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Microscope vs Digital Diagnostics:
Improvements and Challenges in Logistic and Diagnostics after Digitalization in a Pathology Laboratory

Laboratory Pathology East Netherlands Hengelo

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Director Computational Pathology

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Pathology Laboratory East Netherlands in Hengelo

Facts & Figures

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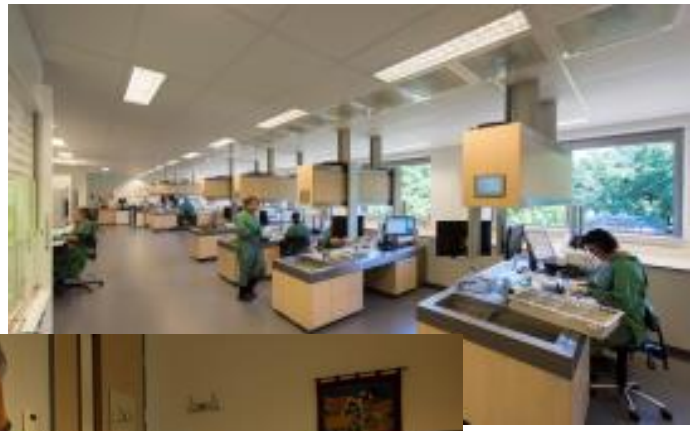
120 employees
21 pathologists
90 laboratory technician
60,000 histological cases
16,000 cytology cases
8,700 moleculair
12,000 IHC



100% digital diagnosis

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July 9, 2015

LabPON Achieves 100 Percent Digital Diagnosis for Clinical Cases with Philips

Largest pathology laboratory in the Netherlands becomes first in the world to complete transition to digital pathology

PHILIPS

Collaboration with Philips Digital & Computational Pathology

Challenges in flow

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Digitalisation changed the flow of the entire process in the laboratory

Challenges in flow

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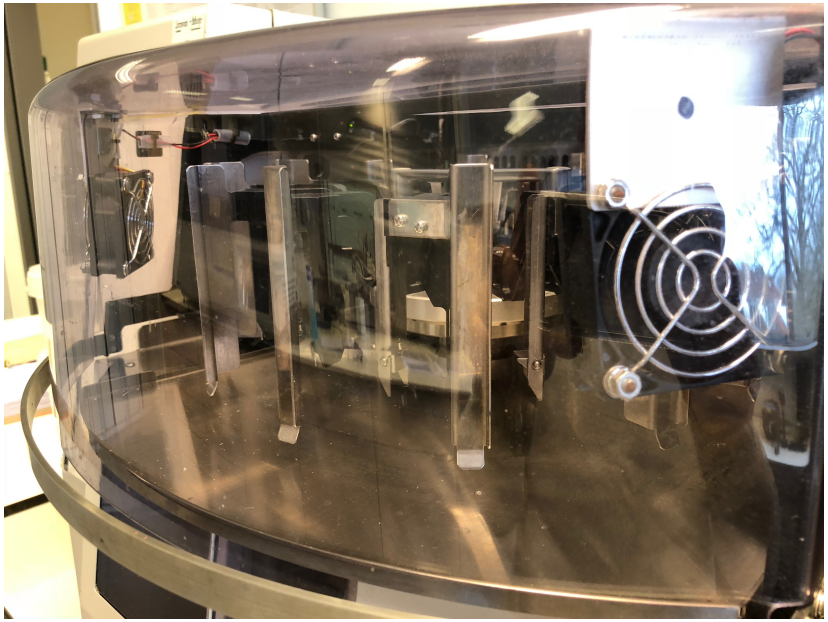
LabPON:

- Coverslipper
- Labelling machine or (paper) labels
- sticky slides (IHC)



Challenges in IT adjustments (internal and external network, switch)

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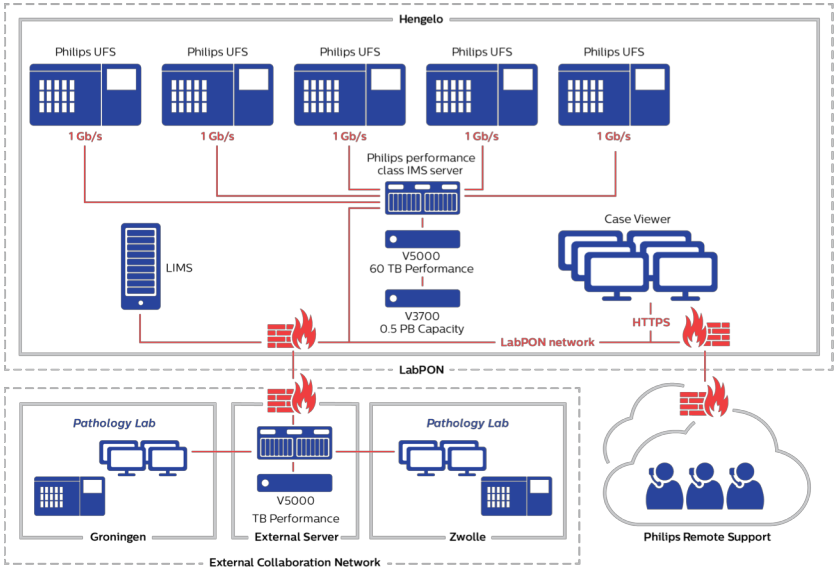
1. Internet, network, switches …
2. Computer (processor, SSD, Video card …)
3. Monitor
4. Interface
5. Server; speed and (temporary) storage.
6. Archive storage: disc or tape



Scanners

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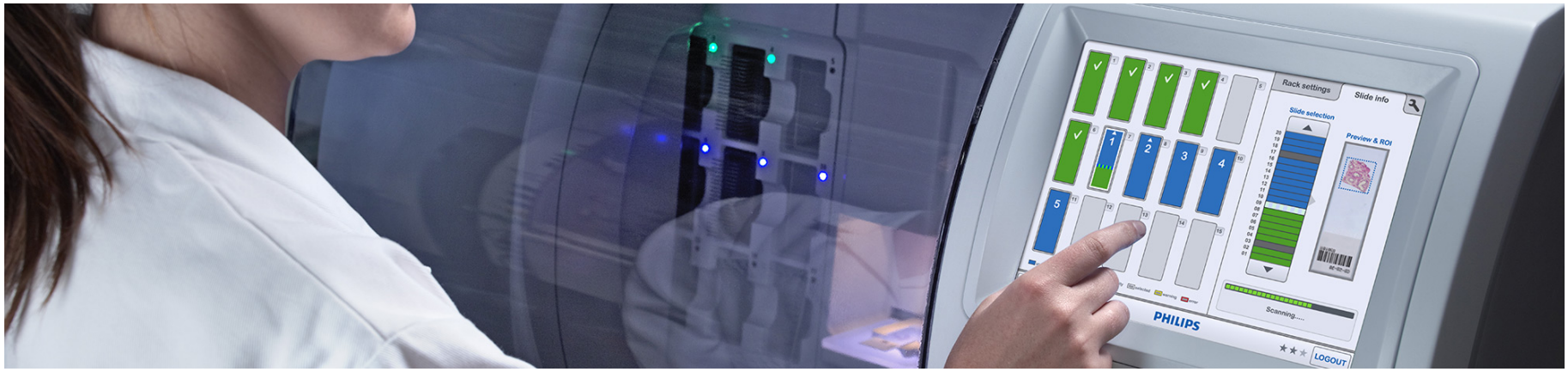
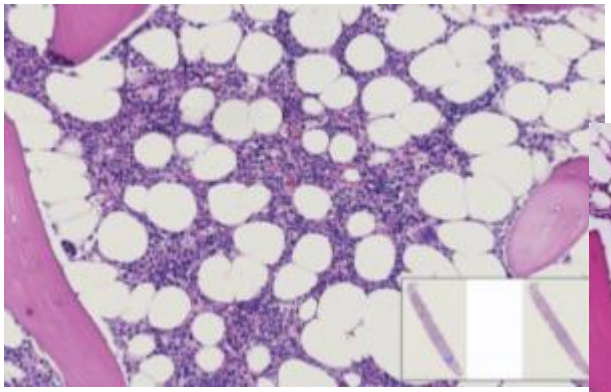
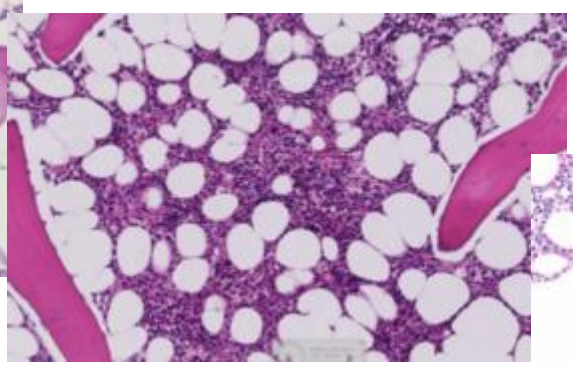


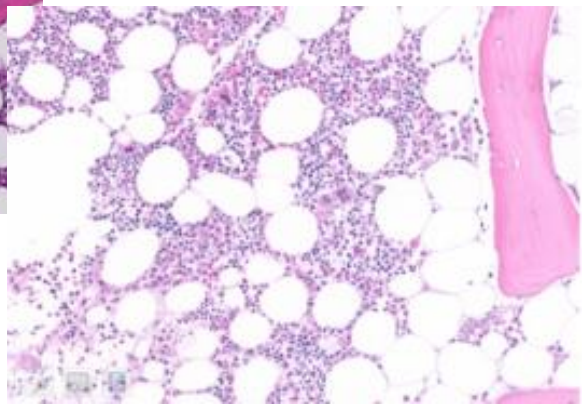
- Easy to operate
- Clear instructions
- Fast
- Service
- Image quality

- Mechanical problems
- Out of focus, mostly fatty tissue and IHC
- Multi-layered image
- IF scan
- Big slides

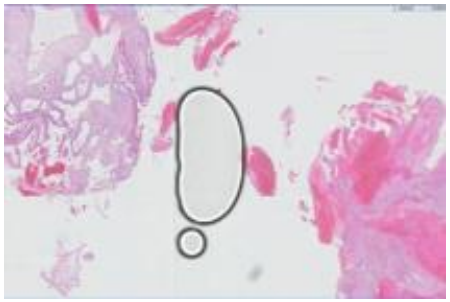
Challenges - Image quality

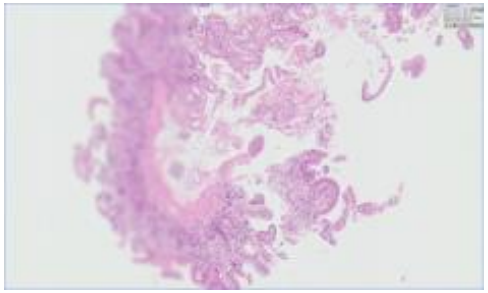


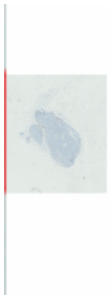


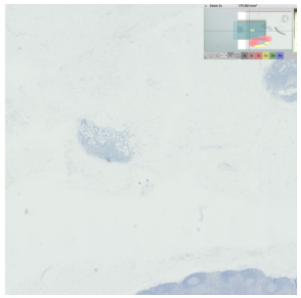


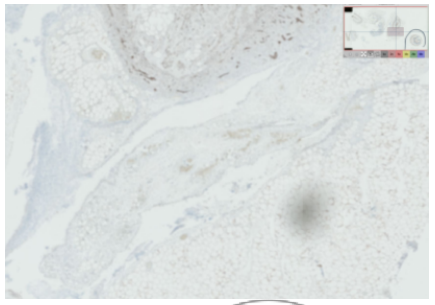
1. Image quality.
2. Missing a piece of tissue.
3. Out of focus, mostly fatty tissue and IHC.











IMS – LMS integration

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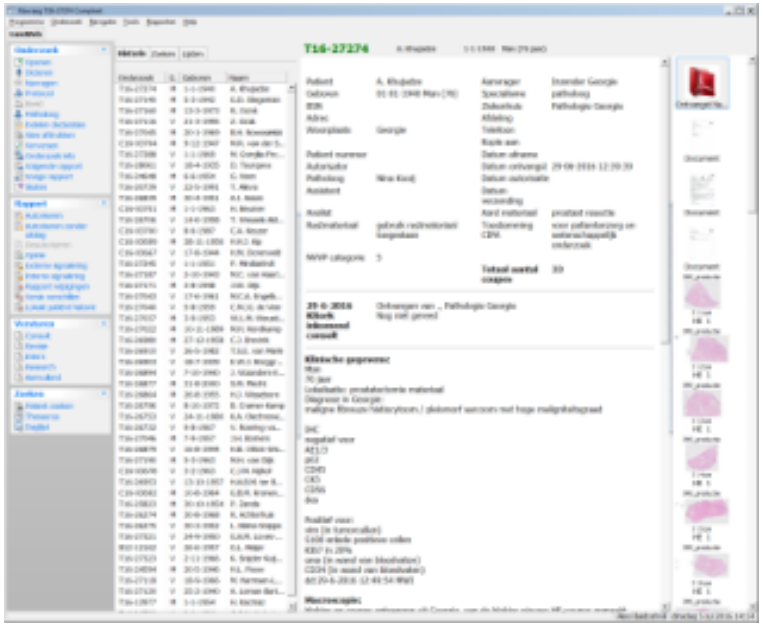
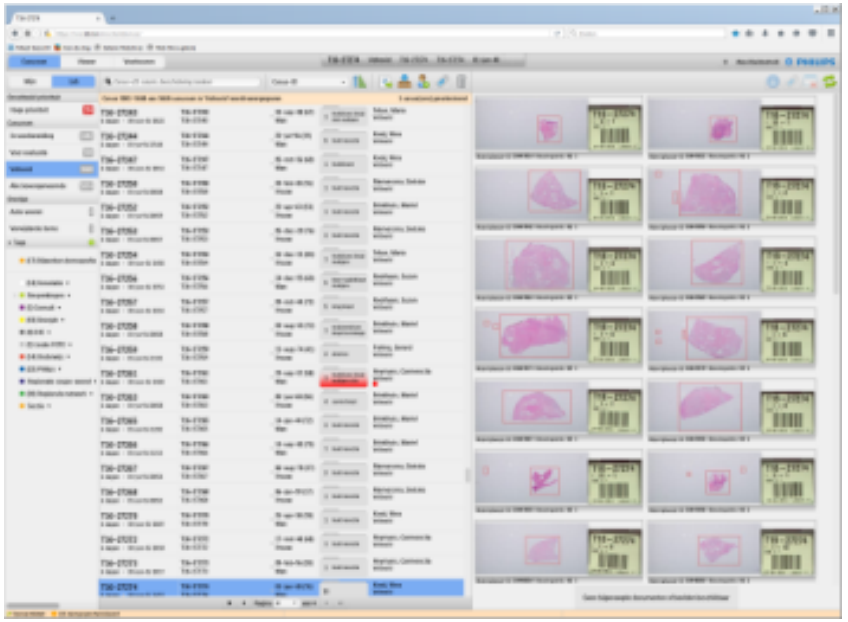
Bilateral integration





Workflow and Quality Improvements

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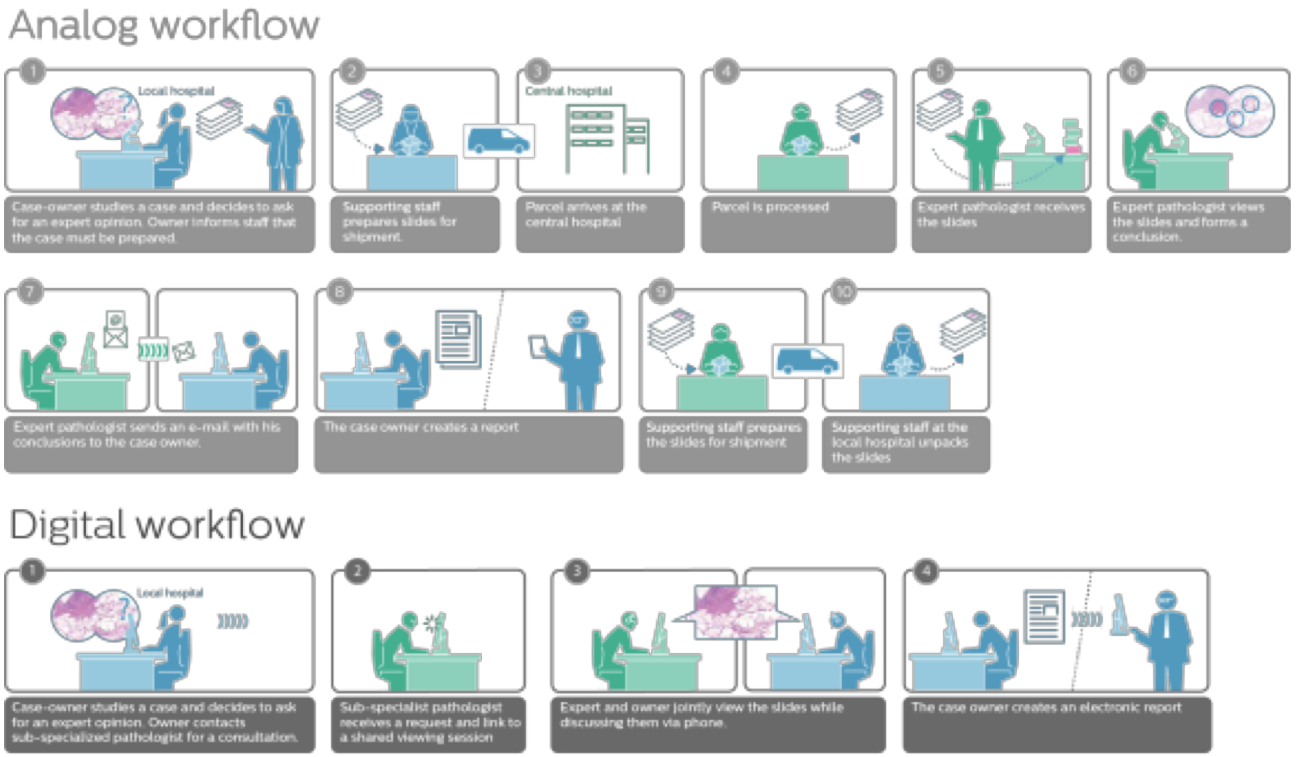
Logistics concerning glass slides in laboratory

Analog vs Digital

Quality improvement
- time-saving secretary
- equipment-saving
- risk damage material
- quality of service

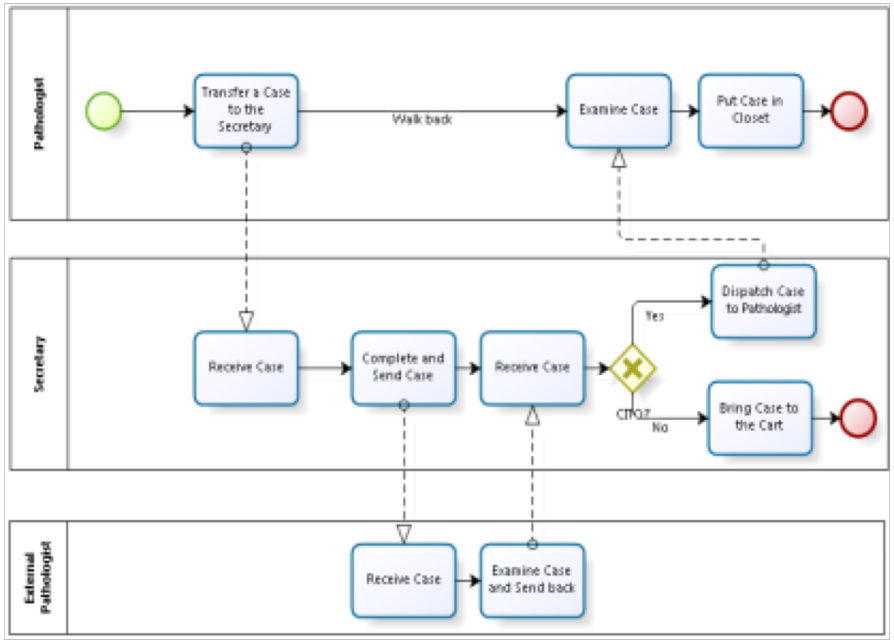
External network
Consultation / revision

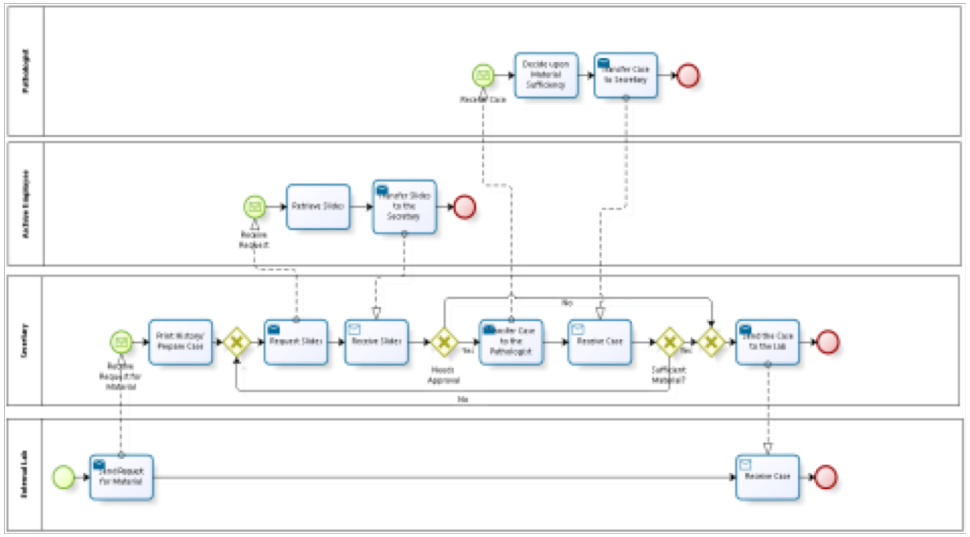


Consultation: analog versus digital workflow

- time-saving secretary
- mail and packet cost
- risk and cost damage material
- quality diagnostic

Flow analysis – Consultation extern and Revisions





Total 2 hours per day

Flow analysis and validation of External network for consultation / revision

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Validation of a whole-slide image-based teleconsultation network.

Baidoshvili A, Stathonikos N, Freling G, Bart J, 't Hart N, van der Laak J, Doff J, van der Vegt B, Kluin PM, van Diest PJ. Validation of a whole-slide image-based teleconsultation network. Histopathology 2018 Jun 12. doi: 10.1111/his.13673.

Improvements in diagnostic logistic

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Fast and efficient replies to queries over the phone

Fast and efficient internal and external consultations

Fast and efficient - MDM

Remote live (CITRIX) consultations

Information and images are accessible everywhere and anywhere

Education and research are much easier to organise

Workflow Improvements and Challenges after Digitalization

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Flow analysis and experiences

In 2013 we investigated workflow:

- Experienced pathologists - both methods - analogously slightly faster.
- Only diagnostics time was examined, without logistical aspects.
- MDDs (multidisciplinary discussions), switching from slides to digital diagnostics

In 2015 and 2016 LabPON we set up a new flow analysis, in which workflow optimization becomes transparent."

Flow analysis and experiences

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Evaluating the benefits of digital pathology implementation: time savings in laboratory logistics.

Baidoshvili A, Bucur A, van Leeuwen J, van der Laak J, Kluin P, van Diest PJ. Evaluating the benefits of digital pathology implementation: time savings in laboratory logistics. Histopathology 2018 Jun 20. doi: 10.1111/his.13691.

Better Logistics in Laboratory

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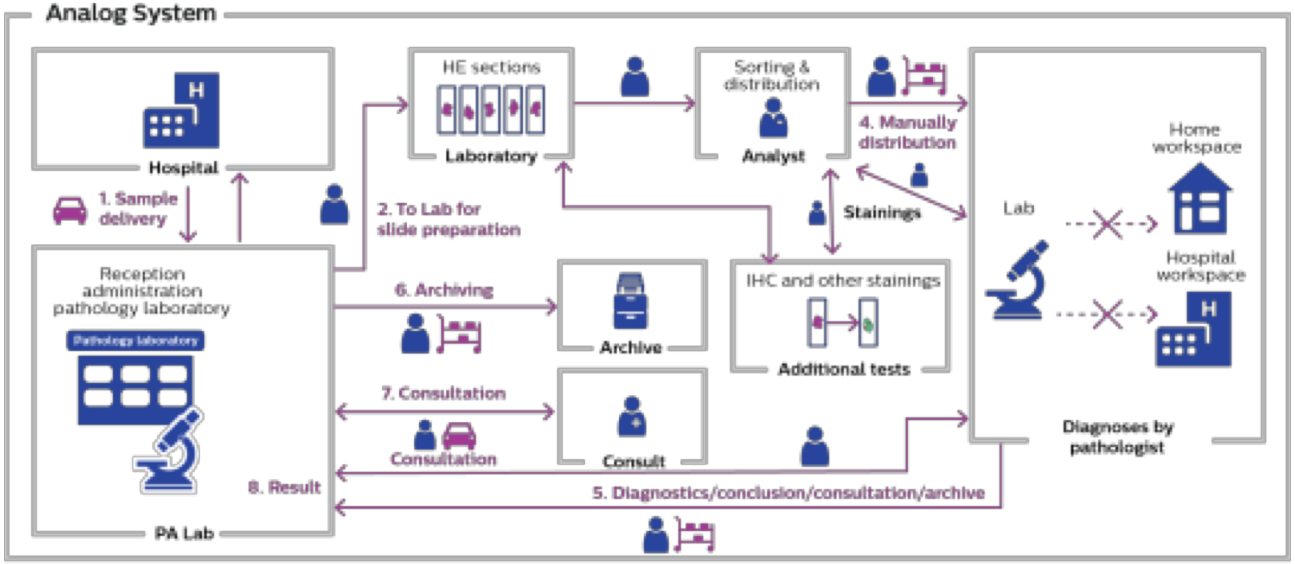
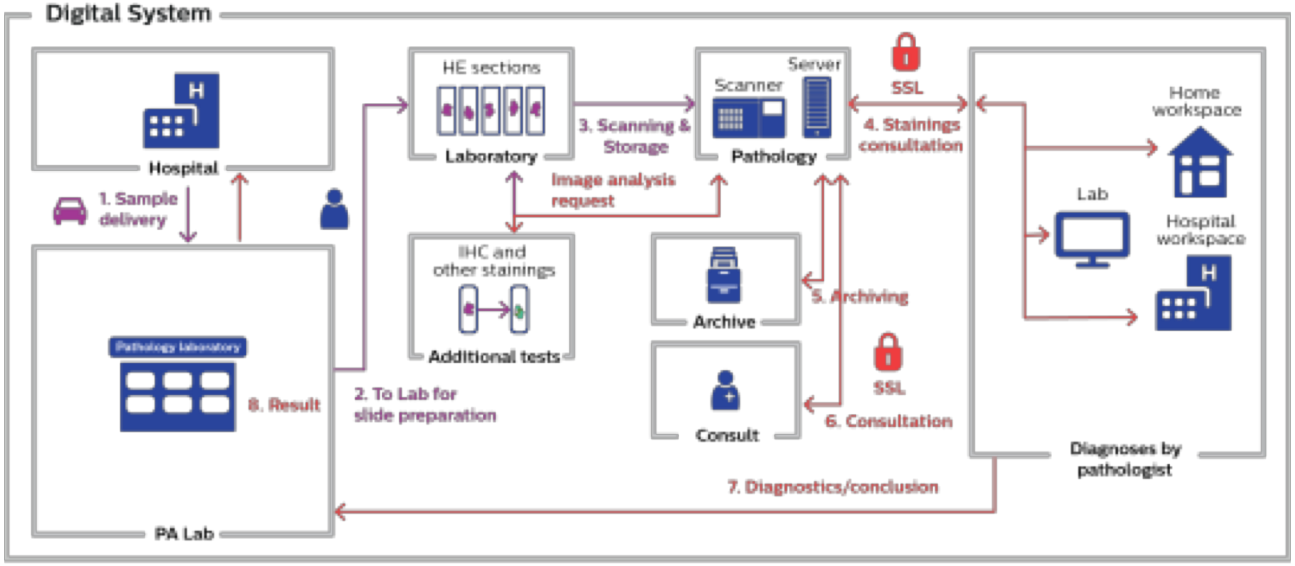
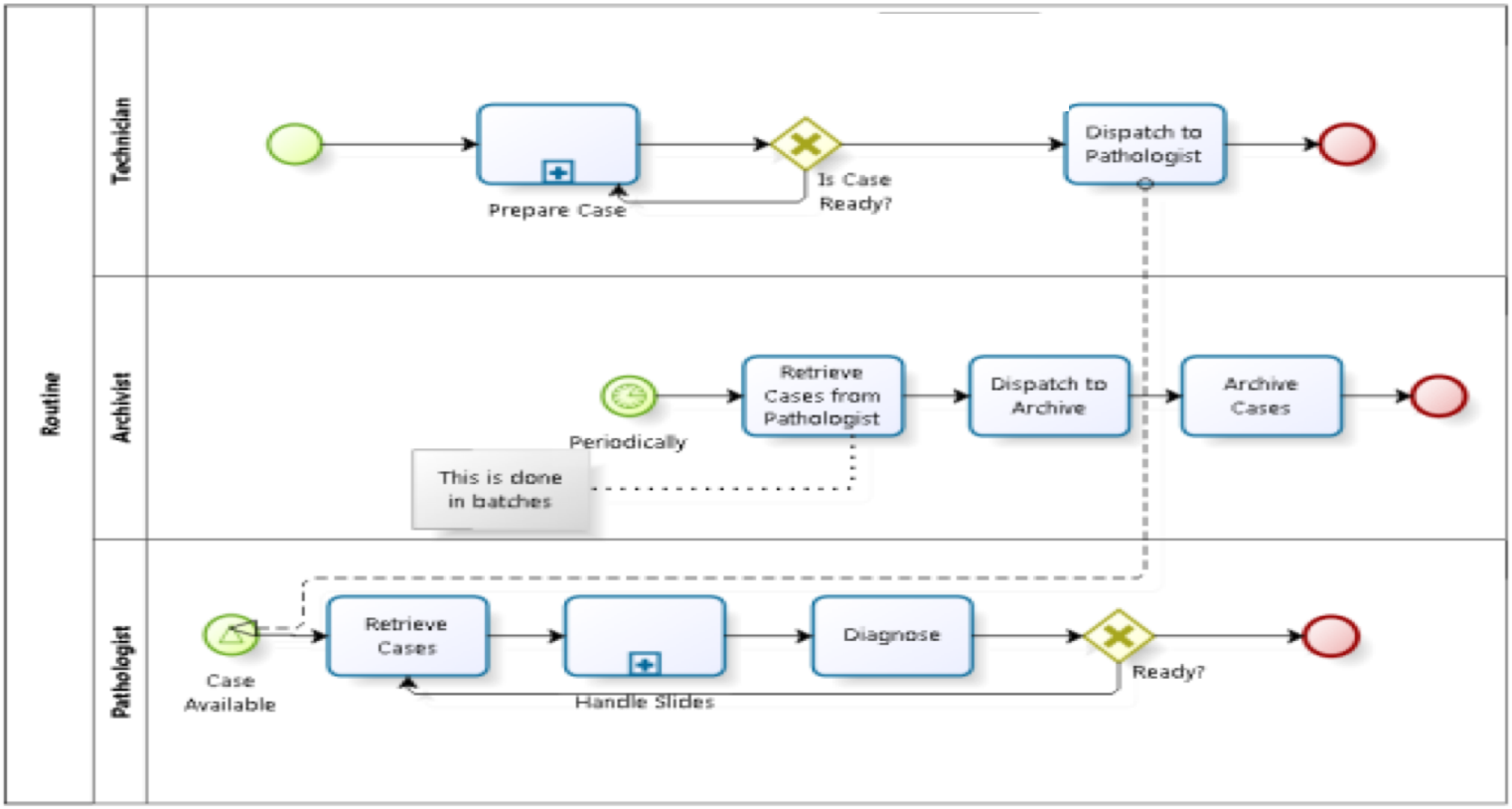




Flow analysis - Routine



Preparation of cases more than 19 hours per day

Workflow improvements by pathologist

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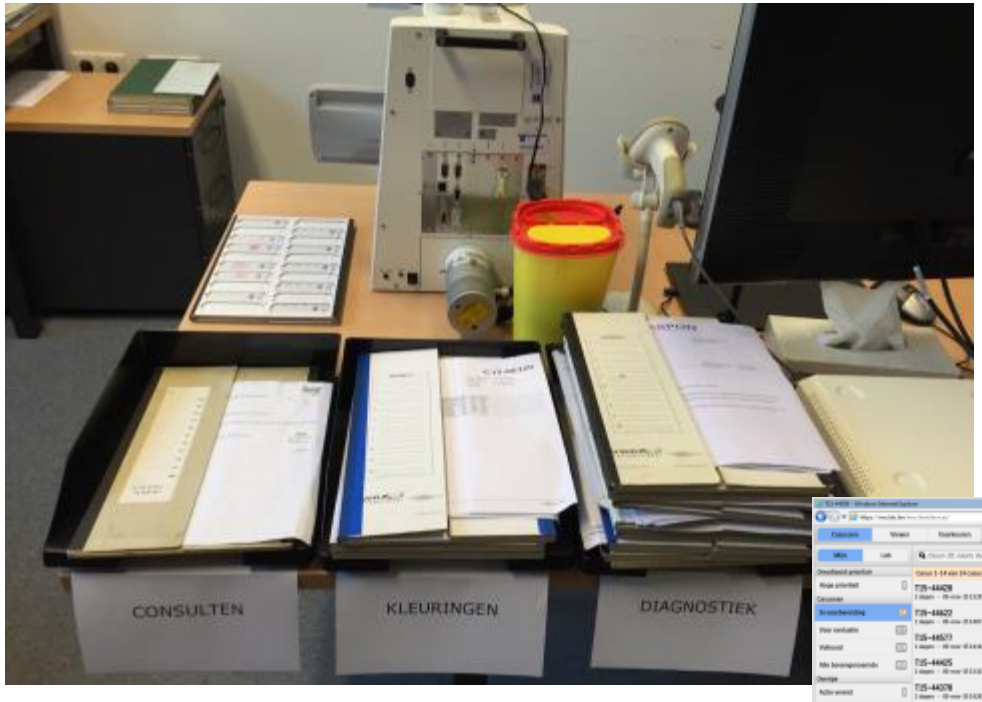
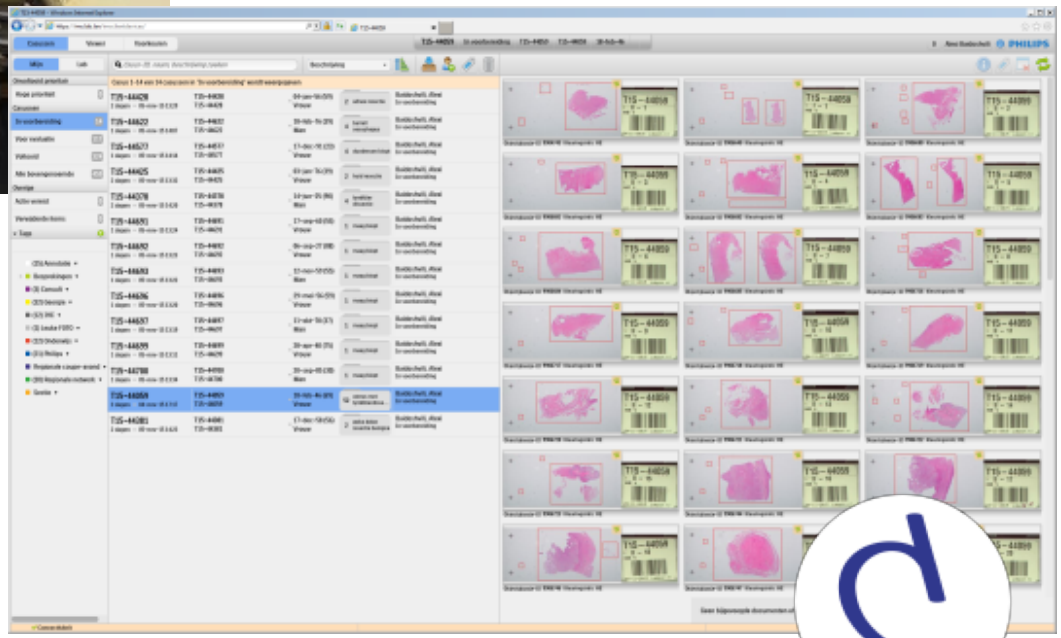


Image Management Systeem



Folders and Slides

VS

Digital file and WSI

Workflow improvements - pathologist

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Case type	Conventional	Digital	Difference
appendix	1.67	1.35	0.32
Barret / oesophagus	2.68	2.90	-0.22
breast biopsy	4.72	2.98	1.74
colon polyp excision	2.43	1.50	0.94
skin neoplasia	1.29	1.25	0.04
stomach biopsy	3.65	2.18	1.47
appendix	1.67	1.35	0.32

With handy tools of digital diagnostics we reduce the diagnostic time of pathologist by more than 12%.

Improvements - IMS

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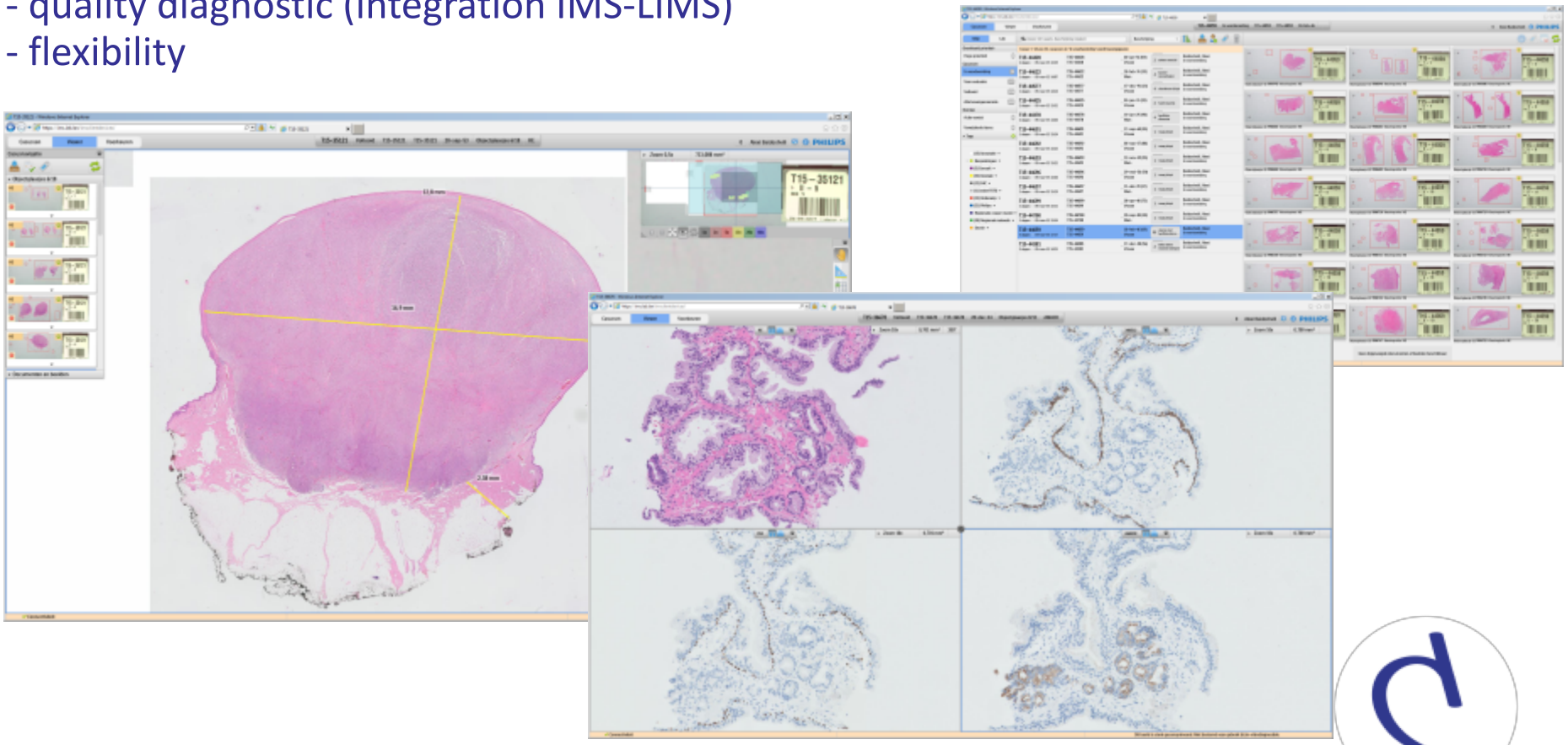
- improve logistics concerning slides/WSI (archive, MDM, consultation ...)
- improve diagnostic logistics by pathologist (internal consultation, overview of work)
- high efficiency (comparison with old material, tel. cons. clinician ...)
- handy tools (parallel viewing, measurement, quantification)
- quality diagnostic (integration IMS-LIMS)
- flexibility



Computational Pathology

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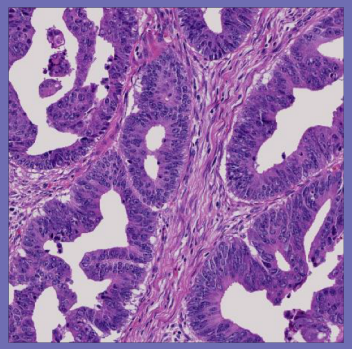
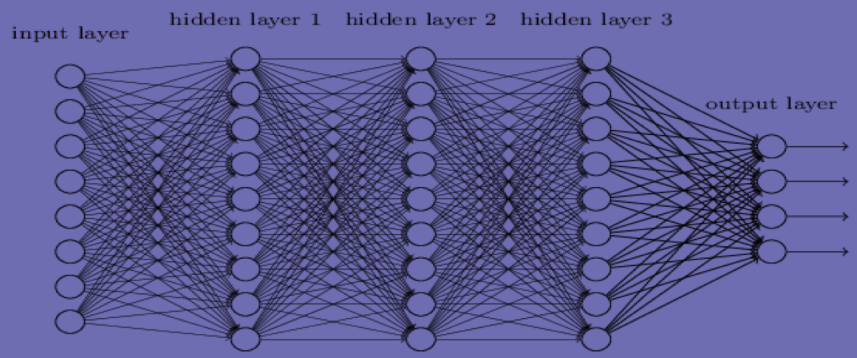
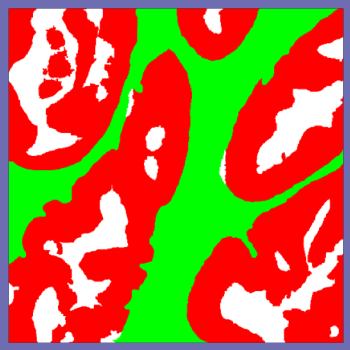
- efficiencies
- triage
- quality diagnostic

The Rise of
Practical Artificial Intelligence

Deep Learning for images







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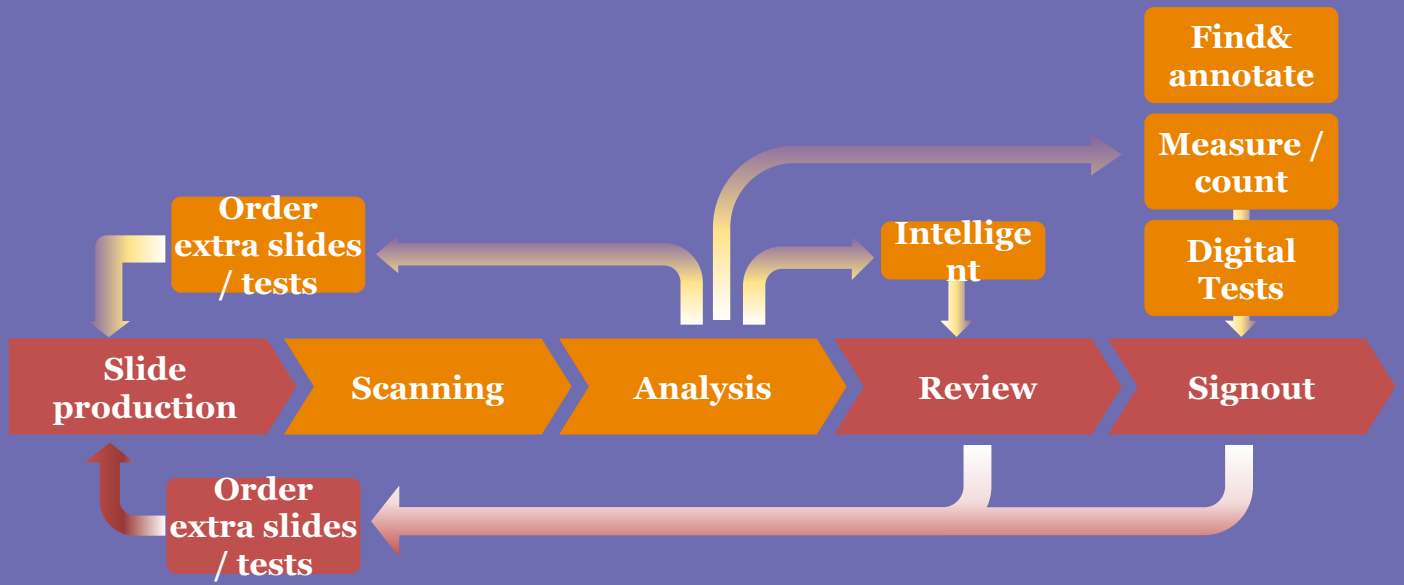
applications that are seamlessly integrated into the lab workflow



Computational Pathology

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Automated complex tasks, and **interactive simple** tasks

Localization - finding relevant cells or lesions; tumor, metastases, lymphocytes. Complex, but can be Automated by running on the whole slide image.

Quantification - *the counting* of cells, mitotic figures, structures or quantifying IHC staining. Simple, but need to be **Interactive**

Qualification - grading (Nottingham or Gleason score), molecular analysis, or determining invasive versus in-situ. Complex, but can be Automated by running on the whole slide image.

Quality control - control of quality of HE and IHC staining's, completeness of glasses, quality of focusing, tissue folds. Complex, but can be Automated by running on the whole slide image.

Benefits of Computational Pathology

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1. Increase Efficiency
2. Increase Quality of diagnostics
3. Increase of transparency
4. Financial

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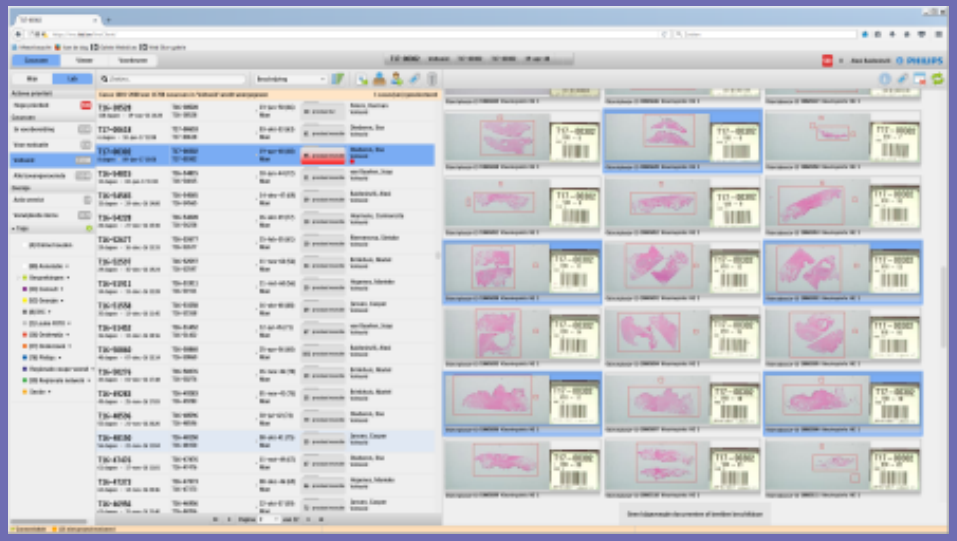
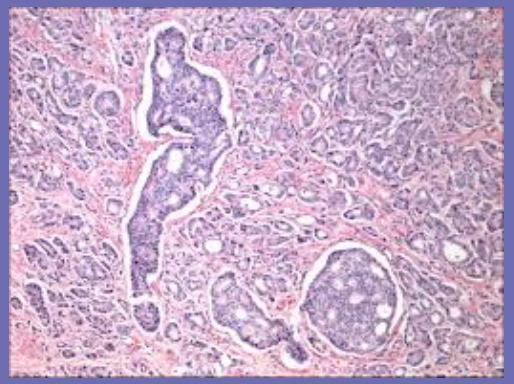
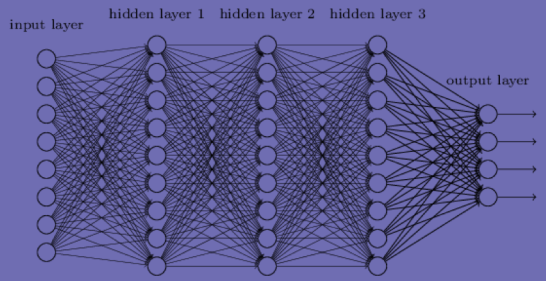
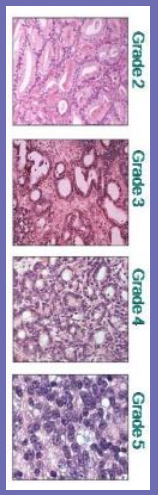


Procedure: radical prostatectomy
Weight: 50 g
Type Tumor: adenocarcinoma
Gleason score: 7 (4+3)
Tumor diameter: 2,1 cm.
Tumor localization: both sides
Extra prostatic grow (EPE): no
Tumor free margin: free
Invasion in Vesicula Seminalis: no
Perineural grow: yes
TNM-CLASSIFICATION (8e edition): pT2c







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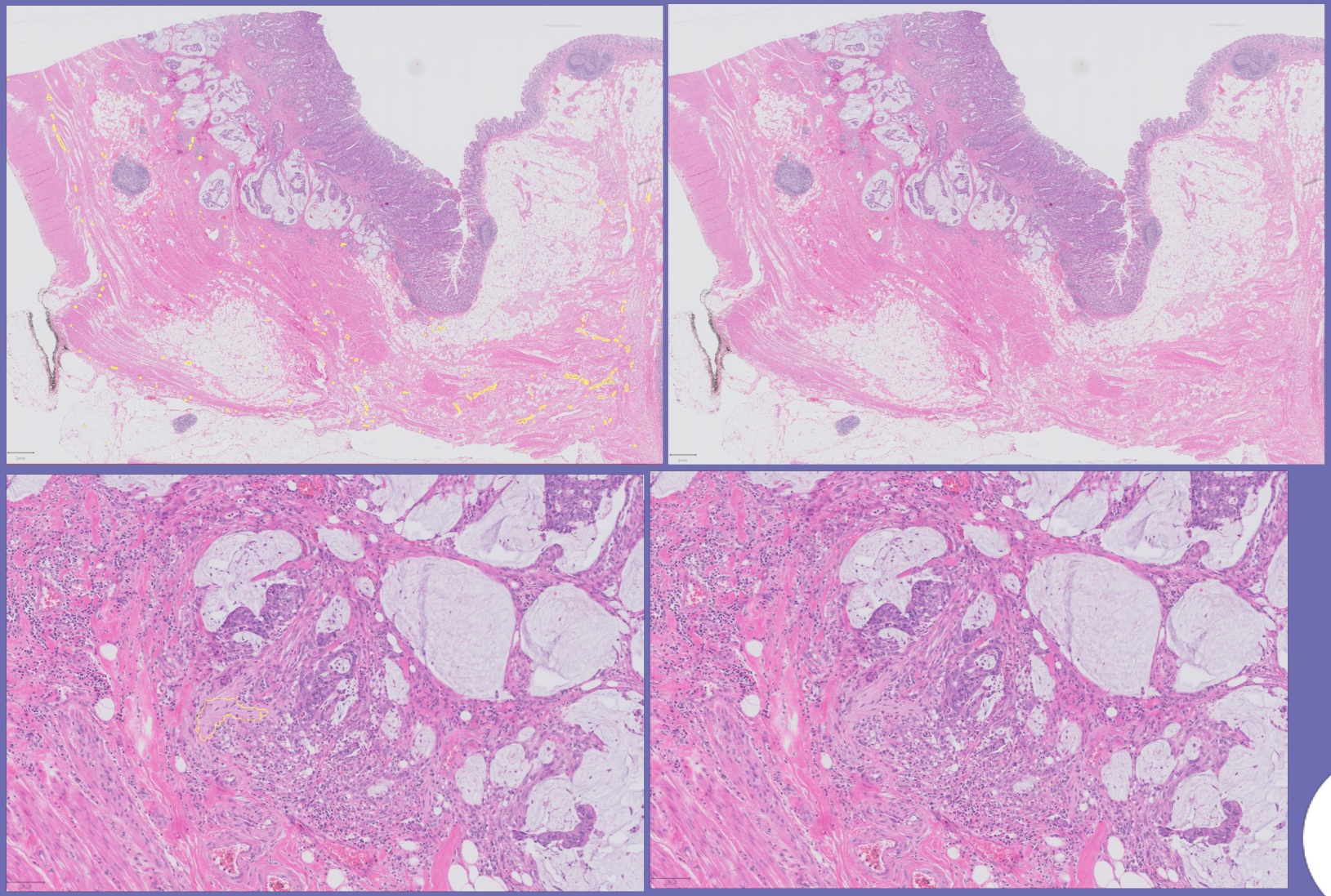
Colon adenocarcinoma - perineural growth



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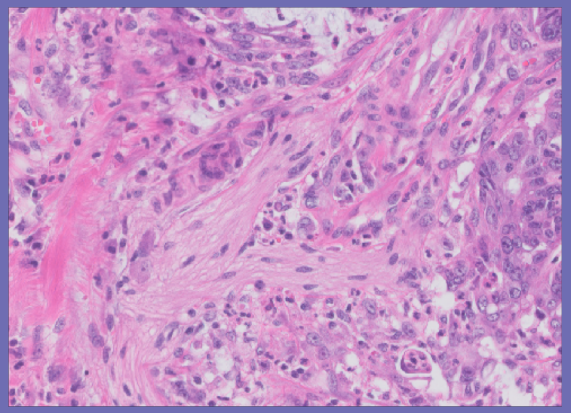
Literature: in colon adenocarcinoma 12% - 20% perineural growth

Microscope

LabPON: 2013

14% perineural growth

Time: ???

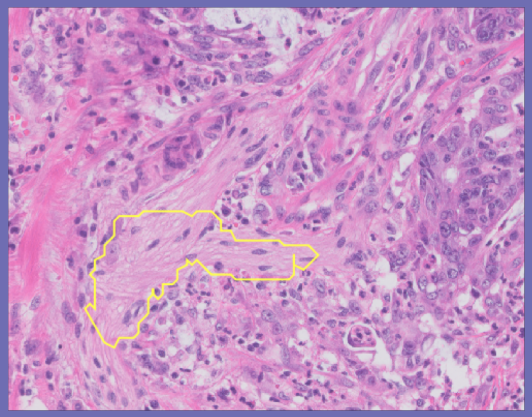


WSI First results (80% ready)

LabPON: 150 cases

15,9% positief

Time: 2 min. and 6 sec.



WSI+IA First results (40% ready)

LabPON: 150 cases

14,8% positief

Time: 55 sec.

Diagnostic time reduction with 1 min and 11 sec. (preliminary results)

Computational Pathology group

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Overview of the improvements after digitalisation

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1. Logistics concerning glass slides.
2. Better and faster logistics for multidisciplinary groups.
3. Cheaper and faster logistics for consultations and revisions.
4. Improved diagnostic logistics for pathologist.
5. Easy access to archives.
6. IMS software with handy tools and high efficiency.
7. Ability to work anywhere (remote work - flexibility).
8. IMS-LMS integration results in less mix ups and thus reduction In insurance costs.
9. Computational pathology - efficiency and better diagnostic quality.

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Pathology Laboratory East Netherlands in Hengelo

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