TPW CTinspect

Enhancing efficiency for industrial CT inspections through automated sample handling

A case study from a service provider

Dr. Thomas Kleinteich

TPW CTinspect GmbH, Neuss

Baker Hughes
Confidential

2006

Hamburg

I collected 1st CT scan experiences at DESY Hamburg

Neuss

ROWO GmbH – a **service provider** for material inspections – started CT imaging service for customers with v|tome|x s 225

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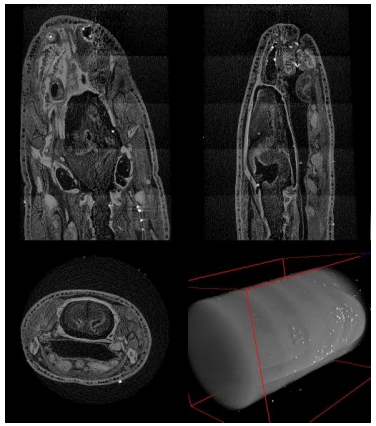
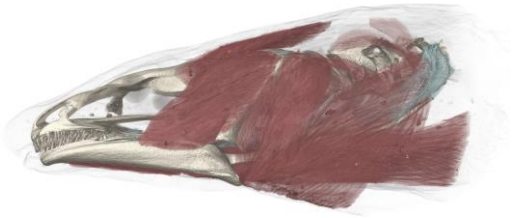
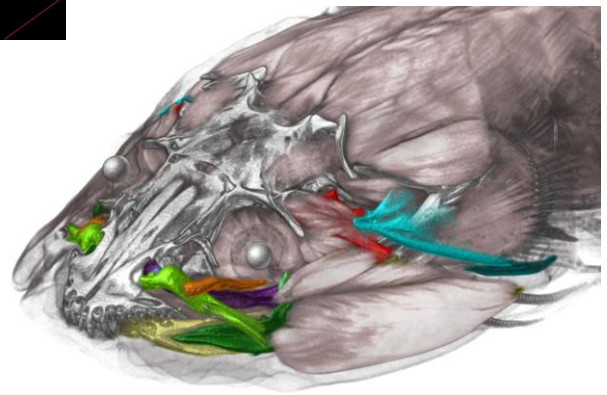
2016

Hamburg – Seattle - Kiel

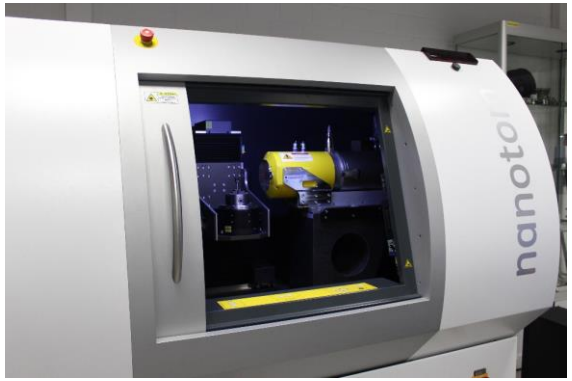






Gained CT experience by working on various projects in vertebrate anatomy and biomechanics

Neuss



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ROWO GmbH, which meanwhile became **TPW Prüfzentrum GmbH**, grew from one to three CT systems

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Once upon a time …

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2016

Hamburg – Seattle - Kiel

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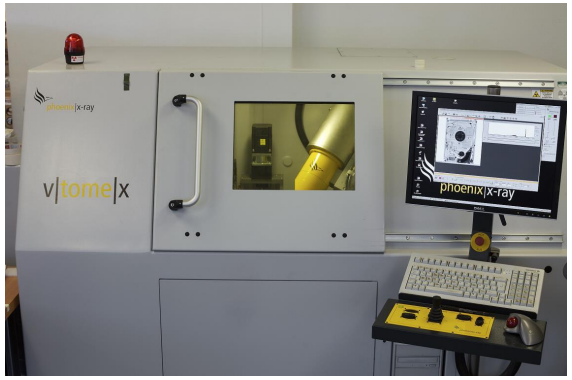

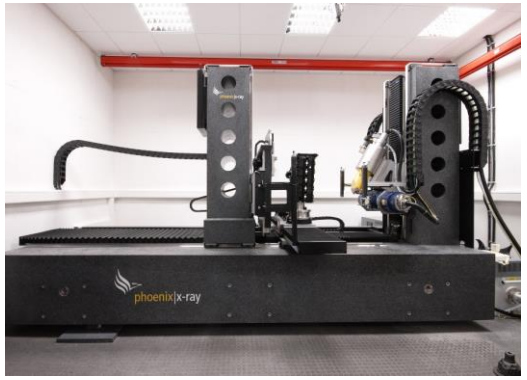

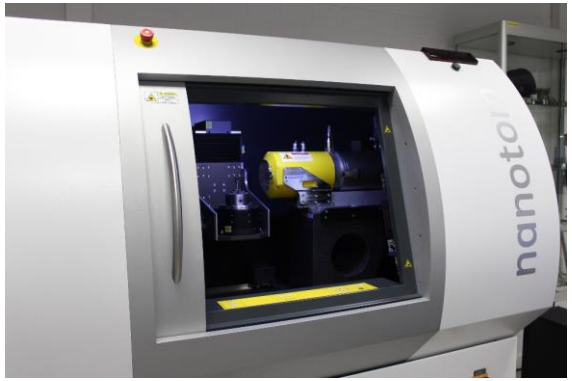

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Our infrastructure

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2024

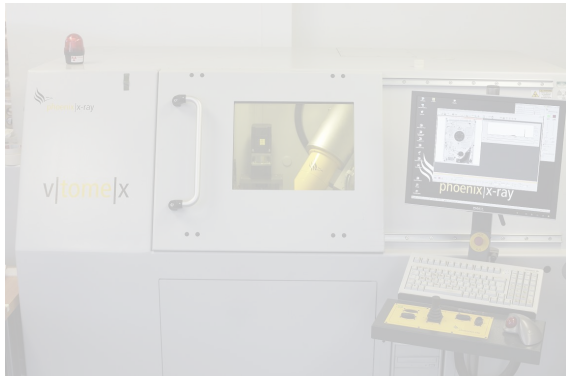
Three CT-systems:

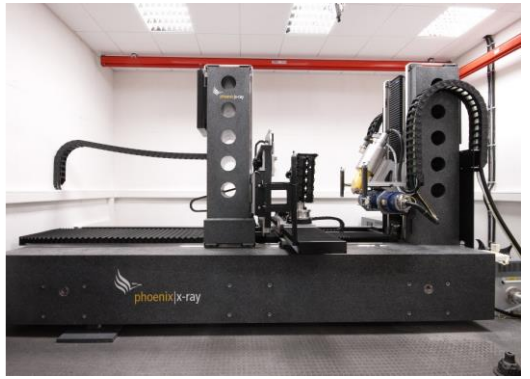
Nanotom m 180 kV nanofocus

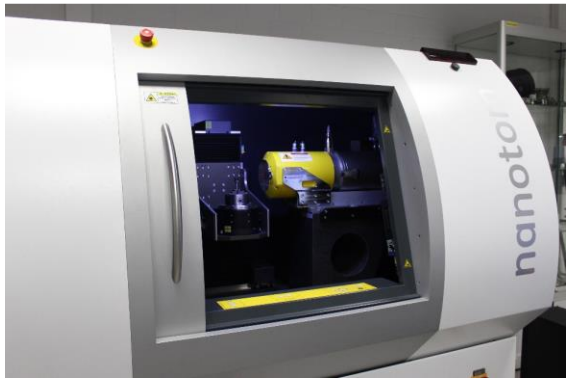
v|tome|x m 180 kV nanofocus + 240 kV microfocus

v|tome|x L 240 kV microfocus + 450 kV minifocus

Neuss







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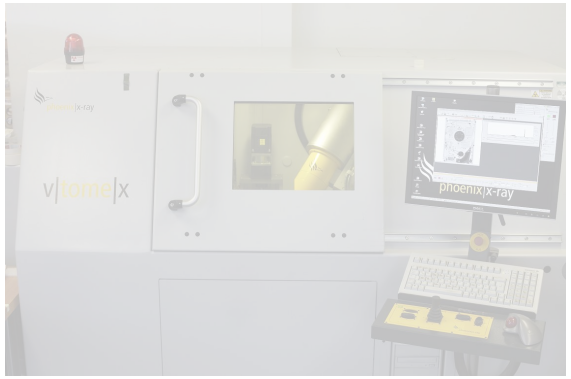

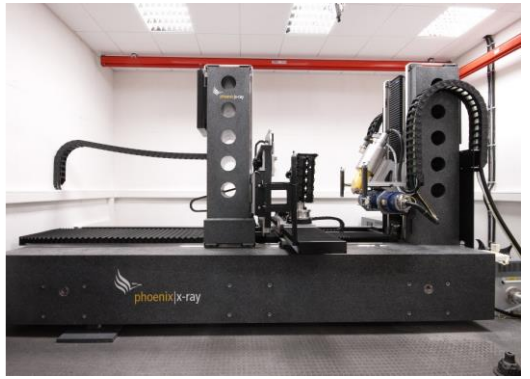

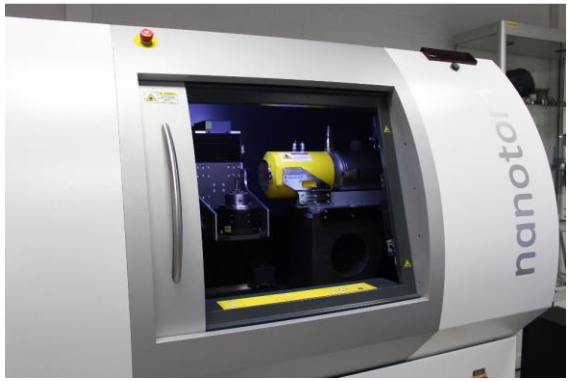

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Team of 10 people – 7 of them are operators/inspectors

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Our infrastructure

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2024

Three CT-systems:

Nanotom m 180 kV nanofocus

v|tome|x m 180 kV nanofocus + 240 kV microfocus

v|tome|x L 240 kV microfocus + 450 kV minifocus

… coming soon: v|tome|x m 300 kV microfocus

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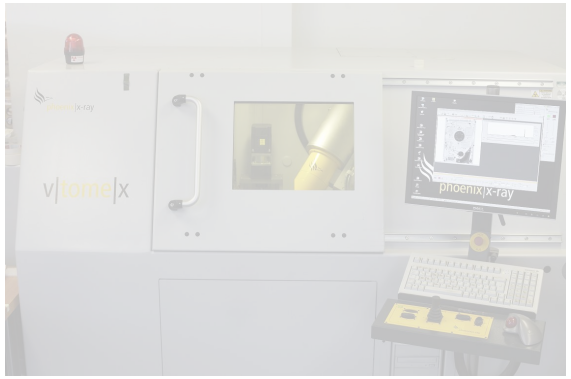

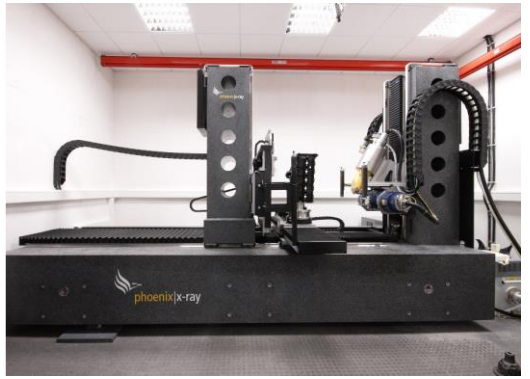

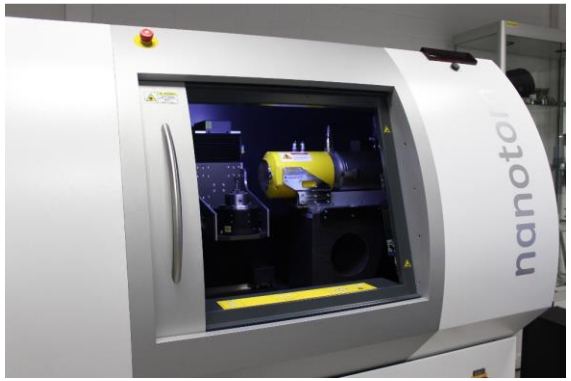

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Service provider

Our customers are:

- companies with no CT equipemt for their own that need to have their products CT inspected
- are experienced CT users in need for over capicities
- universities and other research facilities
- other service providers, e.g. from the field of metrology
- …and more

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Typical scan objects

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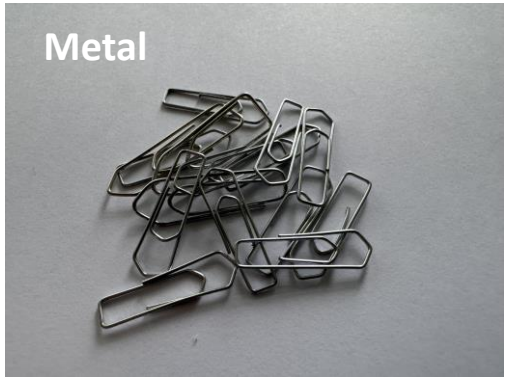

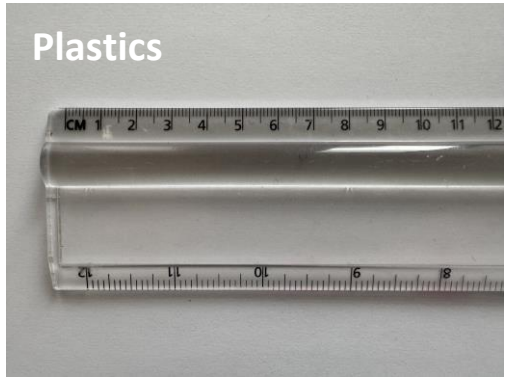

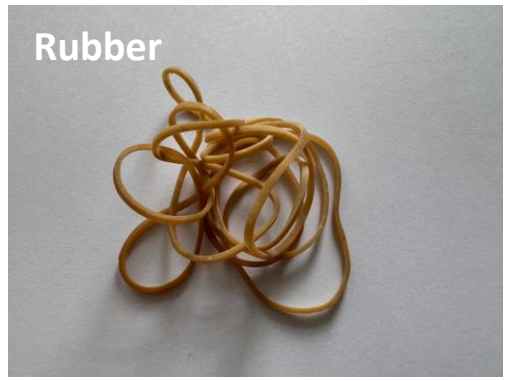

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Typical scan objects

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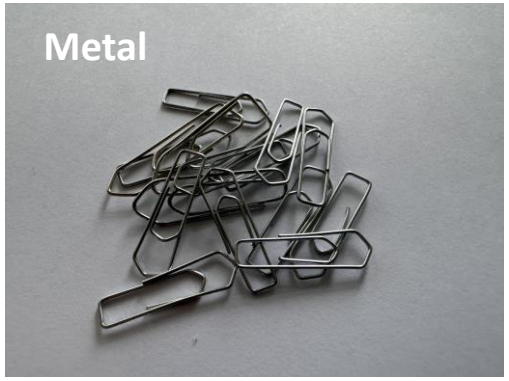

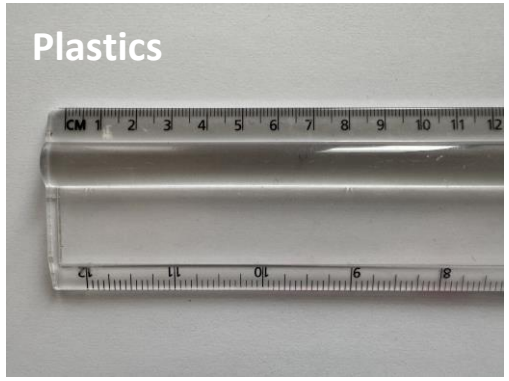

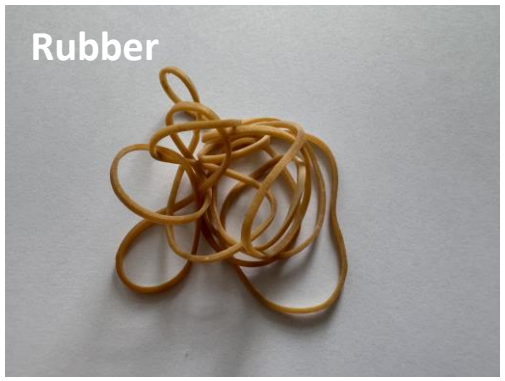

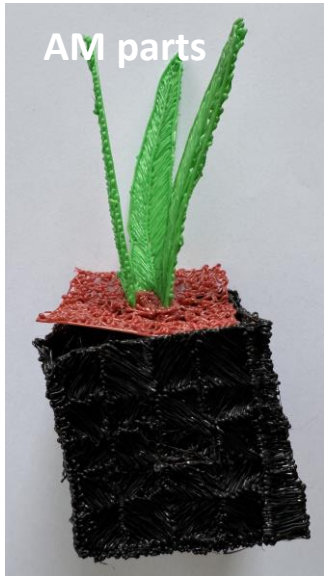

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Typical scan objects

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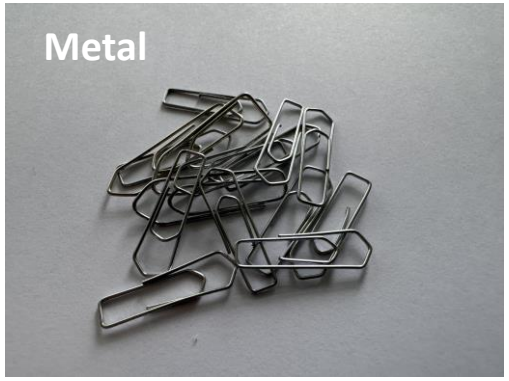

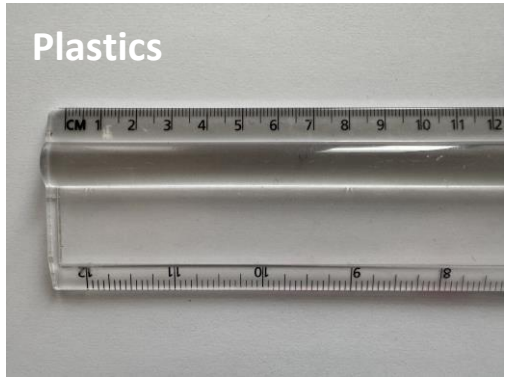

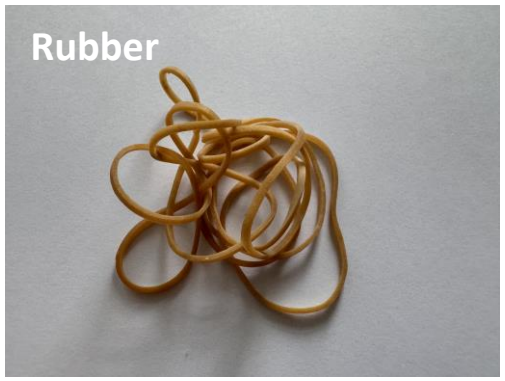

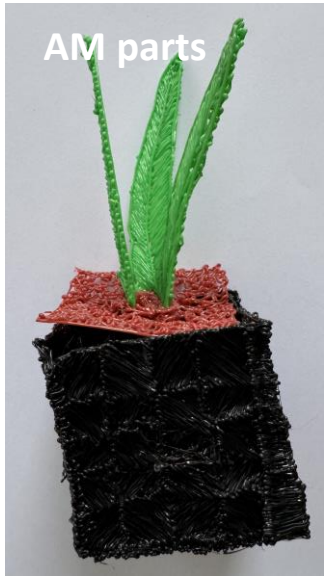

Batch sizes typically 1-20 parts

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Typical scan objects

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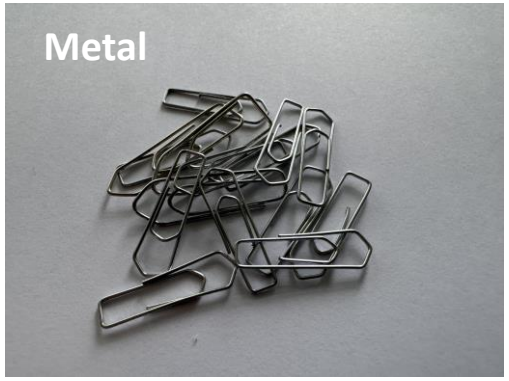

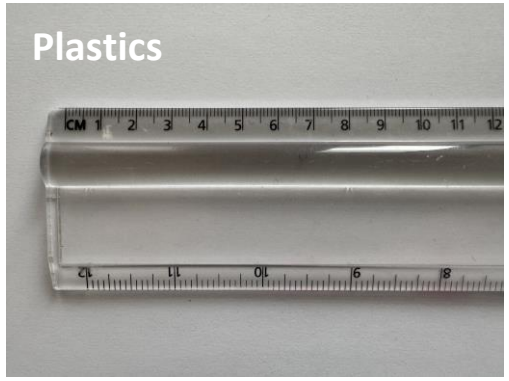

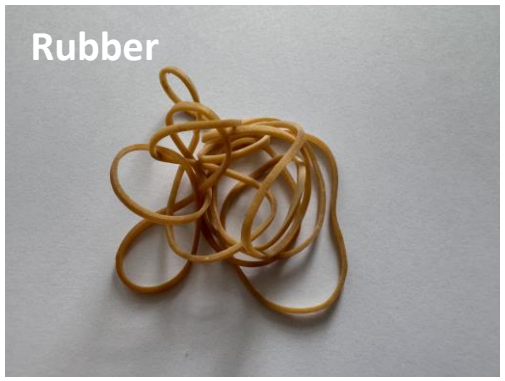

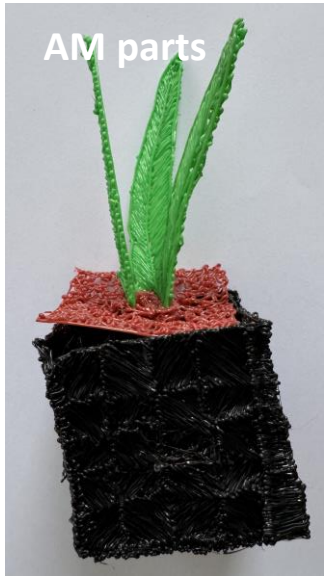

Batch sizes typically 1-20 parts

Exemplary images – no actual customer samples

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CT-inspection workflow

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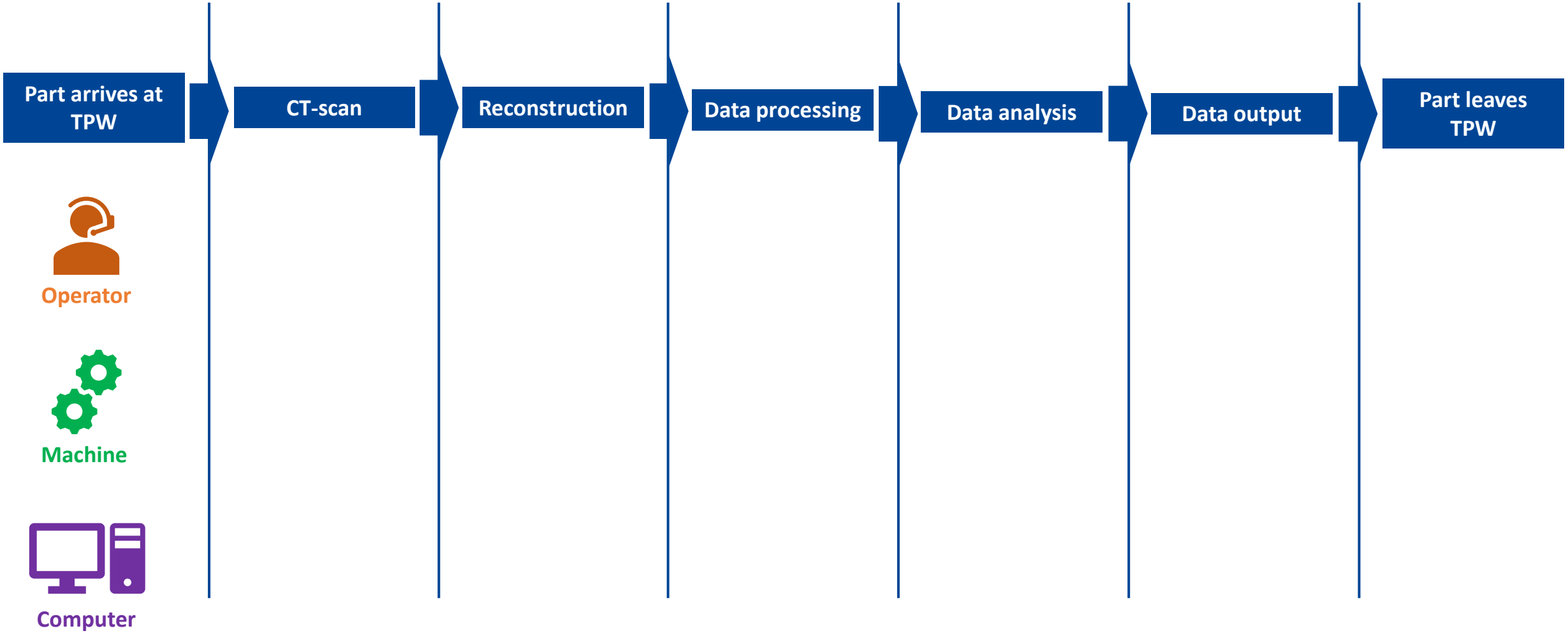

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CT-inspection workflow

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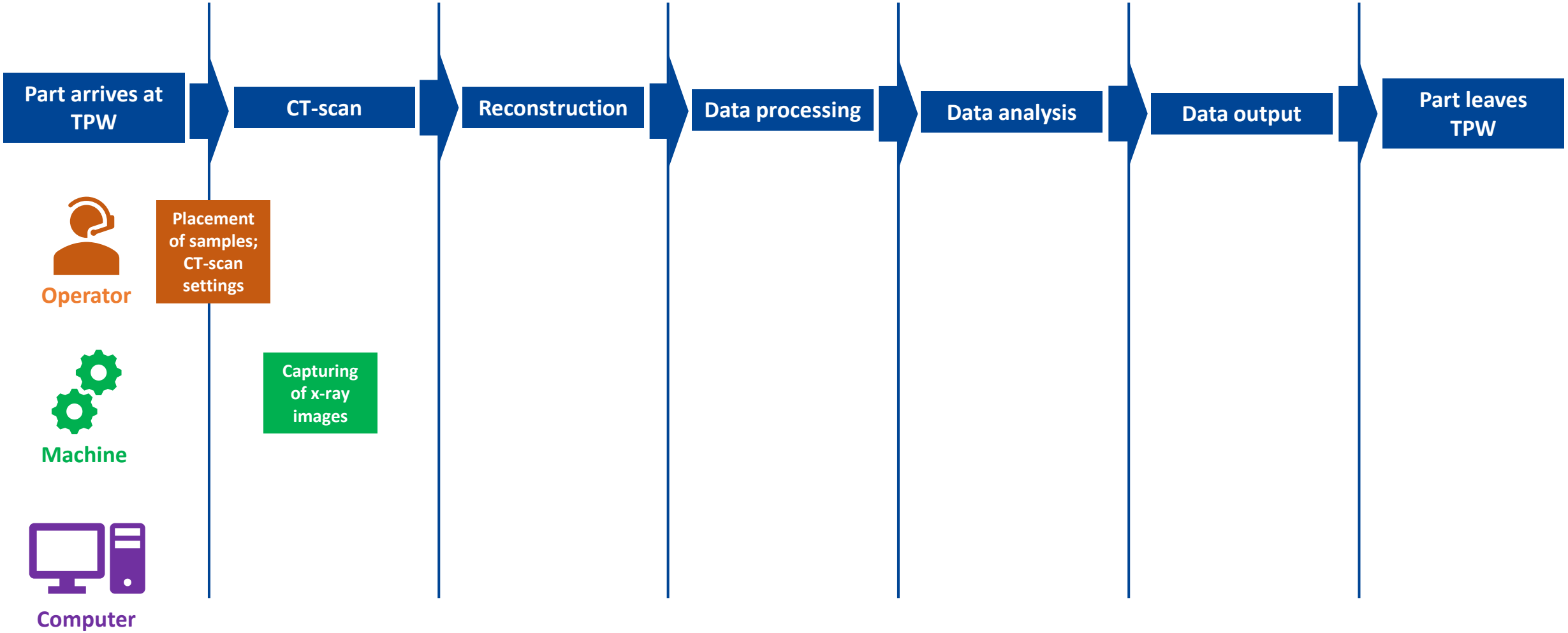

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CT-inspection workflow

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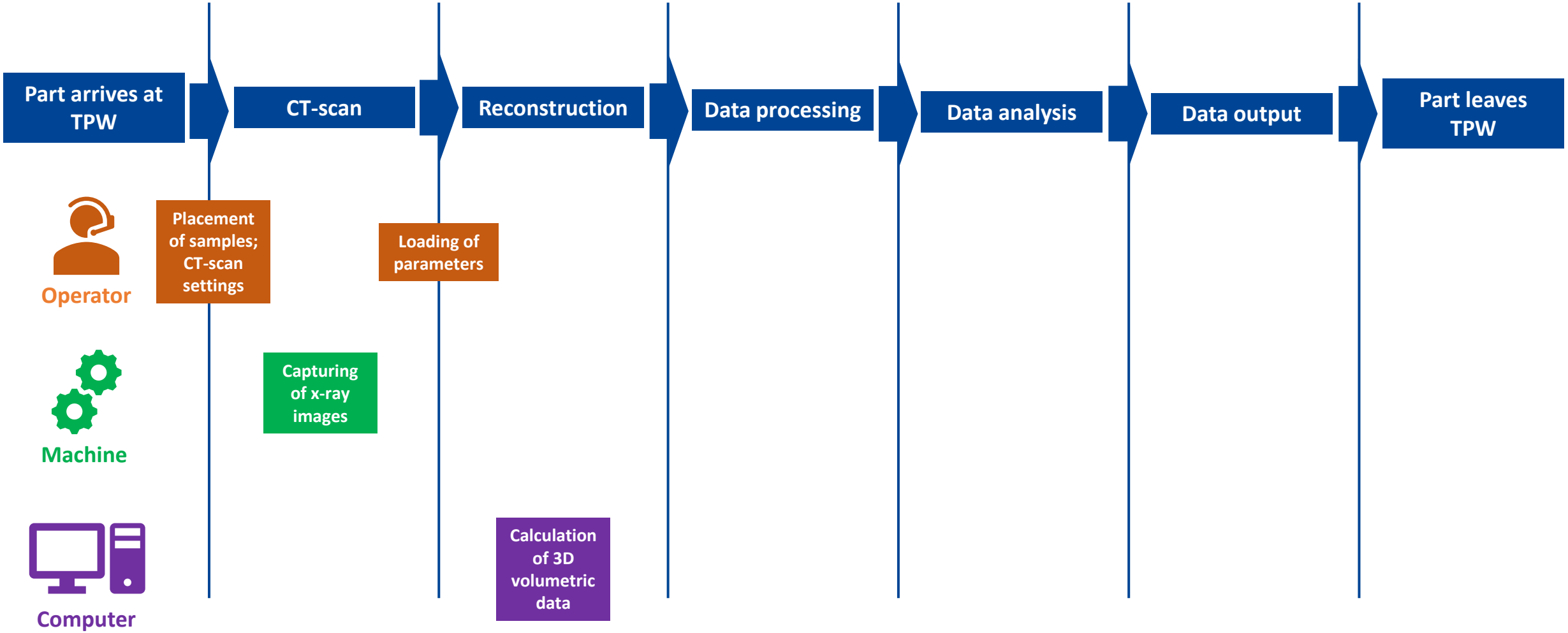

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CT-inspection workflow

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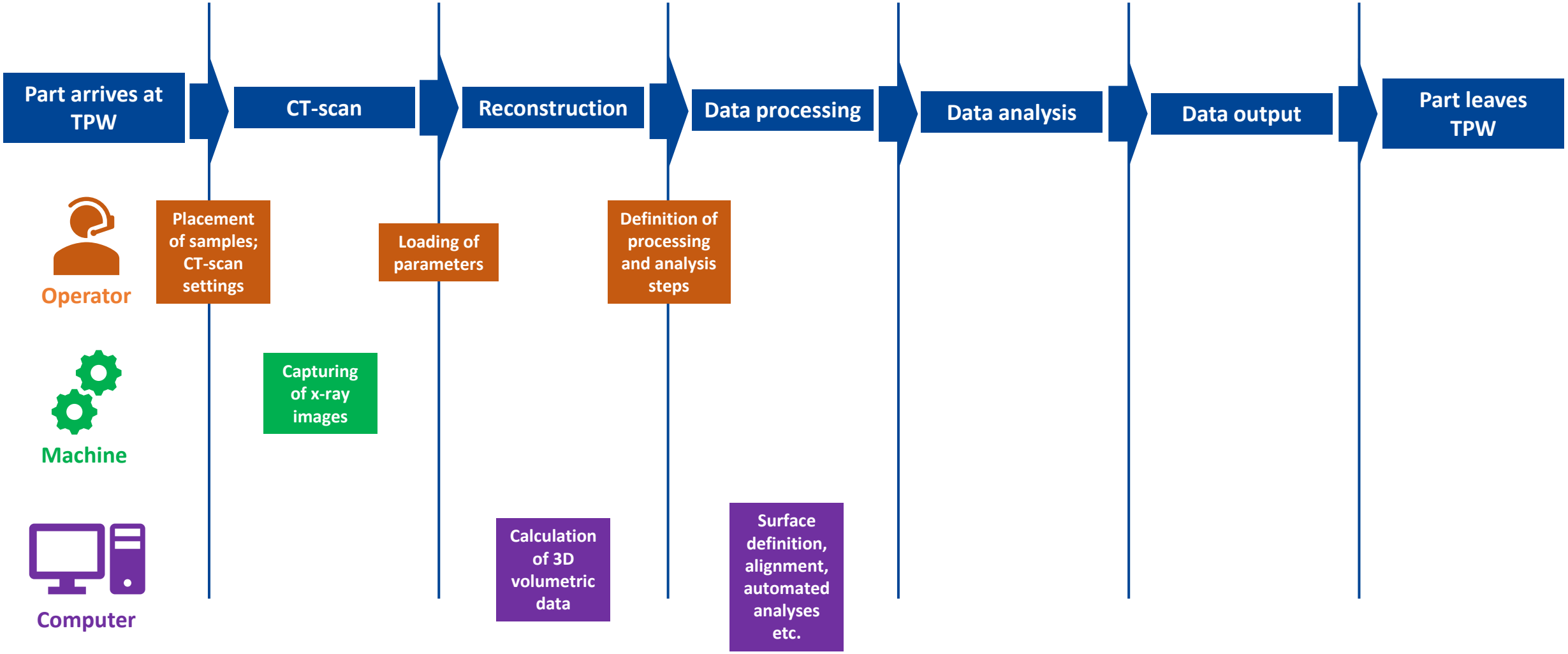

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CT-inspection workflow

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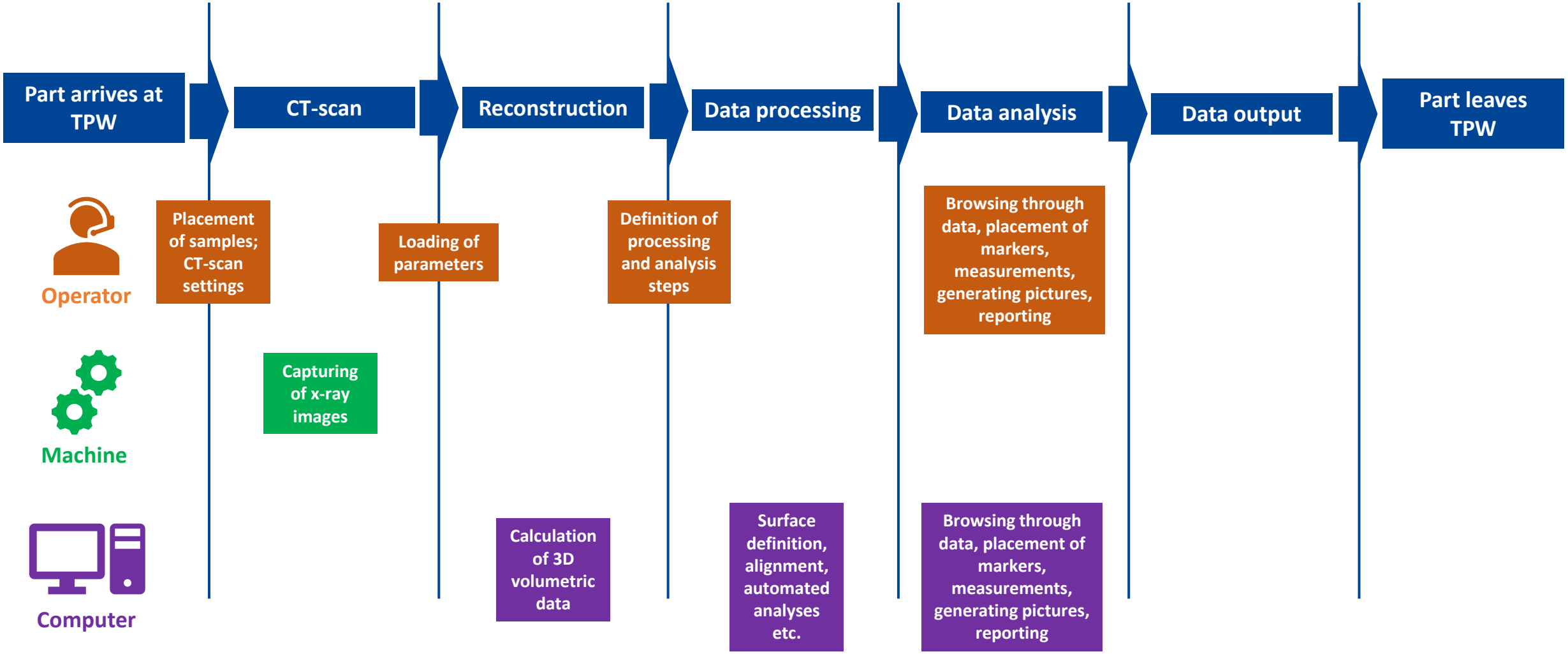

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CT-inspection workflow

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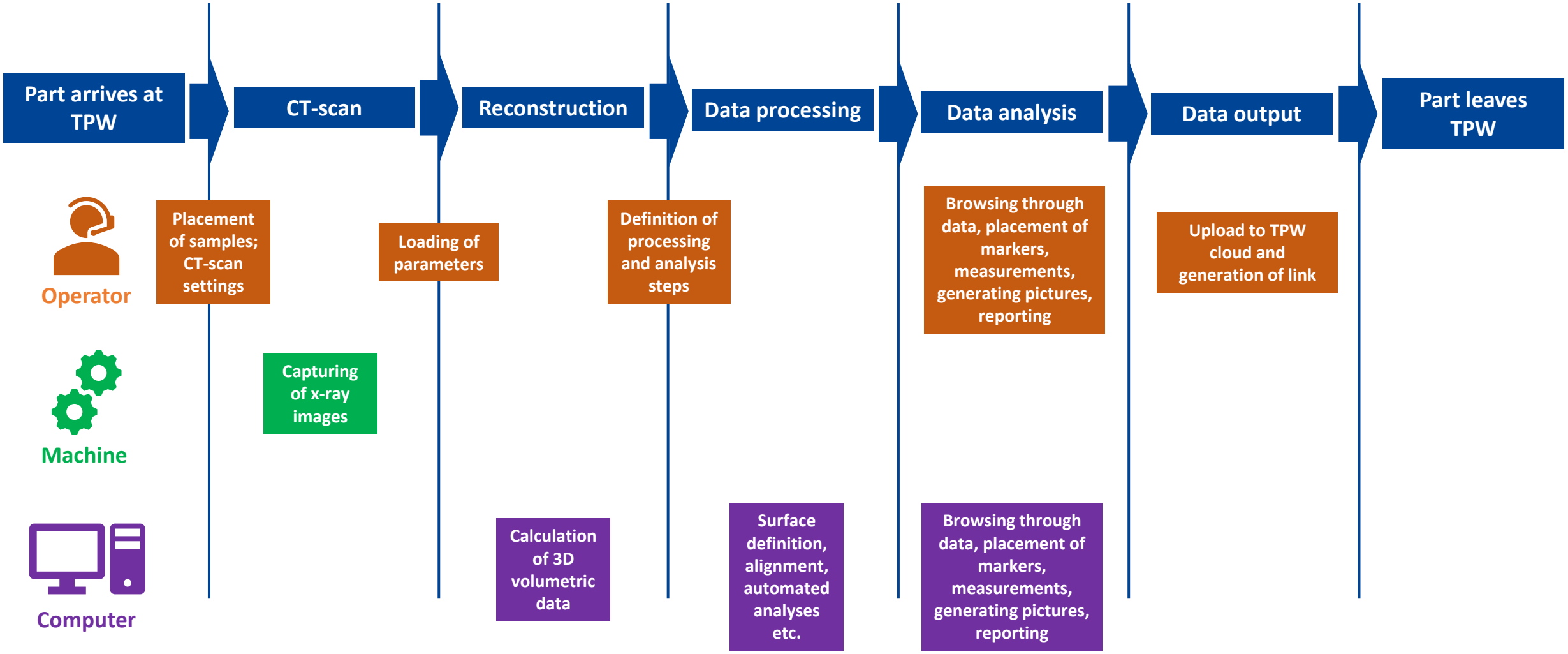

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CT-inspection workflow

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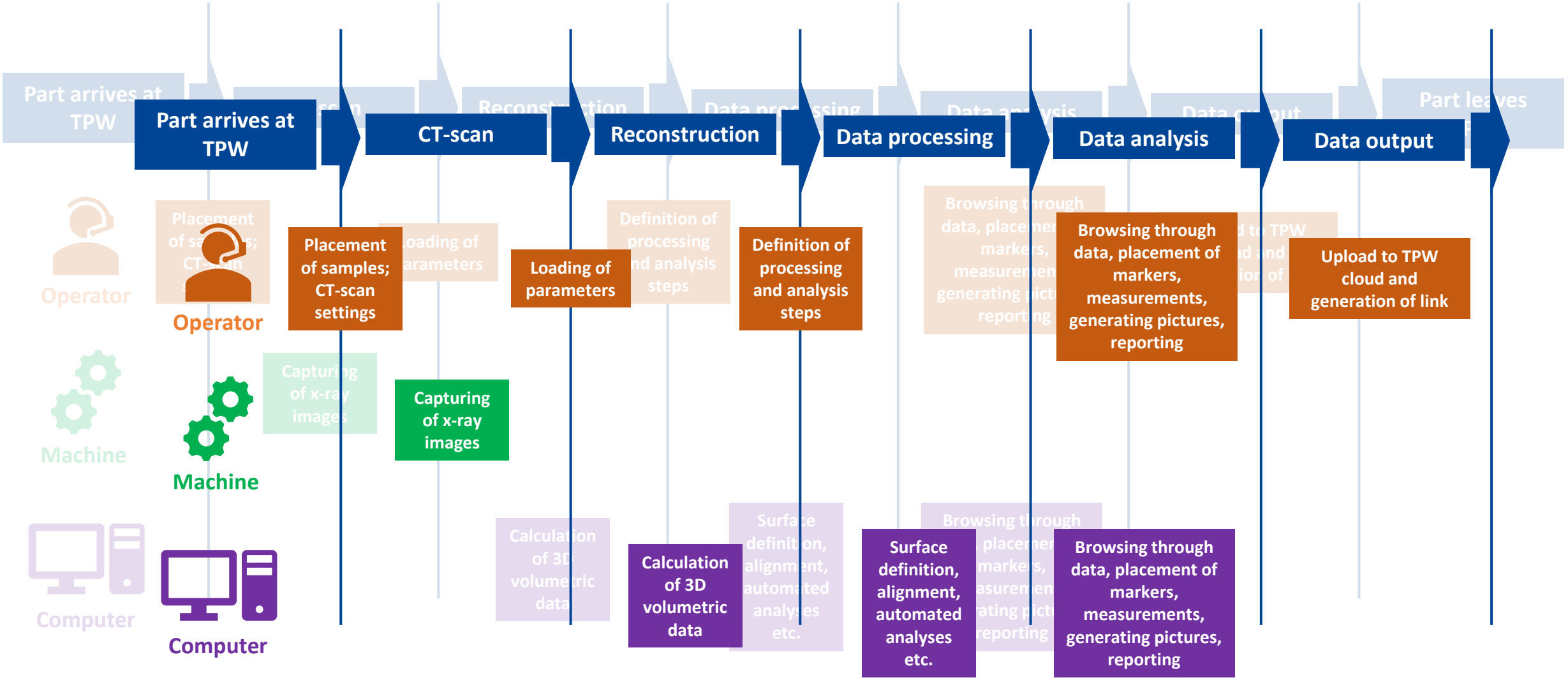

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CT-inspection workflow

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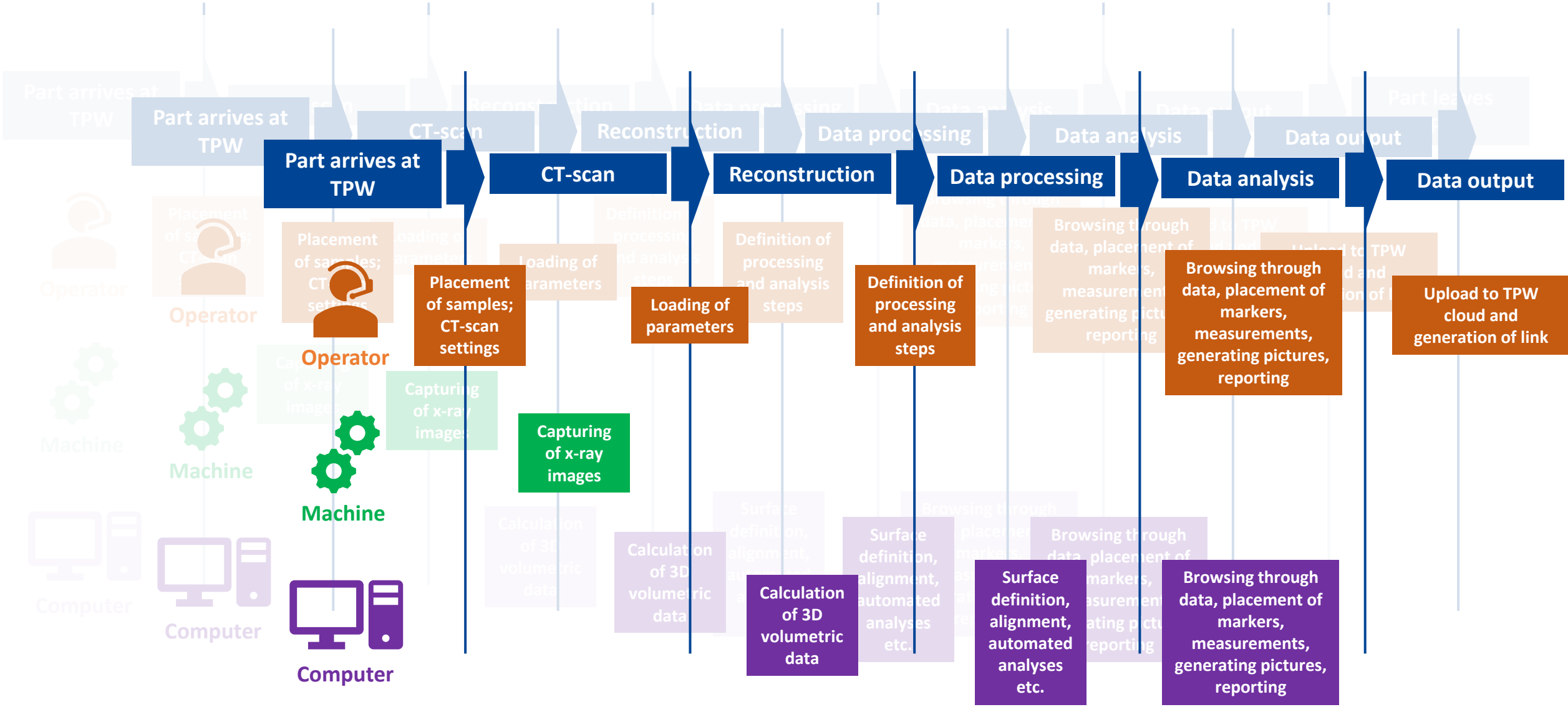

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CT-inspection workflow

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Common that operator performs scans while analyzing data from a different scan or even project

Diversity of objects to CT scan

- **Machine**: 5 mins to 2 hours
- Analysis: 5 mins to 3 hours

Times for **reconstruction, data processing, and analysis** do not correlate with **CT machine time**

Disruptive for **operator** when trying to maximize **machine time** → start next scan once previous scan is finished

Aim: automate processes to minimize distractions for operator

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CT-inspection workflow

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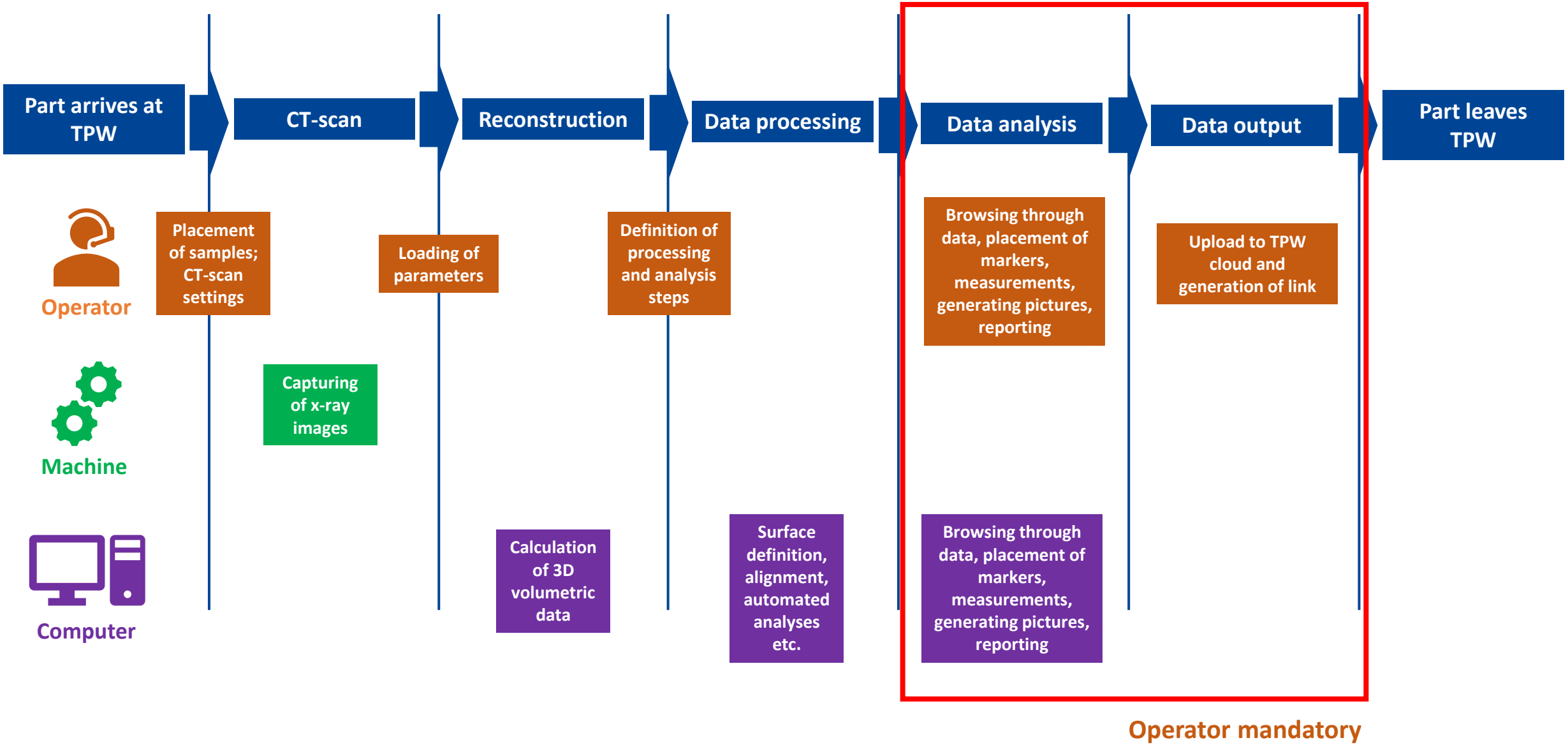

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CT-inspection workflow

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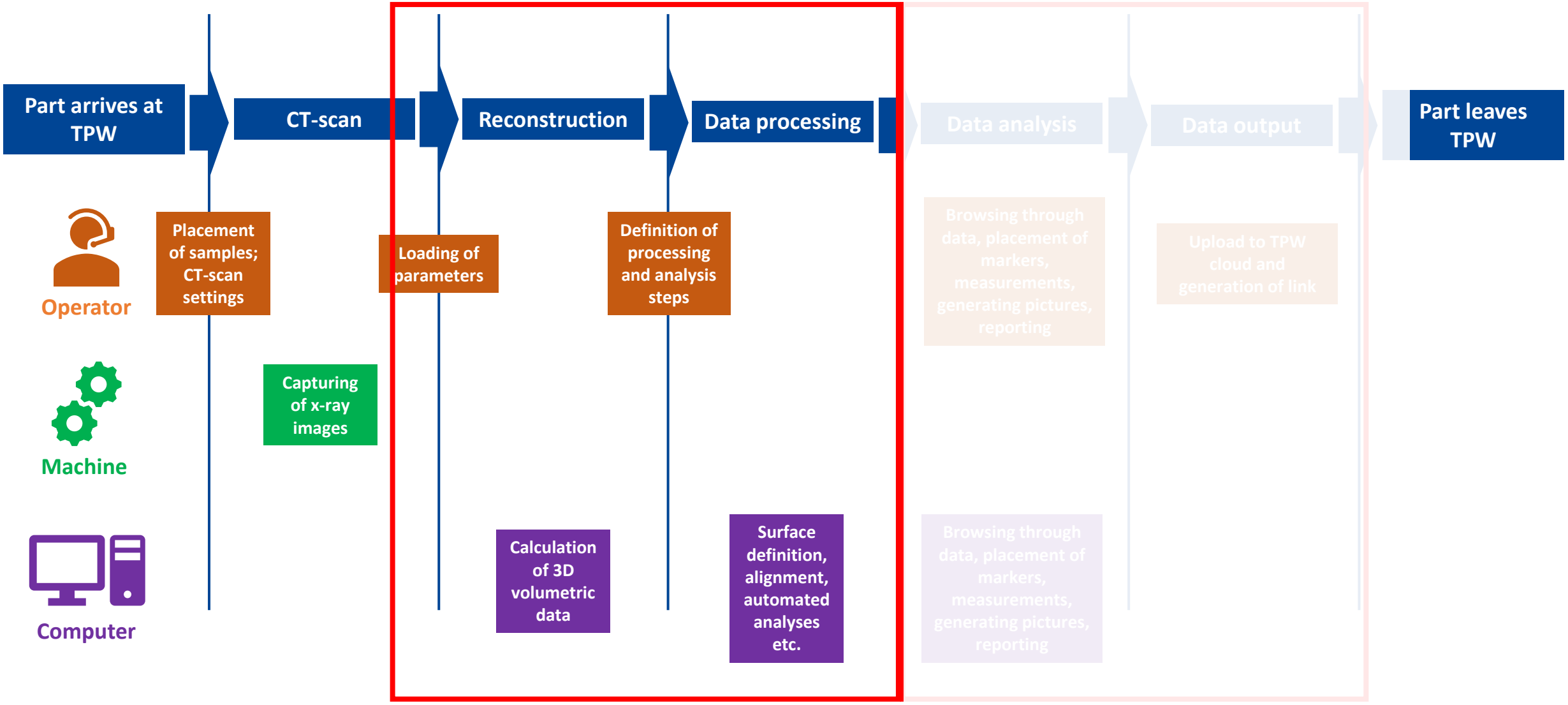

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CT-inspection workflow

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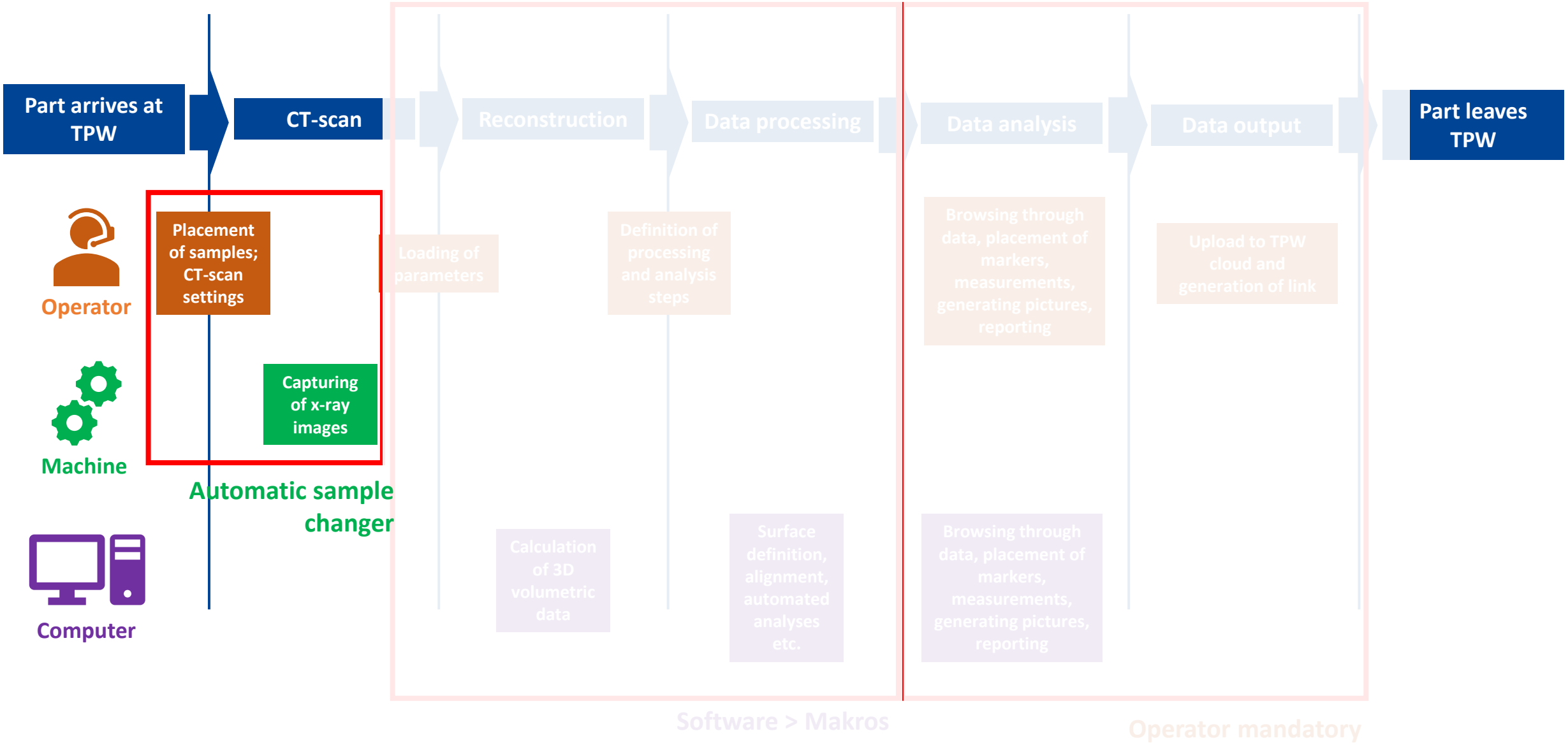

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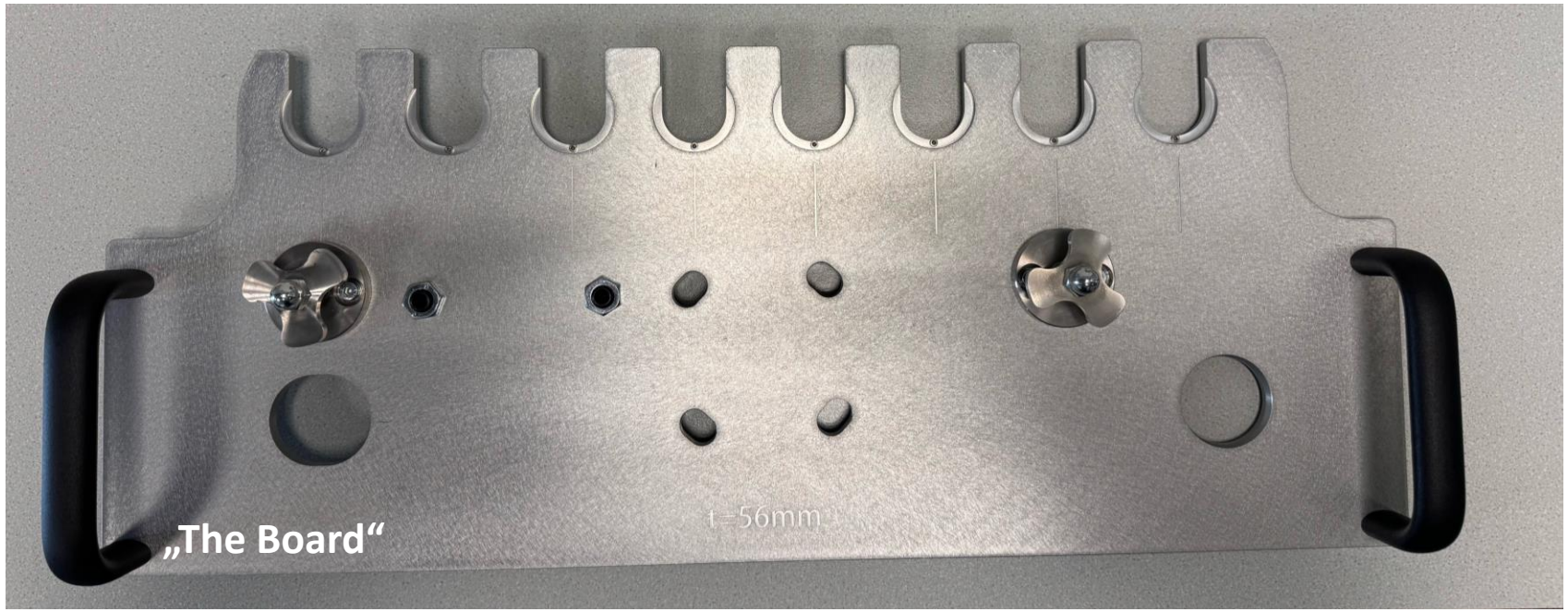
Sample changer hardware



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Sample changer hardware

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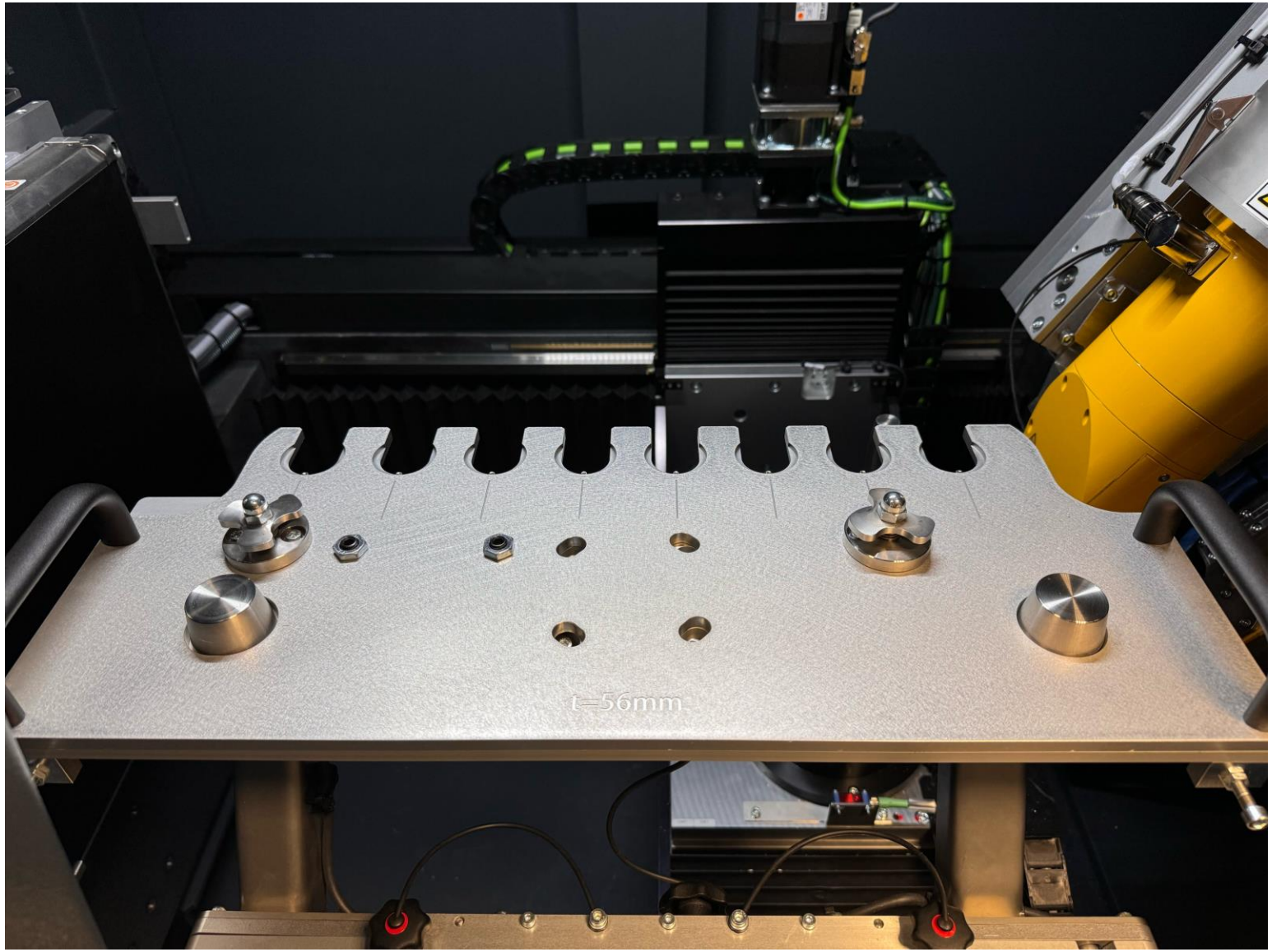

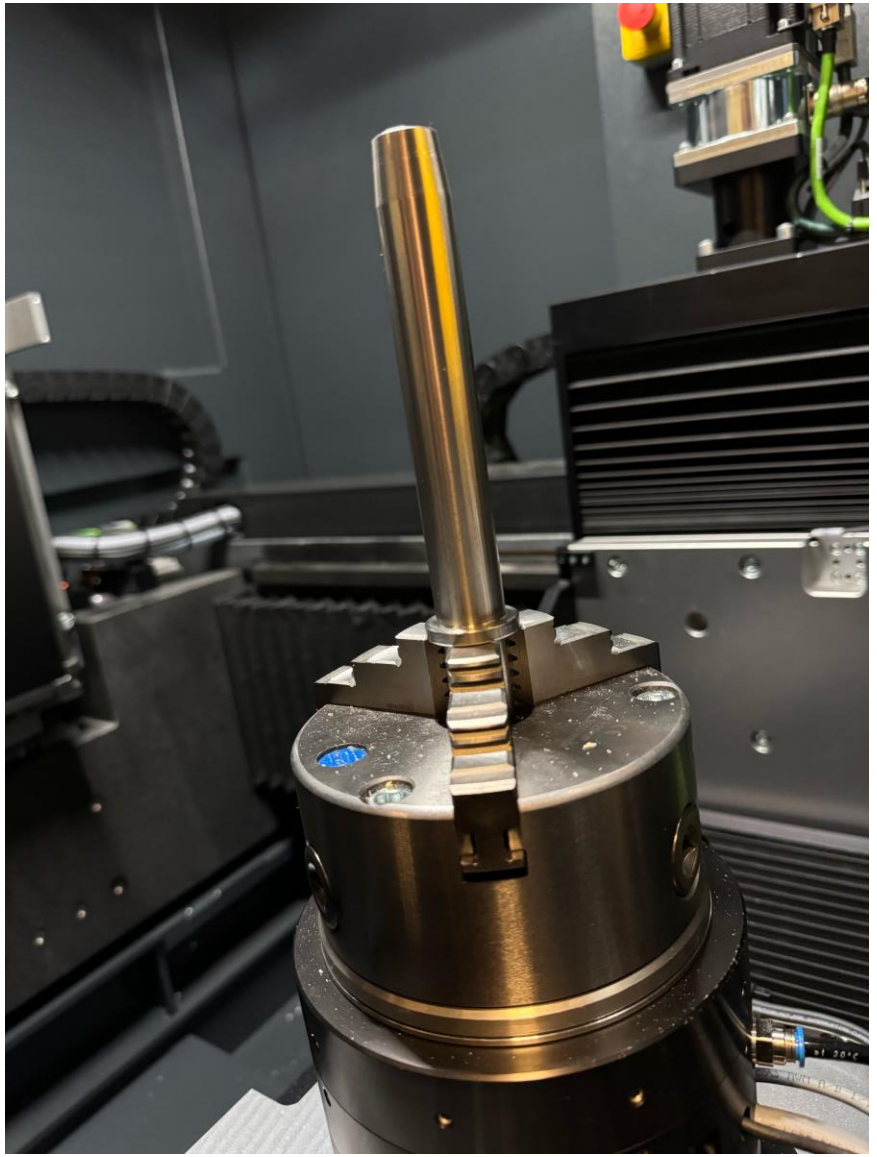

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Sample changer software

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datos|x acq

Standard workflow for CT-scan

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Sample changer software

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datos|x acq

Operator

Placement of samples; CT-scan settings

Save scan settings in .PCA-file

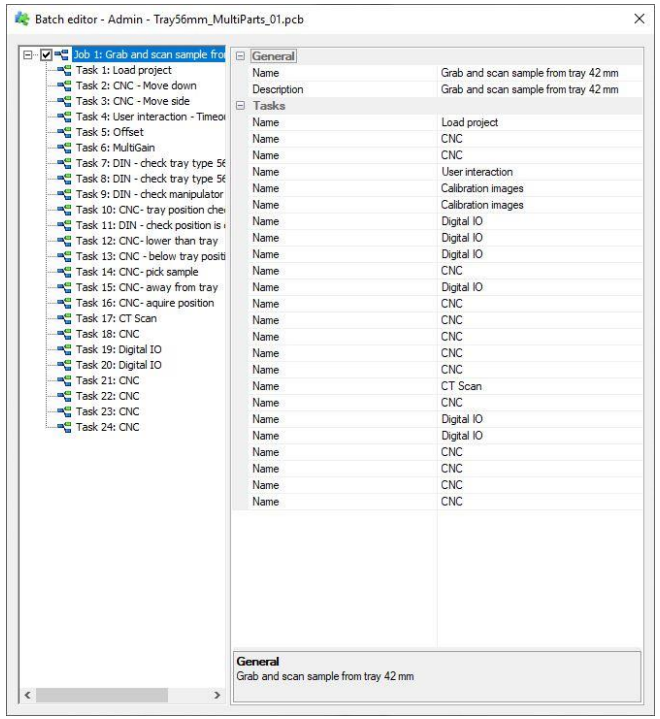
Start scan

Machine

Capturing of x-ray images

datos Batch editor

batch|mode



Define jobs in .PCB-file

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Sample changer software

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Operator

Placement of samples; CT-scan settings

Save scan settings in .PCA-file

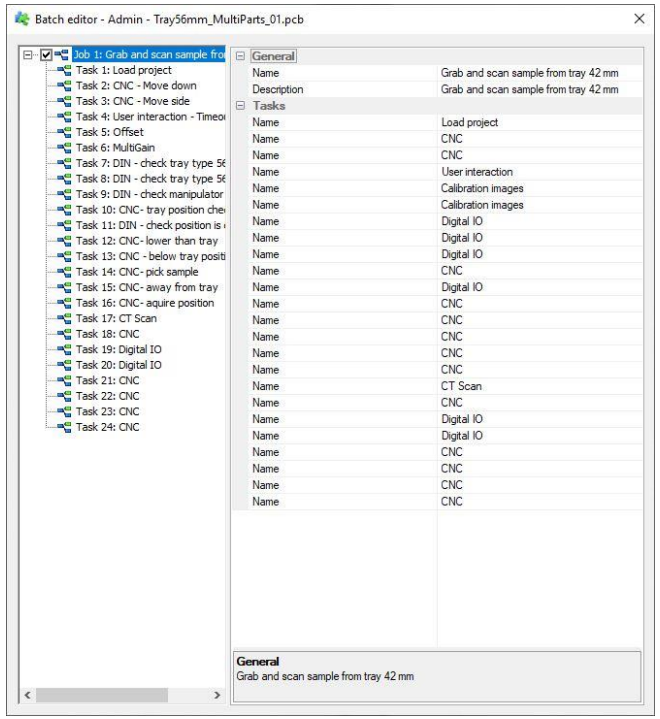
Start scan

Machine

Capturing of x-ray images

batch|mode

datos Batch editor



Define jobs in .PCB-file

Job (= CT-scan plus sample handling)

Defined by tasks

- move CNC out of field of view
- capture gain and offset images
- grab sample
- load .PCA-file
- move to acquire position
- perform scan
- perform reconstruction
- bring sample back

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Sample changer software

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datos|x acq

Operator

Placement of samples; CT-scan settings

Save scan settings in .PCA-file

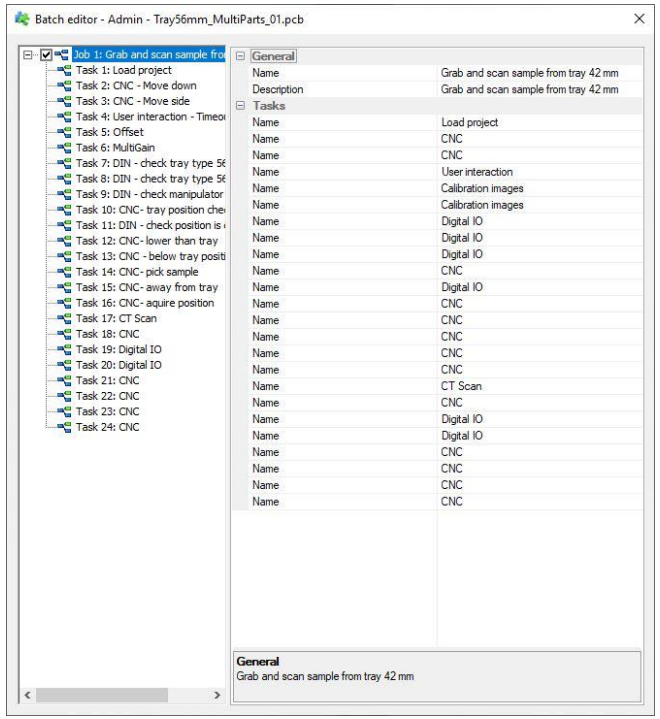
Start scan

Machine

Capturing of x-ray images

batch|mode

datos Batch editor



Define jobs in .PCB-file

Activate jobs through datos|x control

<u>Job</u> (= CT-scan plus sample handling)

Defined by <u>tasks</u>

- move CNC out of field of view
- capture gain and offset images
- grab sample
- load .PCA-file
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Sample changer software

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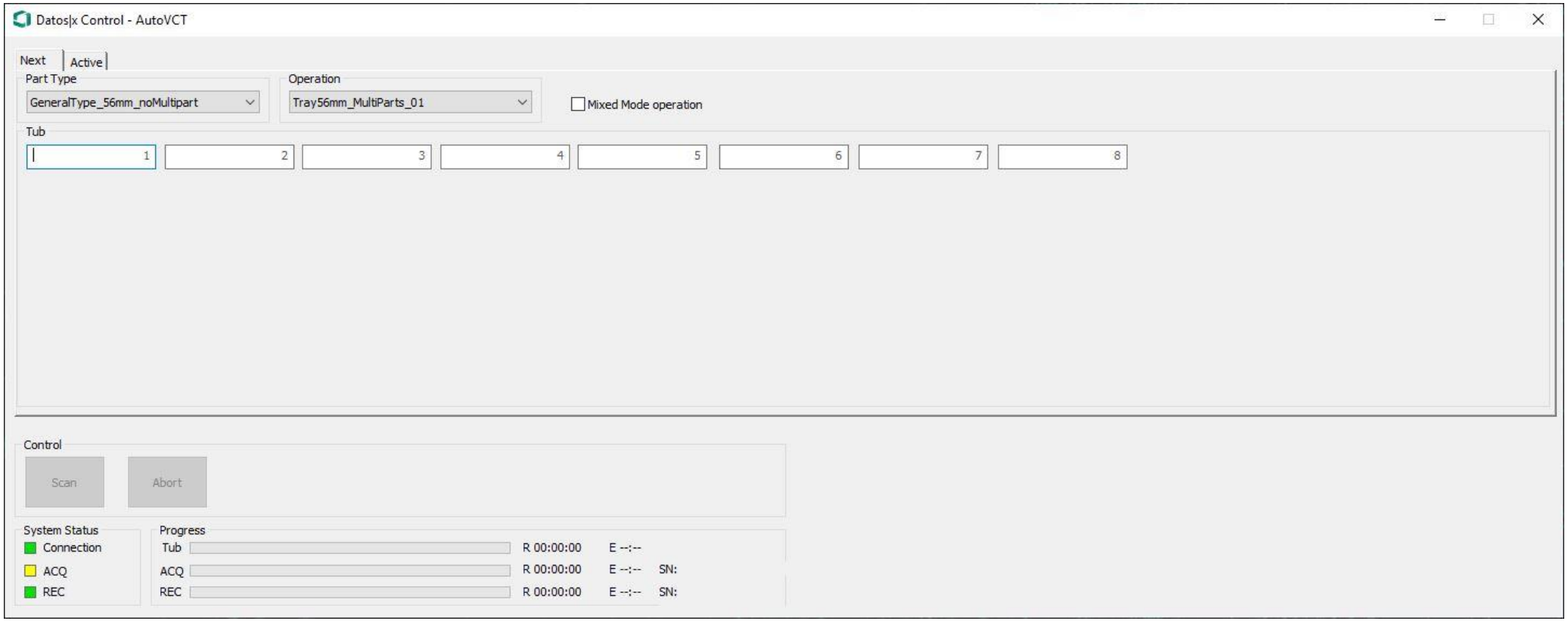
datos|x control



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Sample changer software

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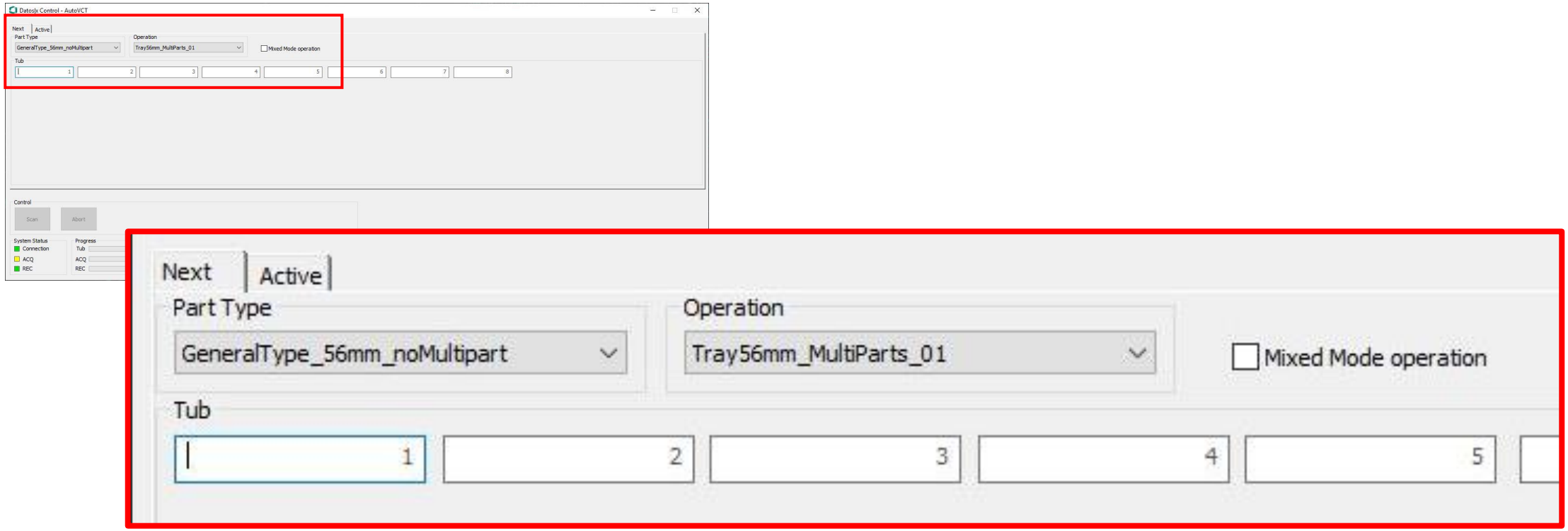
datos|x control



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Sample changer software

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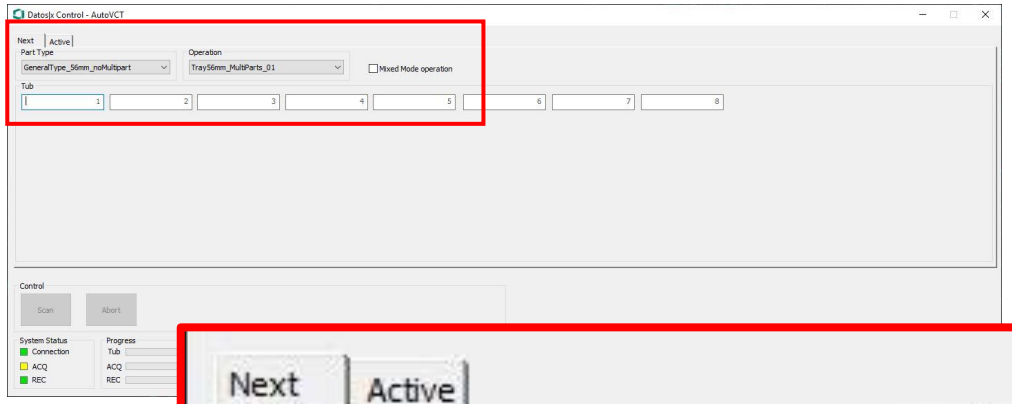
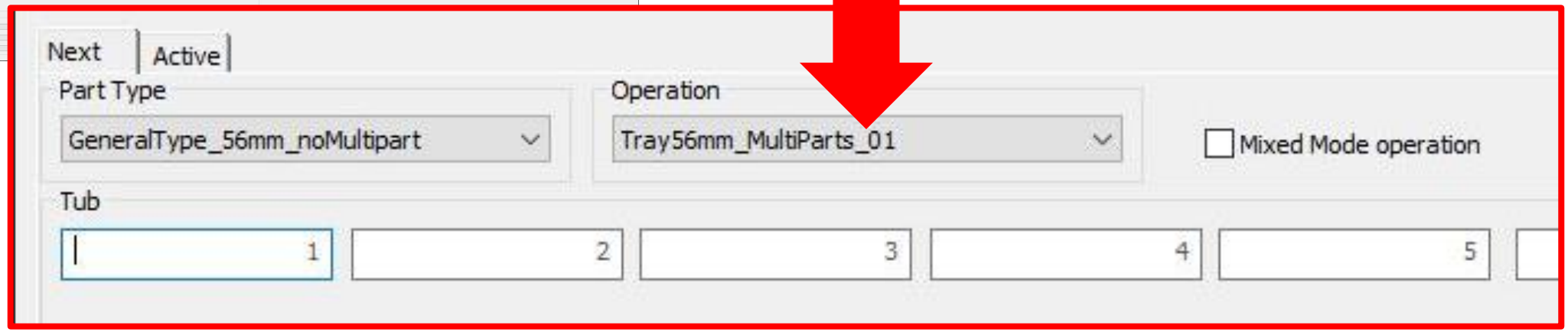
datos|x control



Job defined in .PCB file



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Sample changer software

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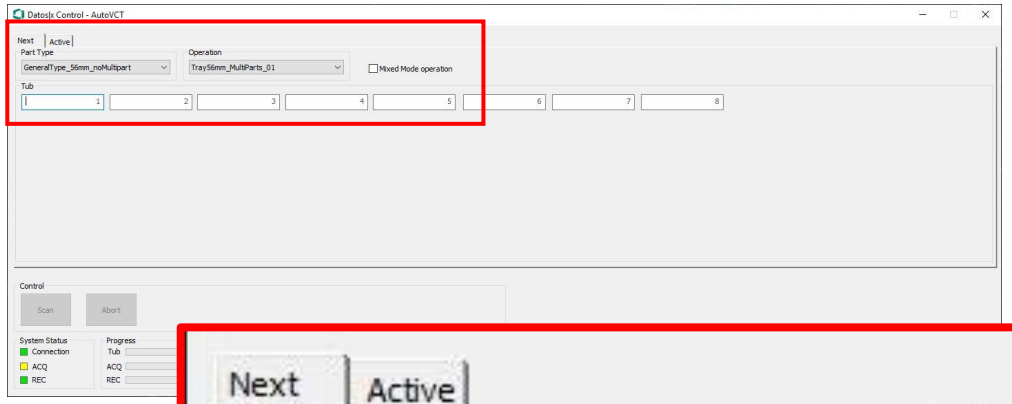
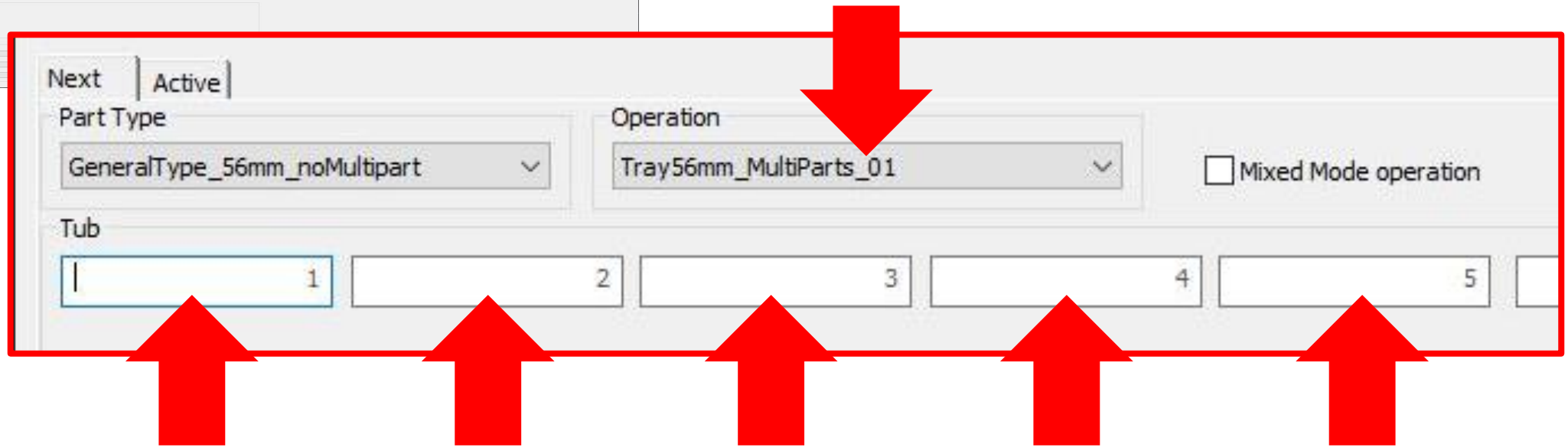
datos|x control



Job defined in .PCB file



File names for scan → Serial numbers

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File names for scan → Serial numbers

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Sample changer software

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Sample changer hardware

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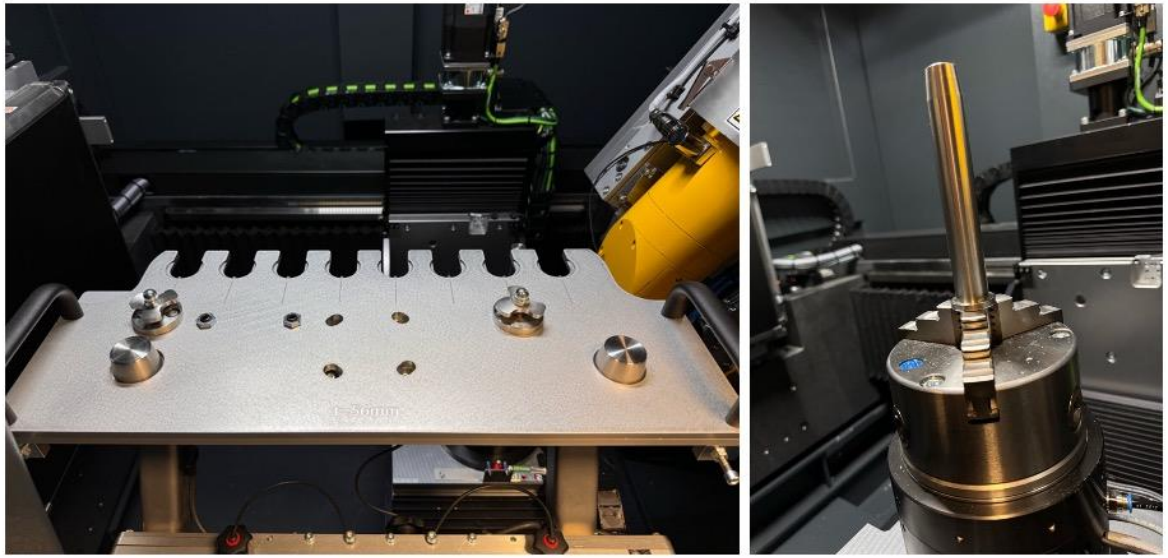

Dr. Thomas Kleinteich

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Sample changer software

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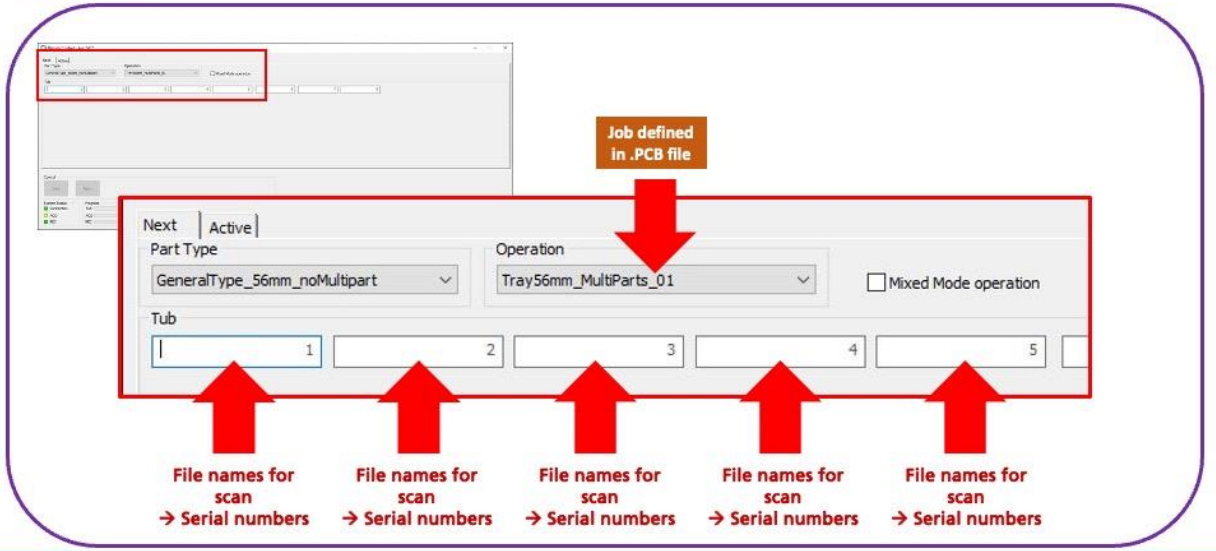
datos|x control



Dr. Thomas Kleinteich

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Usefull for inspections of multiple similar parts

Possible to define multiple jobs in single .PCB → stack parts in sample holder and scan them separately

Link VGSTUDIO MAX makros to reconstruction output → fully automated workflows

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Sample changer software

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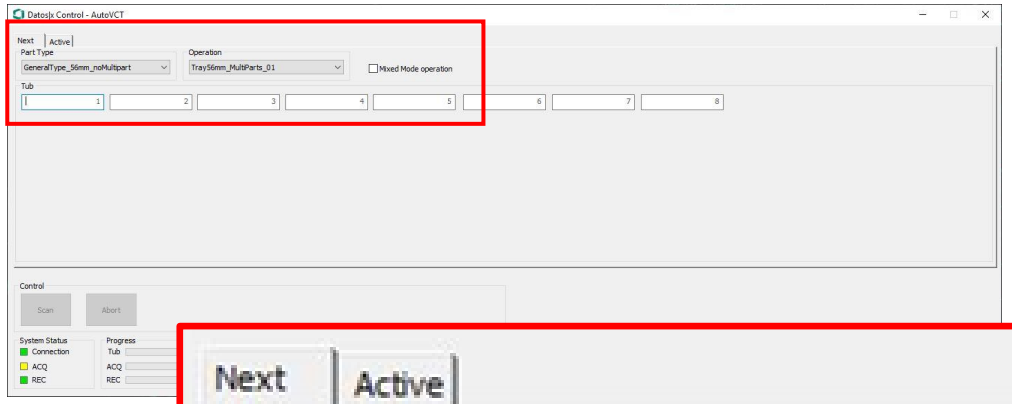
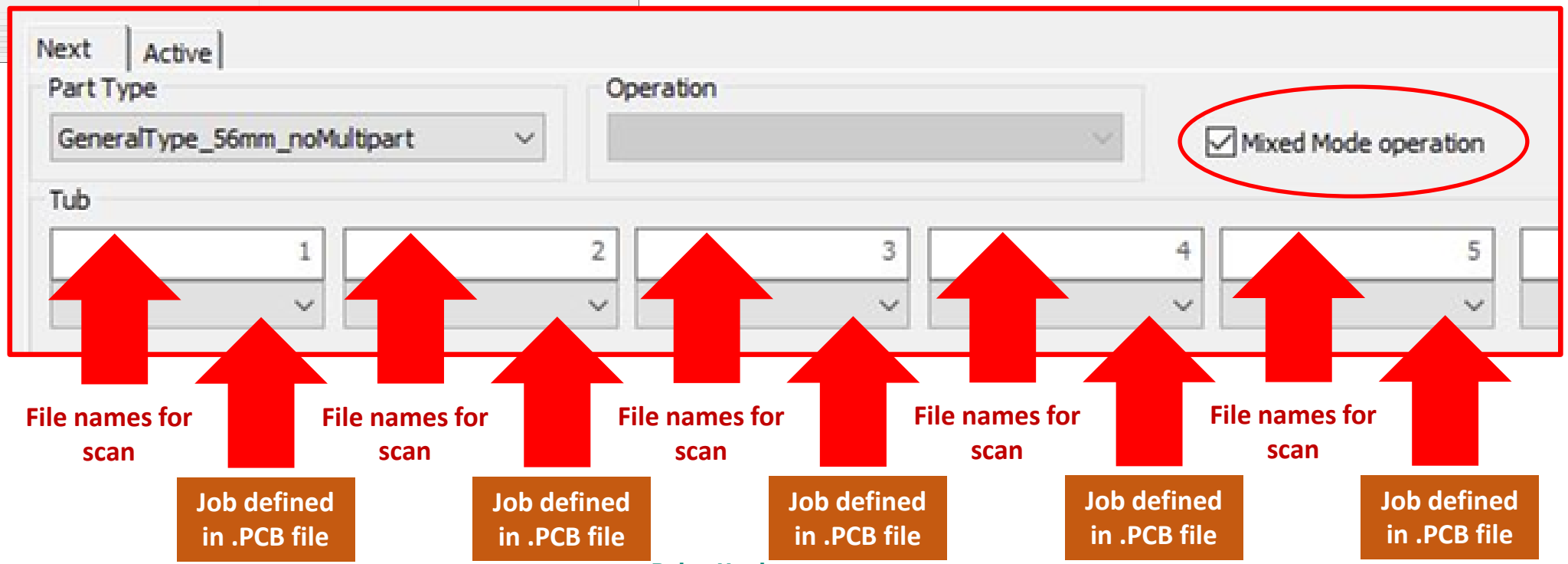
datos|x control





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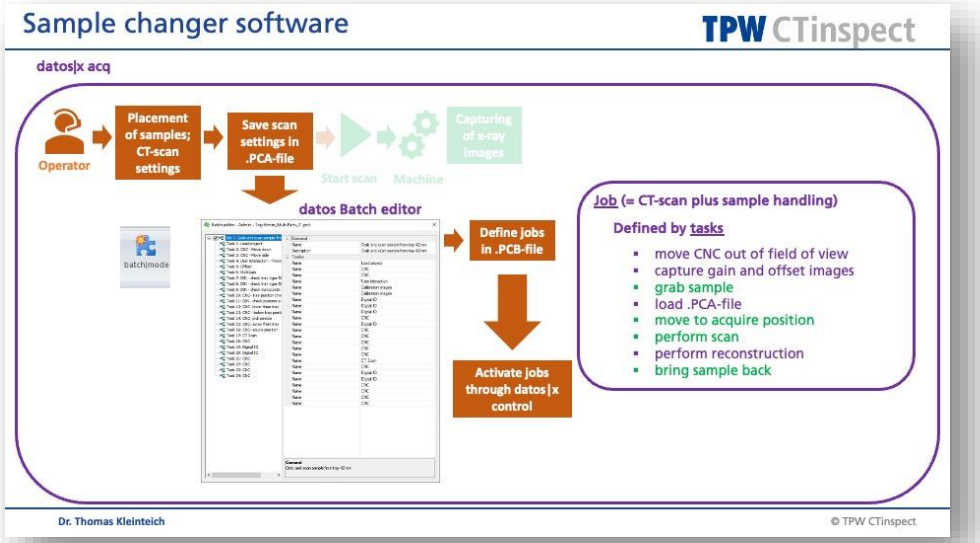
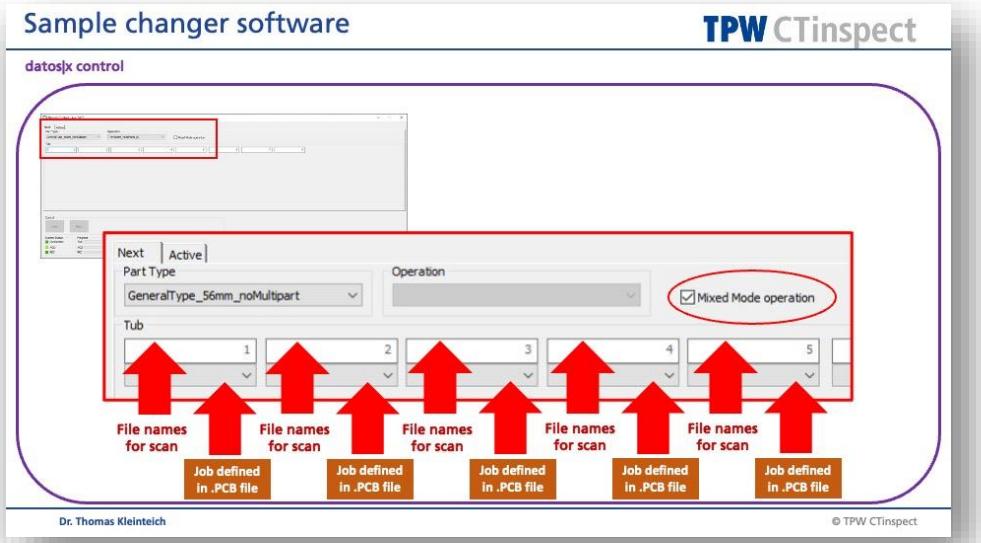
Sample changer software





Job (= CT-scan plus sample handling)

Defined by tasks

- move CNC out of field of view
- capture gain and offset images
- grab sample
- **load .PCA-file**
- move to acquire position
- perform scan
- perform reconstruction
- bring sample back

Scan parameters

- FDD and FOD (z-axis)
- Height (y-axis)
- X-ray settings
- Exposure time
- Detector sensitivity
- Number of images
- etc.

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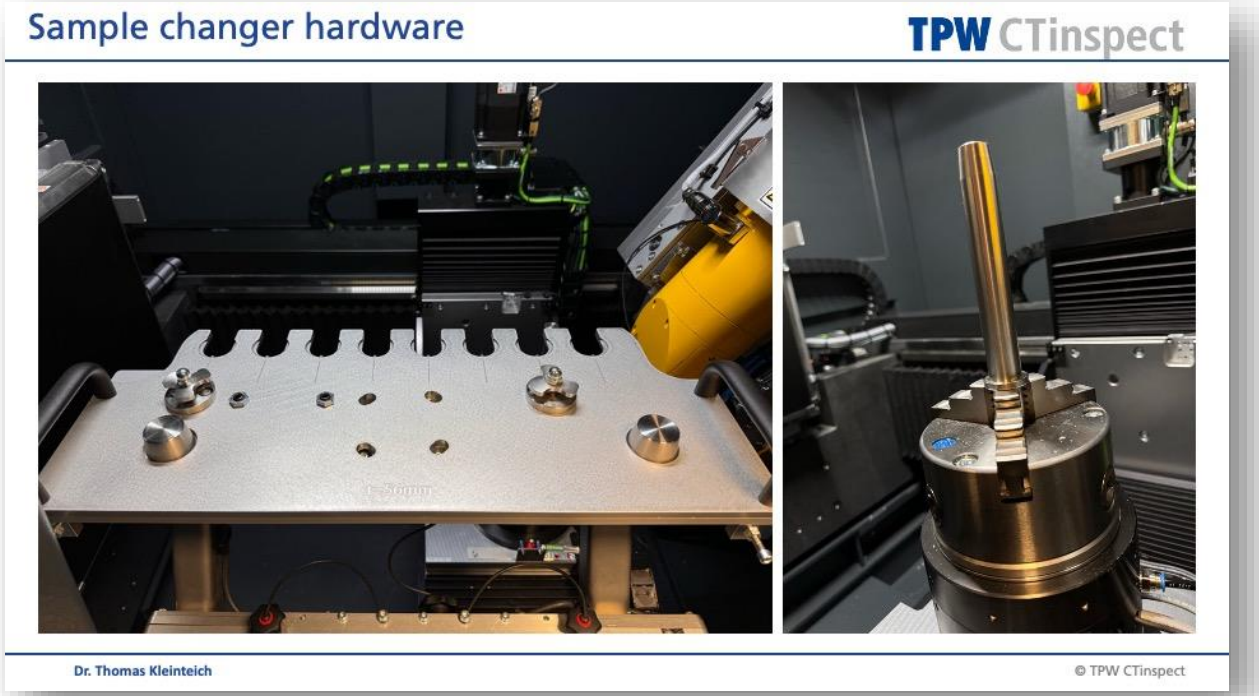
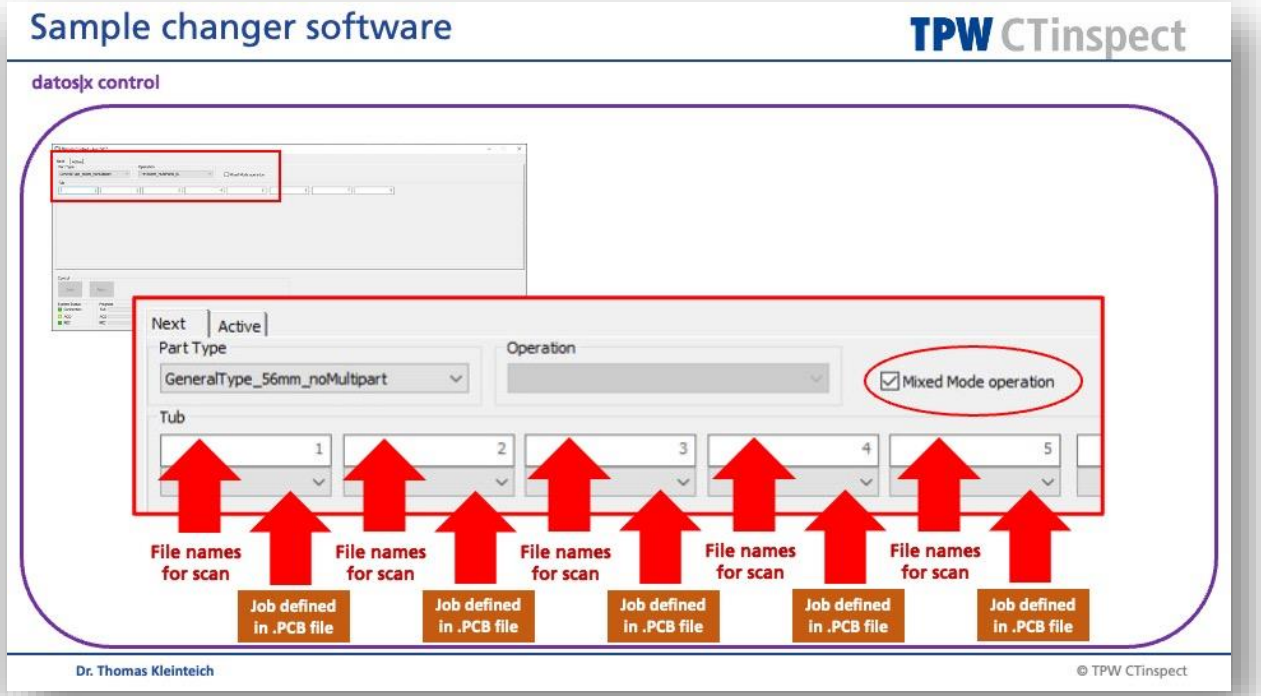
Sample changer software





Different .PCB-files with different jobs link to different .PCA-files

→ Allows to automatically scan very different samples

→ Usefull for all kinds of projects

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CT Setup Workflow

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Is it a lot of work to set-up multiple .PCB files / jobs?

No! It takes not more effort than setting up individual scans.

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CT Setup Workflow

TPW CTinspect

Is it a lot of work to set-up multiple .PCB files / jobs?

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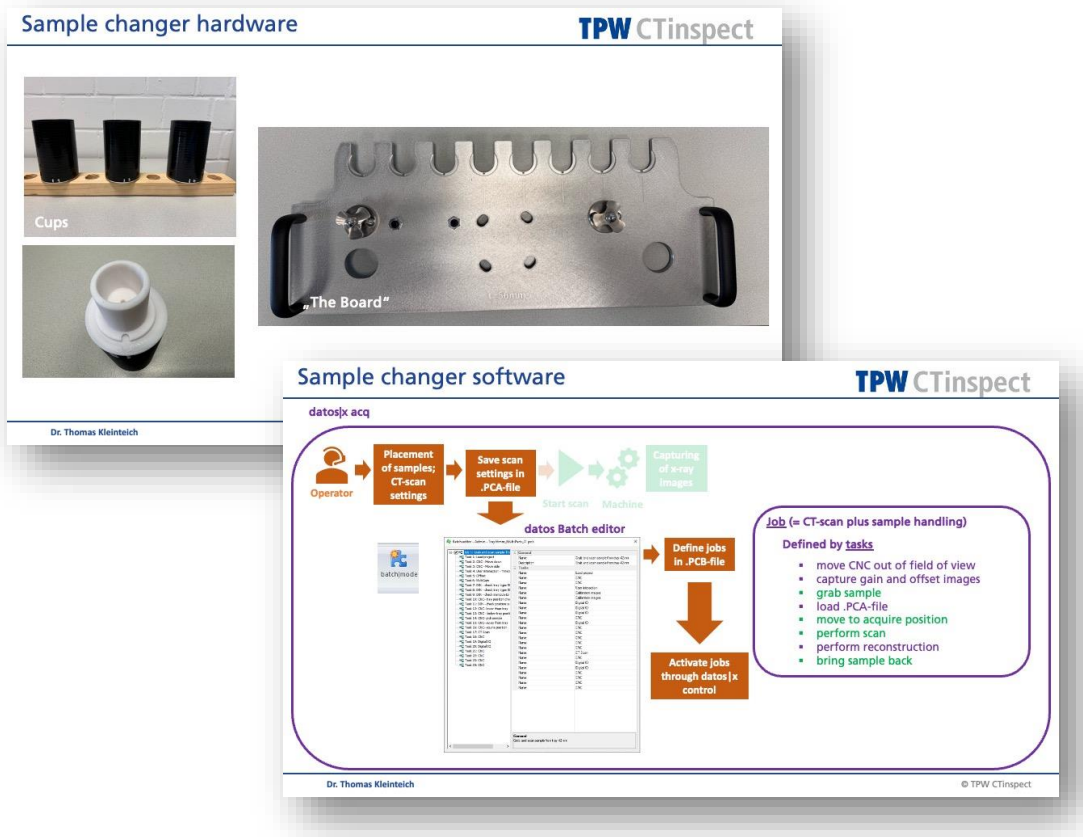
„The Board“ has 8 positions → 8 very generic .PCB-files

load PCA – perform detecor calibration – move sample to acquire position – perform scan



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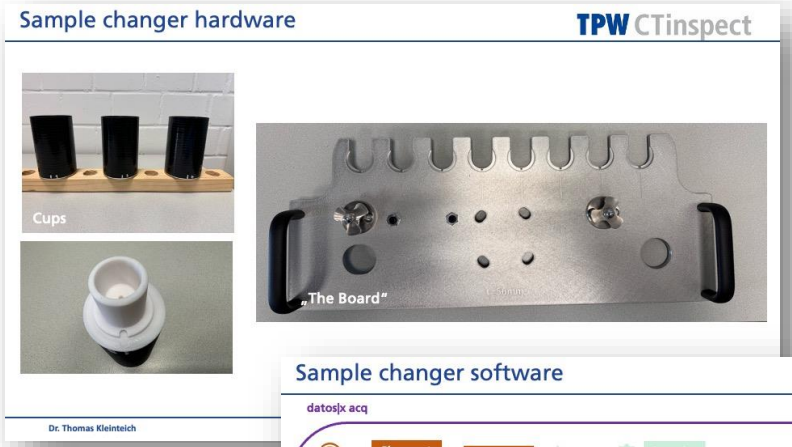
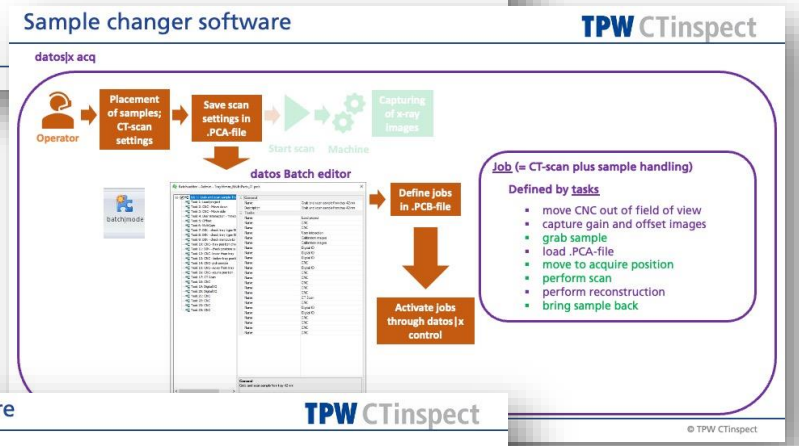
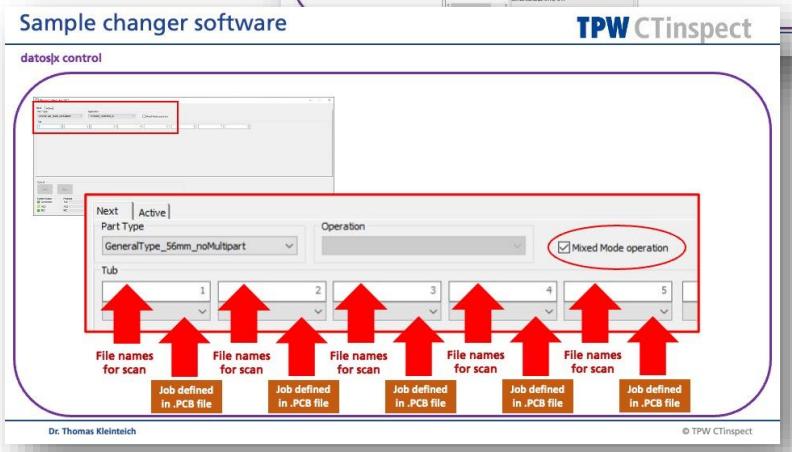
load PCA – perform detecor calibration – move sample to acquire position – perform scan

Operator:

- places samples in cups / customized holders
- creates .PCA files with part-specific scan settings
- links .PCA-files in .PCB-files
- updates path for offset and gain images
- enters file names in datos|x control and selects .PCB-files







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< 10 mins.

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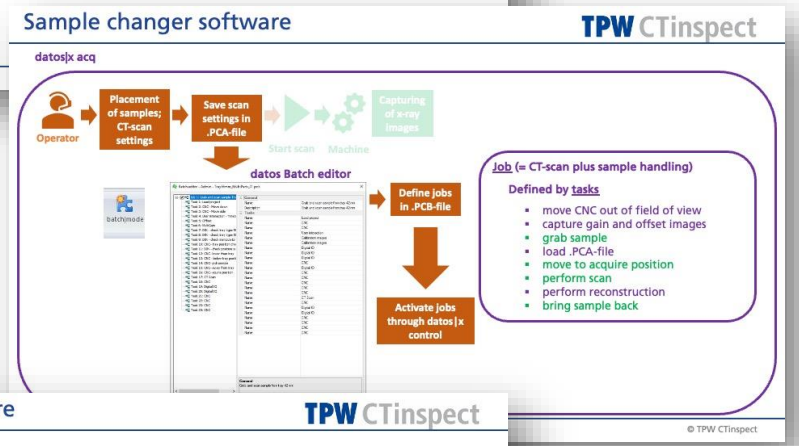

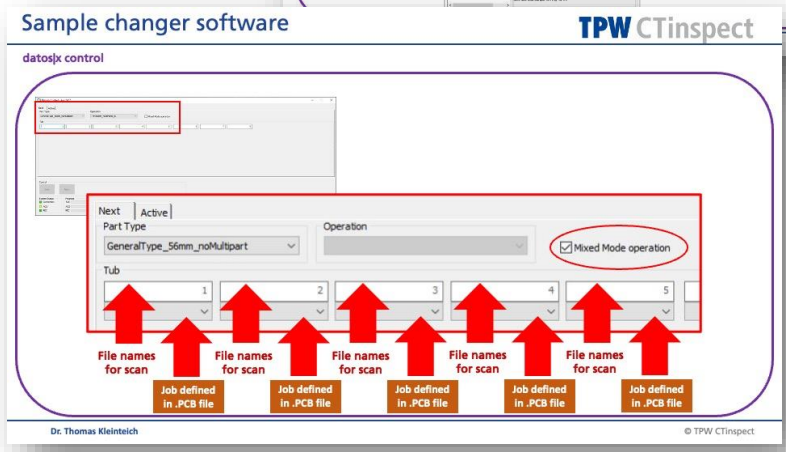

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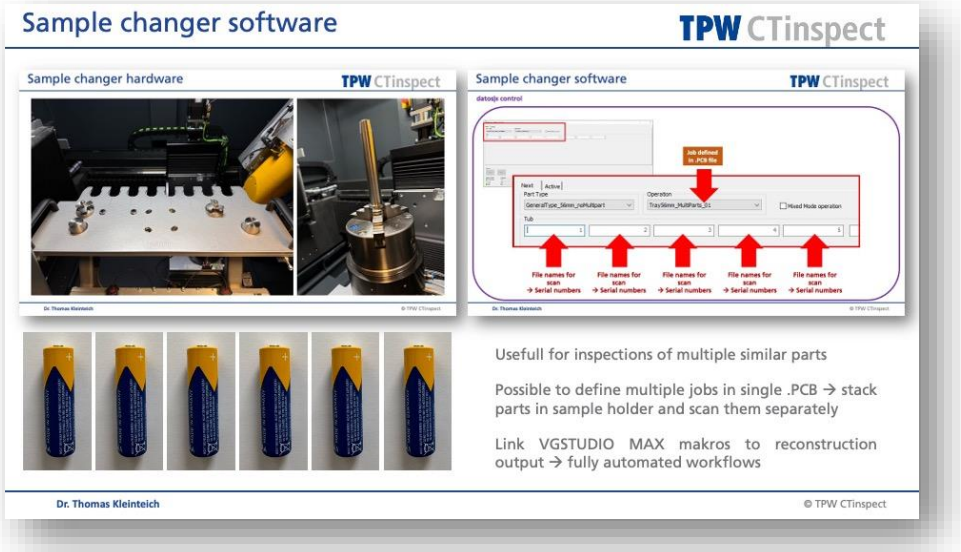
Summary

Sample changer works well for serial inspections

Integration of reconstruction and VGSTUDIO MAX data processing

- ➢ fully automated workflows from scan to PDF report



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Summary

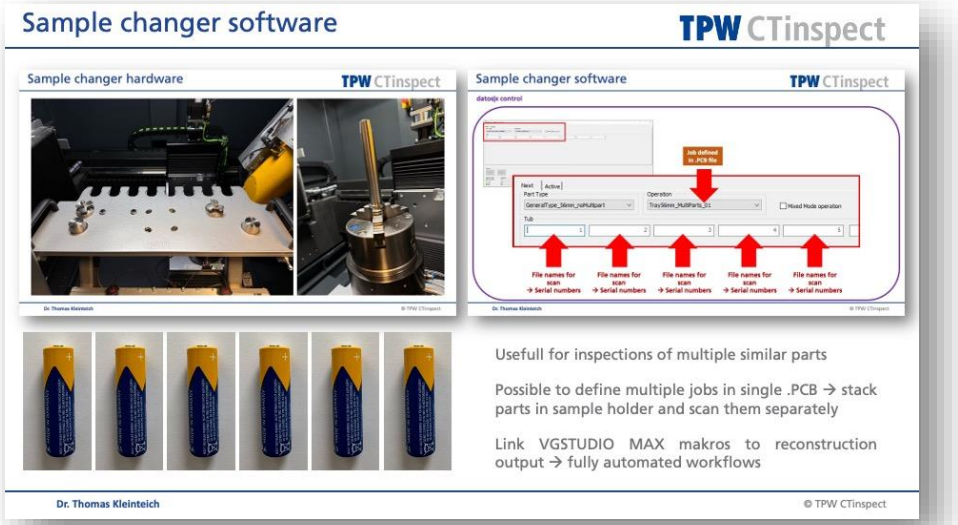
Sample changer works well for serial inspections

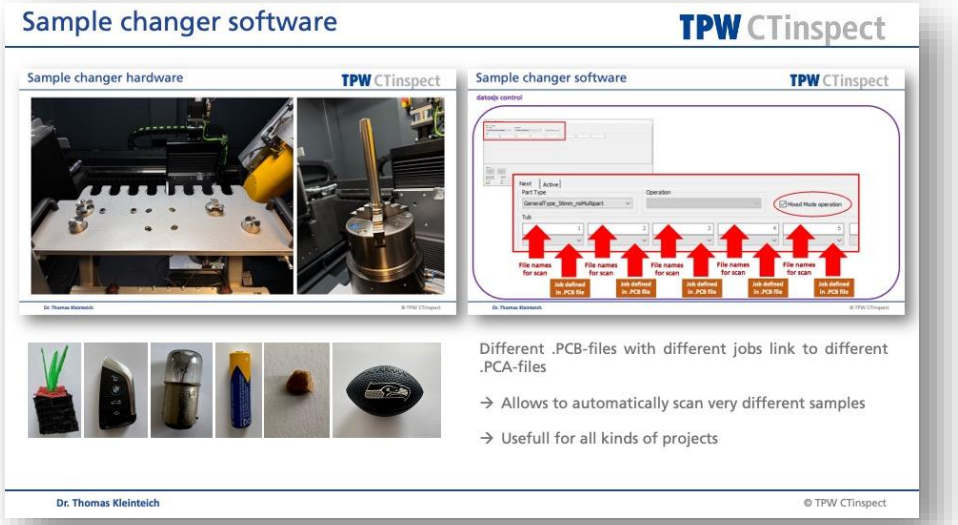
Integration of reconstruction and VGSTUDIO MAX data processing

- fully automated workflows from scan to PDF report

„Mixed mode“ changed the way we operate the machine

- instead of setting scans up on the pace of CT-scanning process, we do it as batches
- machine runs for several hours without interaction
- less disruption for operator
- machine down-times reduced to a minimum





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Thank you!

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