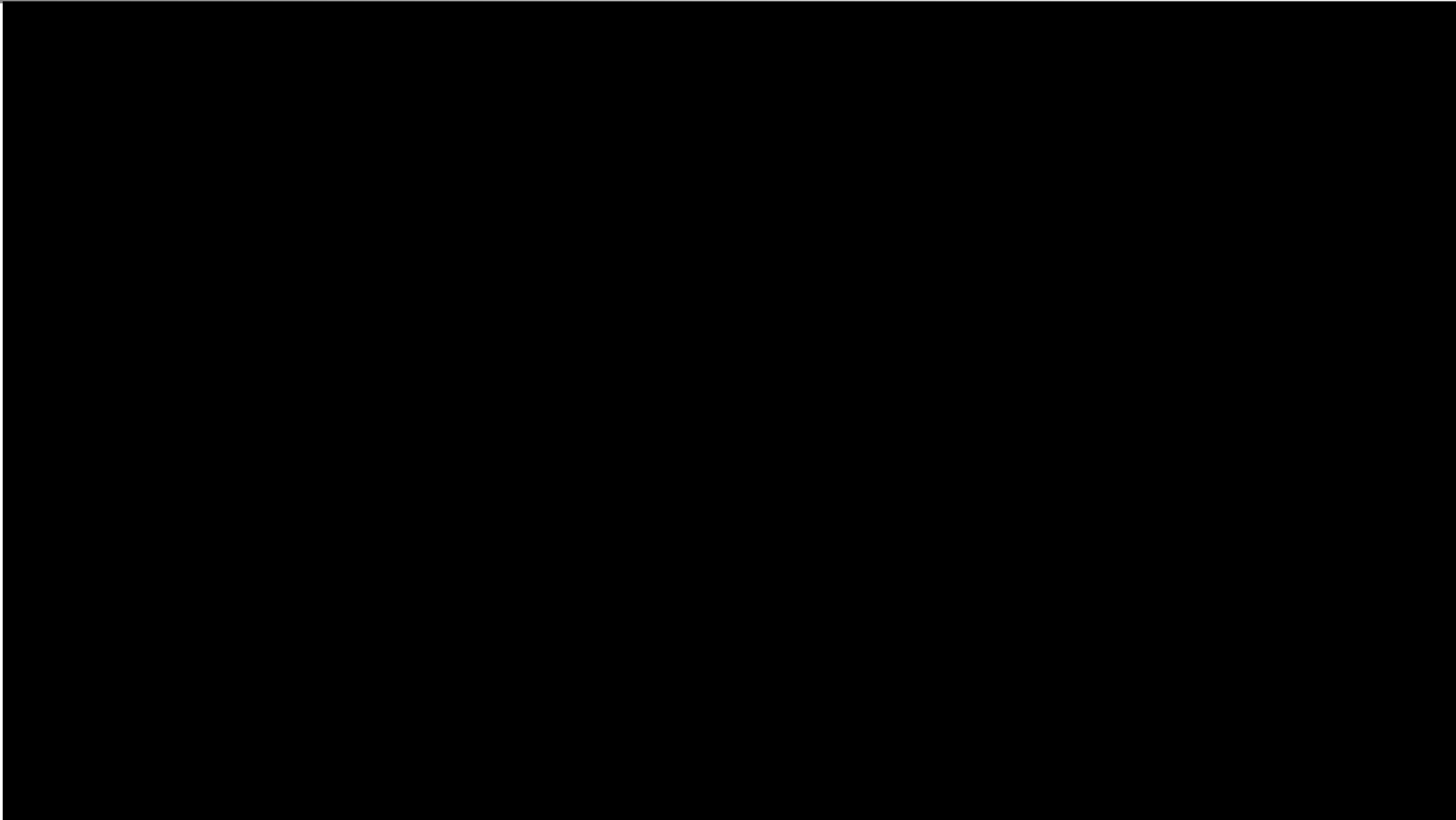
No operator-dependent actions remain – the process has been fully automated.



Presented at Control 2018, a Nikon XT H 225ST was combined with a barcode scanner and Fanuc robot arm to give a real-world demonstration of this functionality.

The following video is from the live demonstration at our booth.





- CT scans can be automated to varying degrees:
  - Built-in CT Profiles and Programs allow operator interaction to be reduced
  - Inspect-X IPC interface allows partial to full automation, with integration to external systems
- These concepts have been implemented as real-world systems, and are already in use at customers



# Thank you!

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[blog.nikonmetrology.com](http://blog.nikonmetrology.com)

