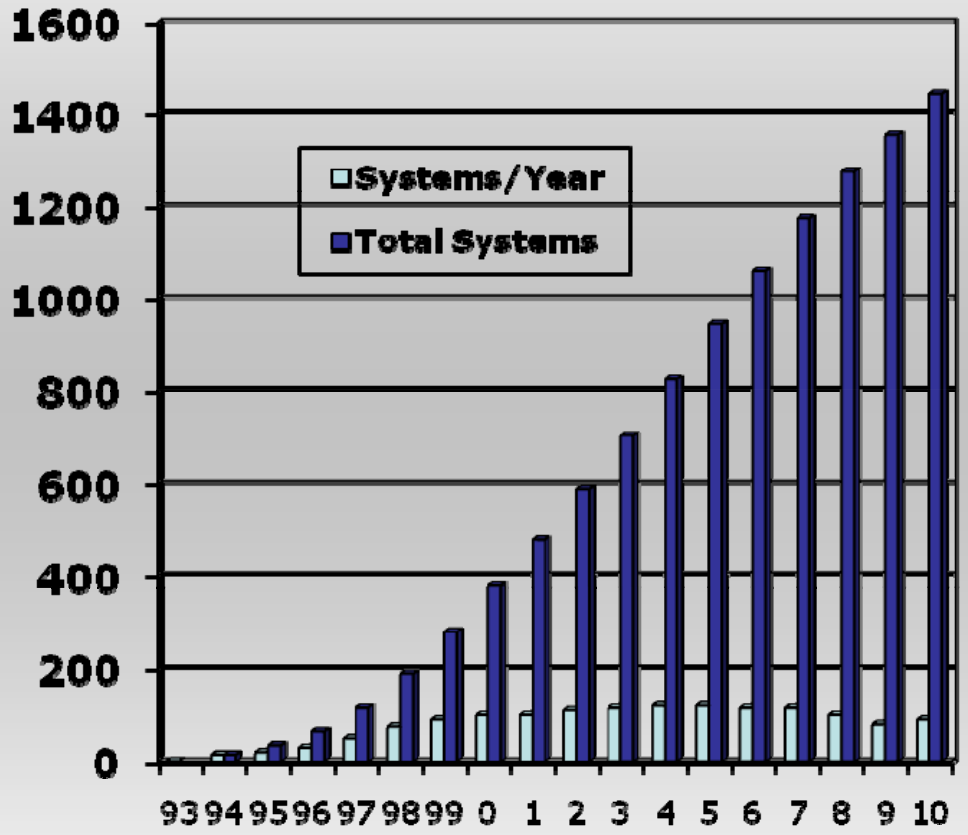
Improving papermaking & coating efficiency with web inspection cameras

Kari Hilden
Papertech Inc.

Tappi PaperCon2011
Covington, Kentucky

Web Monitoring System (WMS)
Rapid Growth

- In the last 5 years 100 to 125 WMS systems installed/year
- There are now over 1500 WMS systems in over 30 countries
- Applications include: newsprint, fine papers, board, tissue, winders, coaters, converting, box plants



Today's Must Have Capabilities

A. **Digital Cameras:** high sensitivity, uncompressed high resolution, high image speed & noise free

B. **No weak links:** cameras that stay clean, effective & efficient lighting, robust mounting, cabling that minimizes noise, industrial computers and reliable software

C. **Operator friendly:** intuitive, complete and easy to operate software.

D. **Instant download:** all event data can be immediately analyzed before re-threading

E. **Long video history:** from tens of minutes to hours

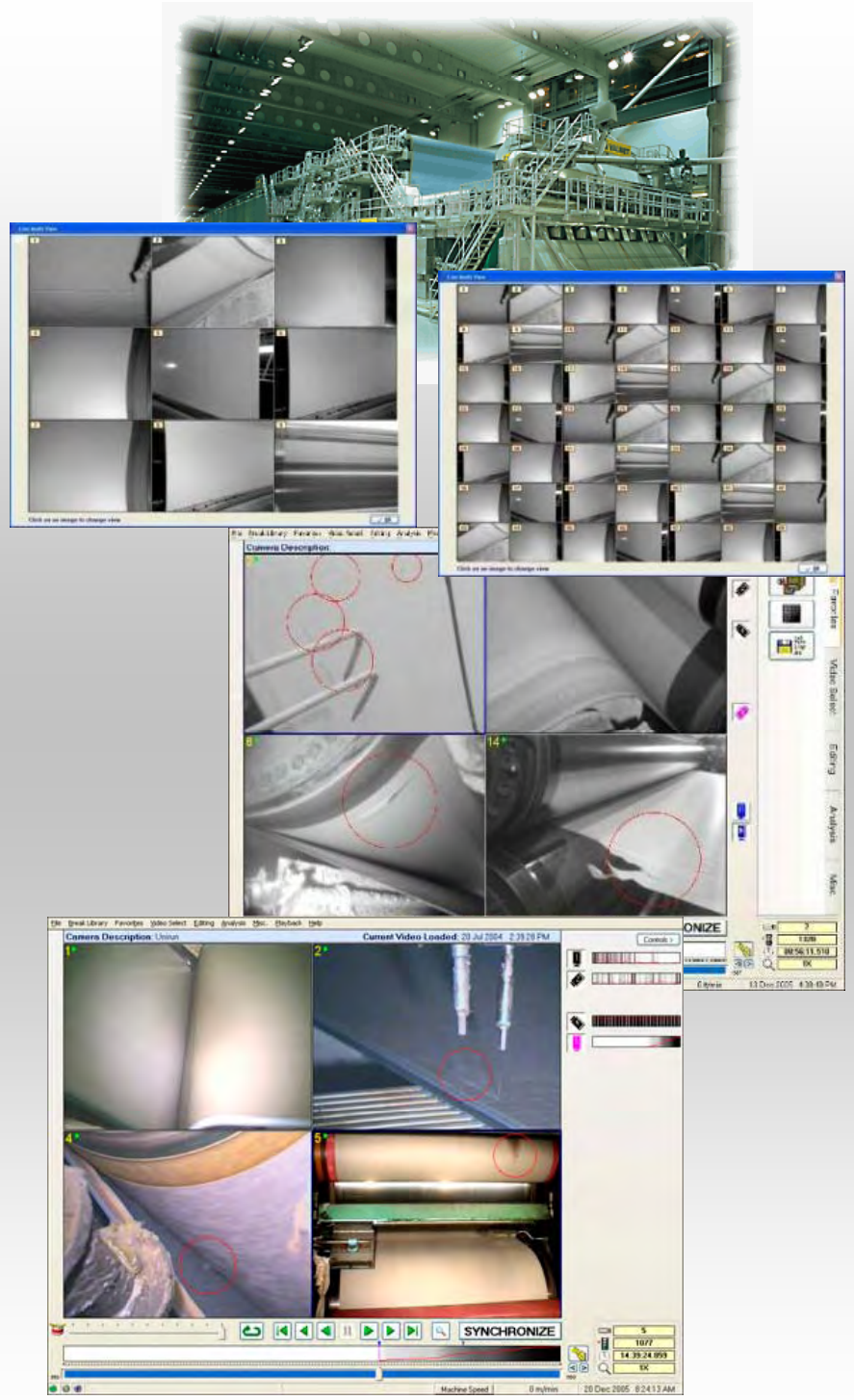
F. **Non proprietary:** all system components including computers should be off-the-shelf & mill maintainable

G. **Full web inspection integration:** web inspection system (WIS) integration allowing rapid dry-end defect to its root cause wet-end detection

H. **Millwide information system (MIS) intergarion:** provides event summary statistics, highlights problem areas, automatic tracking of downtime, etc.

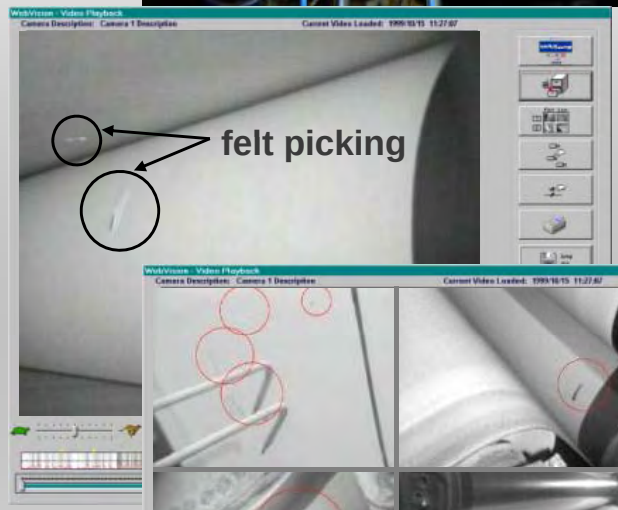
What Can WMS Do

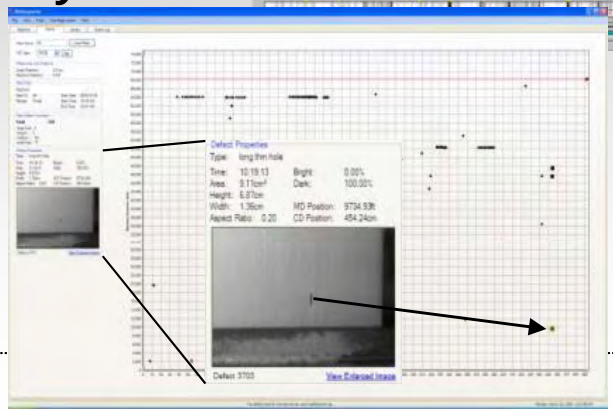
- Automatically, in real-time, monitor all critical locations and take the necessary steps to prevent breaks.
- Using easy to operate Windows based software, allow operators to fully view and manipulate all of the image information.
- Provide a detailed and complete means of solving the break reasons.



What Can WMS Do (cont'd)

- Allow air-cooled & air-cleaned cameras & lights to be placed in any desired location
- Provide a permanent record of events that can be printed, categorized and easily retrieved
- Fully total vision interface with web inspection systems (WIS) for total defect to root cause visibility
- Interface with millwide systems, allowing the data to be automatically downloaded and categorized by event type, location, shift, day, month, etc.



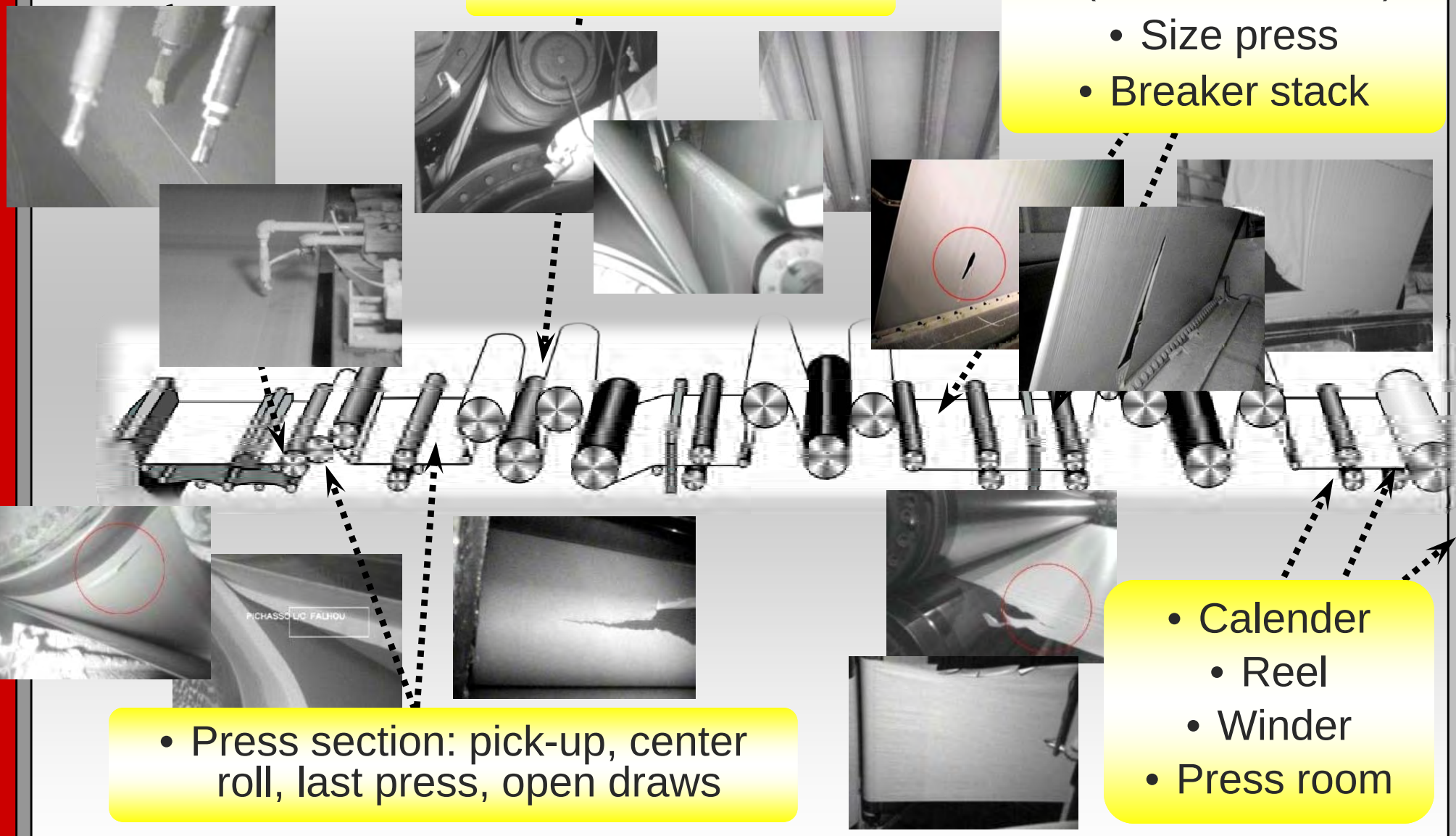


Typical Paper Machine Applications

- Trim squirts

- Dryer first and second sections

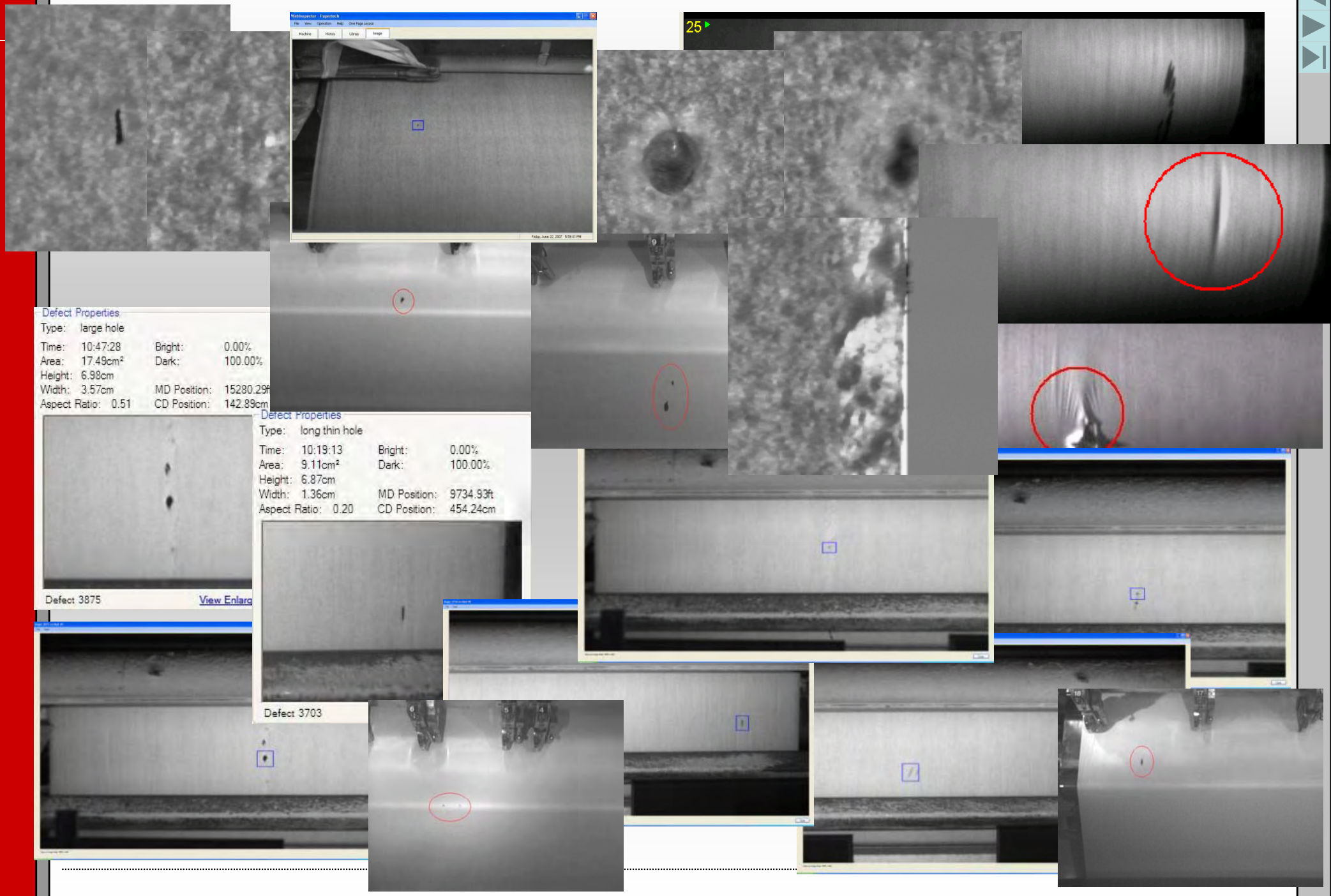
- Coaters (on & off machine)
  - Size press
  - Breaker stack



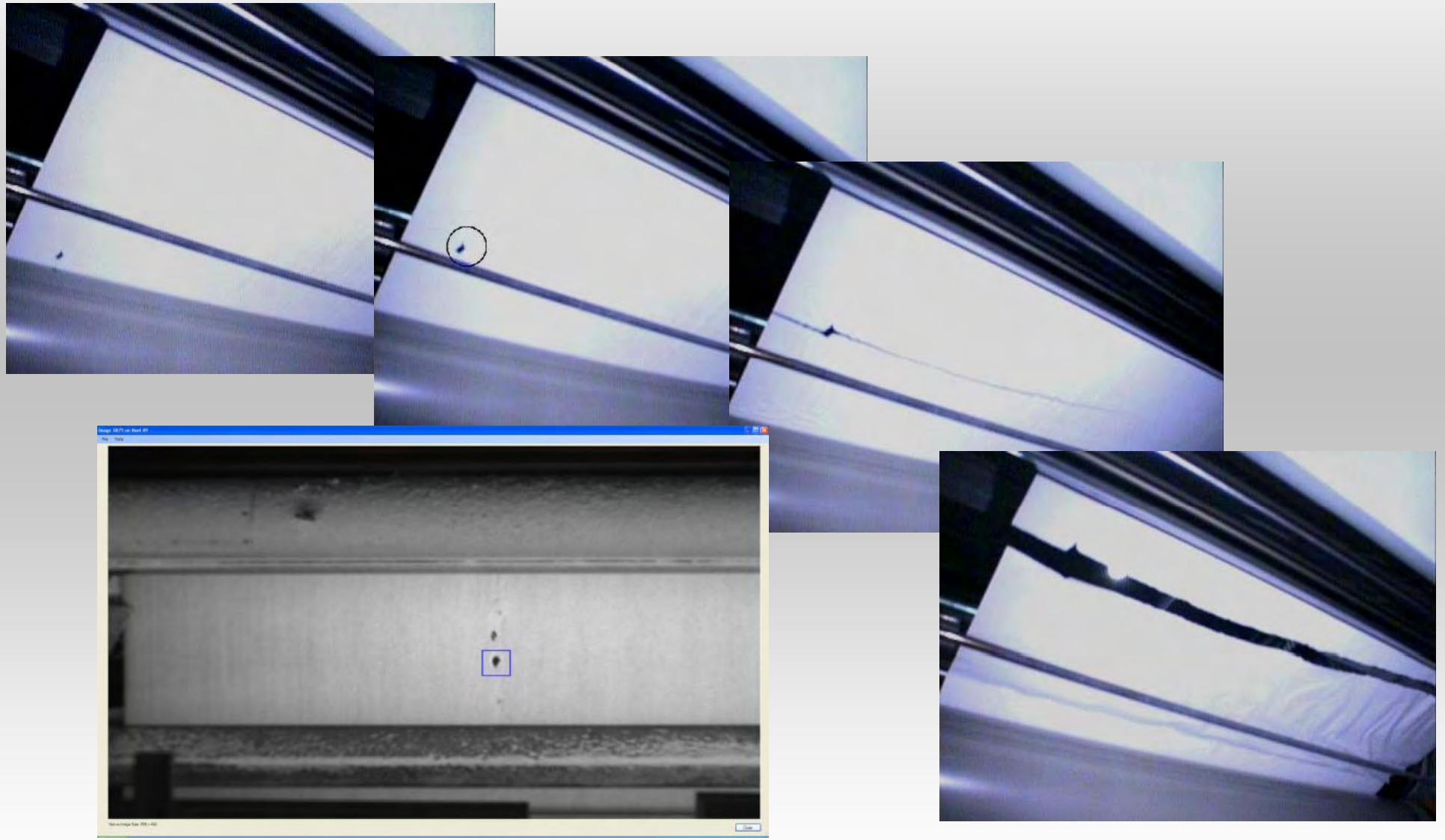
- Press section: pick-up, center roll, last press, open draws

- Calender
- Reel
- Winder
- Press room

Example WIS Captured Defects

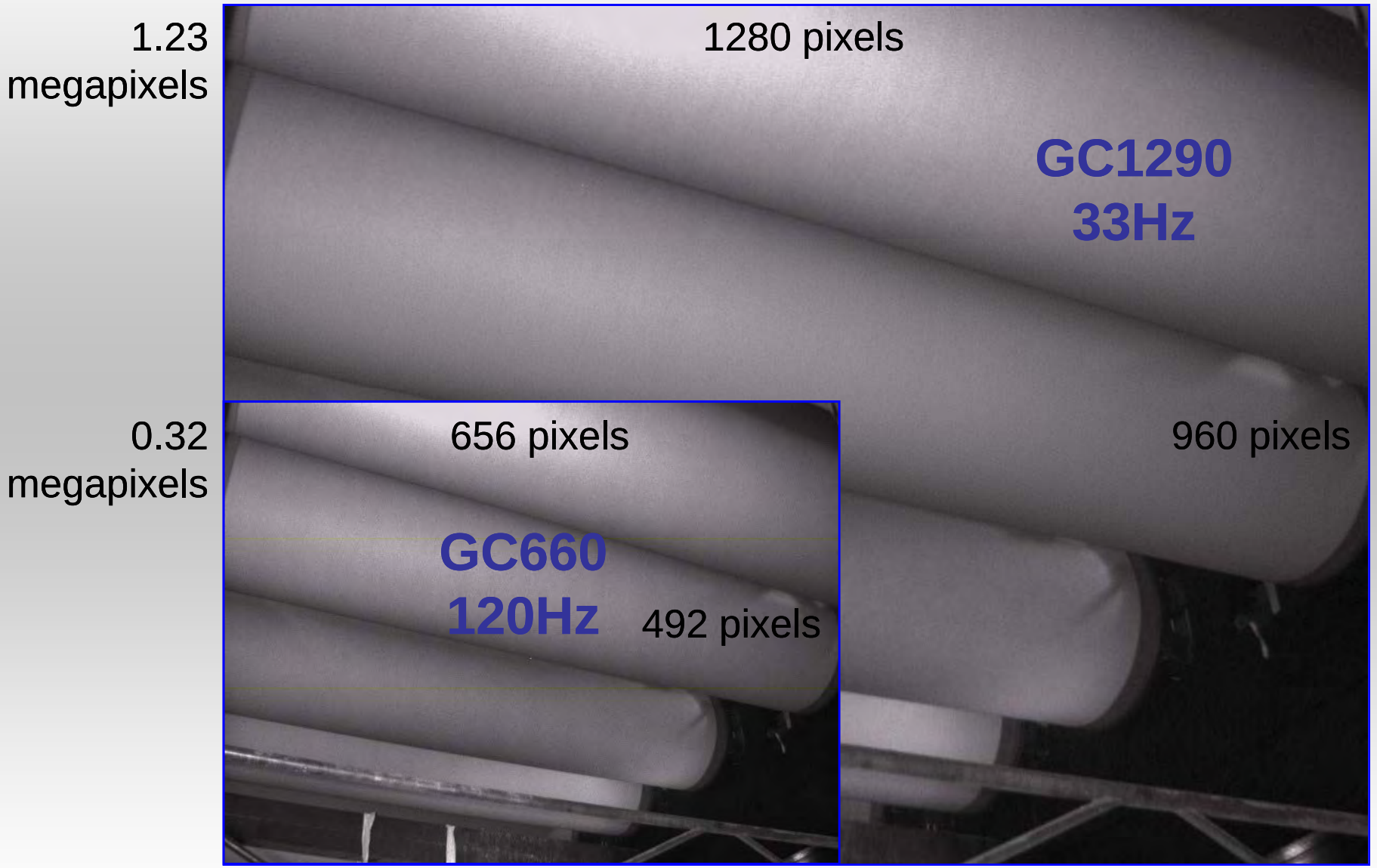


Web Monitoring (WMS) and Web Inspection (WIS) allows an effective means of finding the root cause of breaks and defects



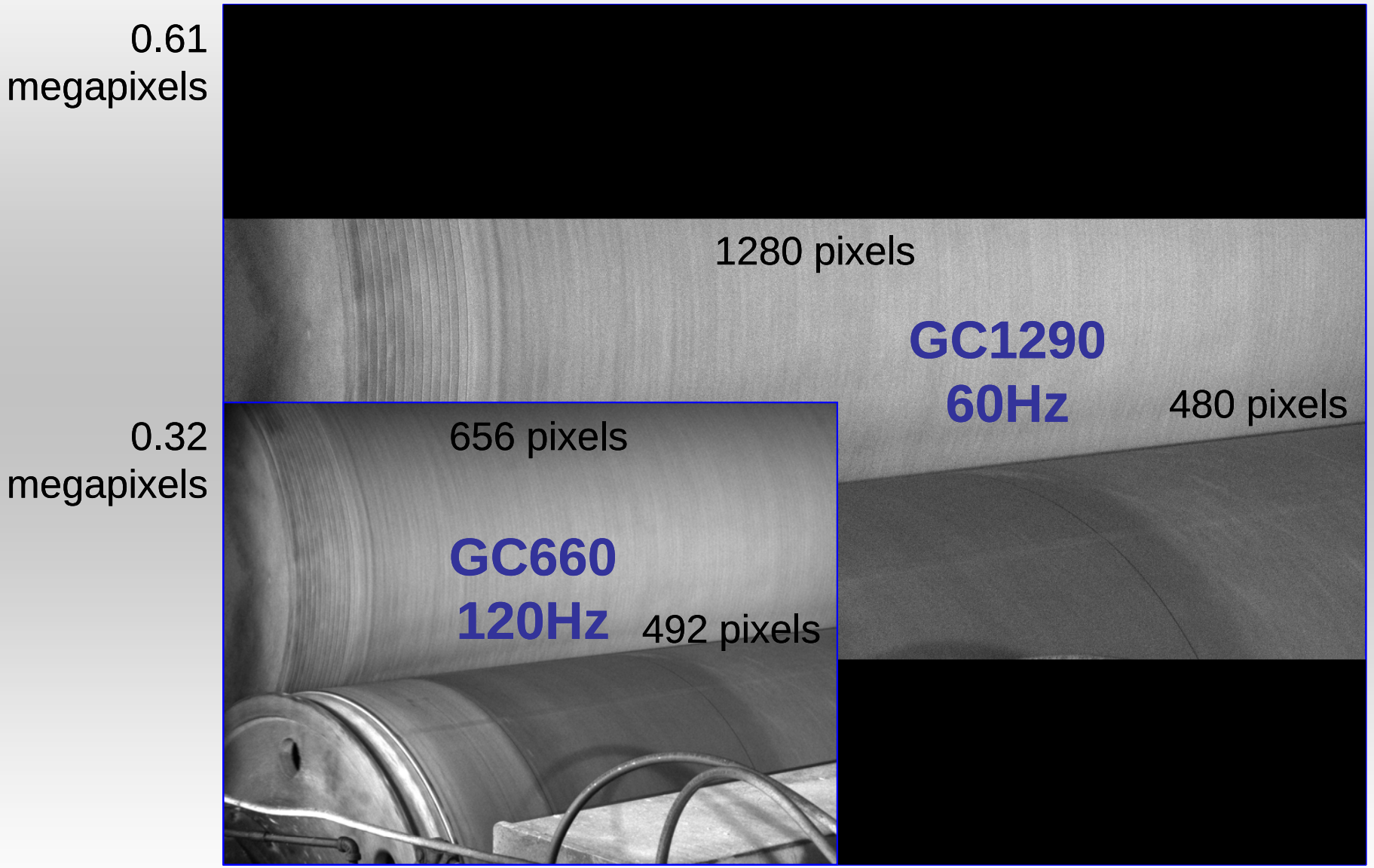
How do digital cameras work

Note: both of these cameras produce the same data throughput: 39Mb/sec



How do digital cameras work

GC1290 cropped to ½ in vertical to produce higher image speed



How do digital cameras work

GC1290 cropped in vertical ¼ size to produce even higher image speed

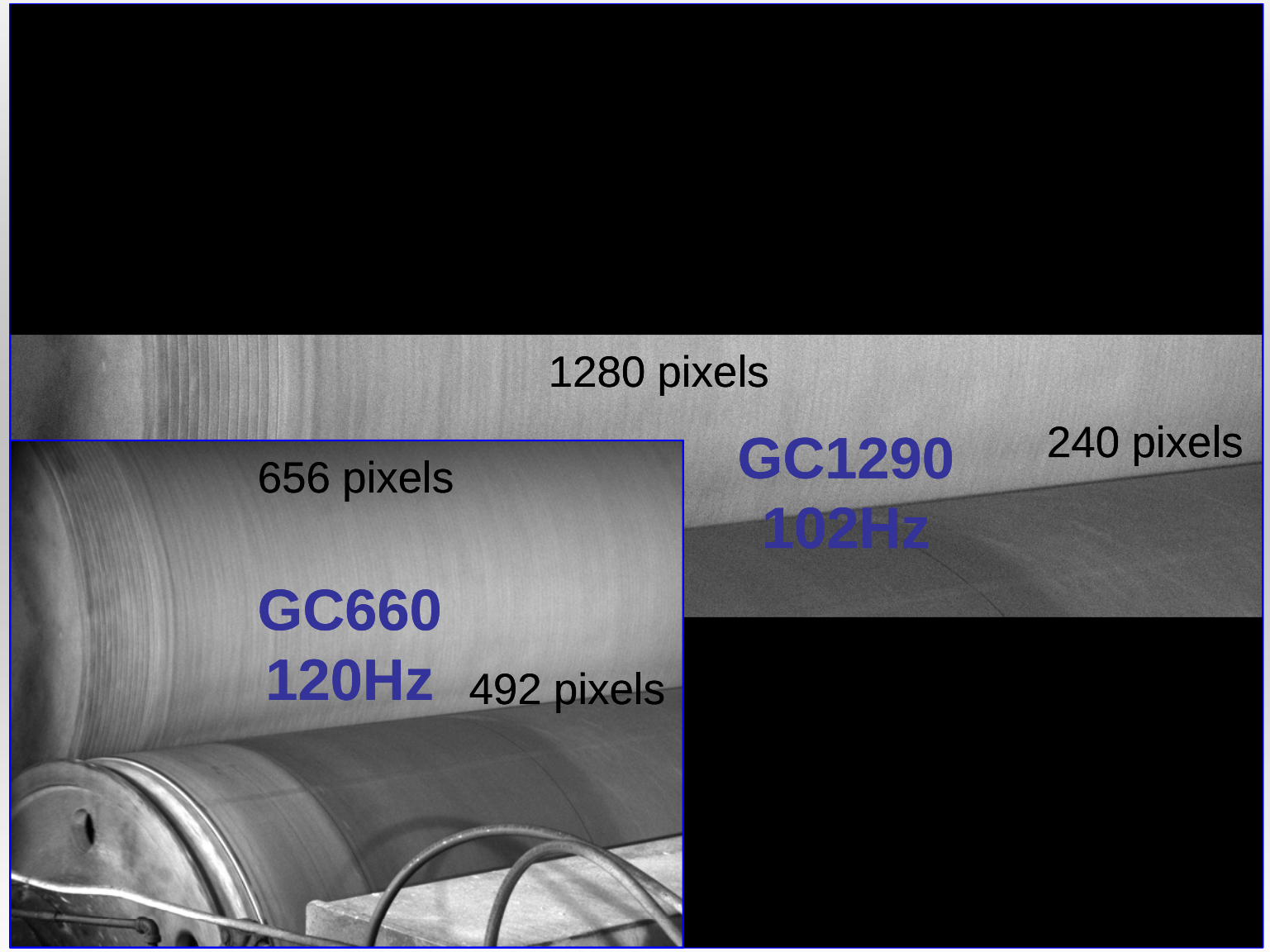
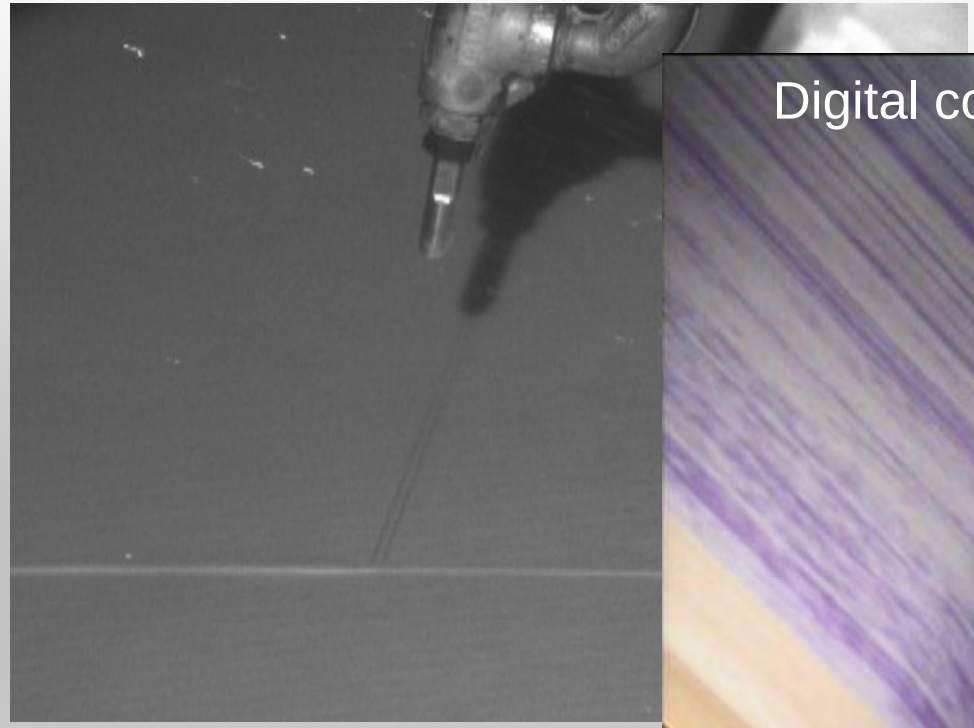
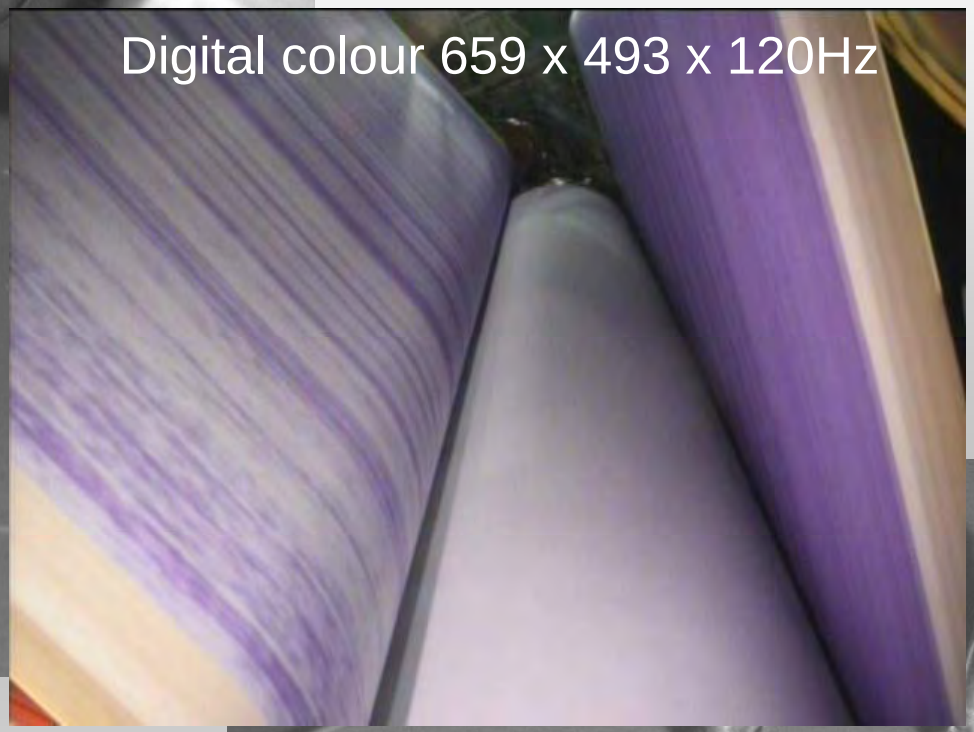
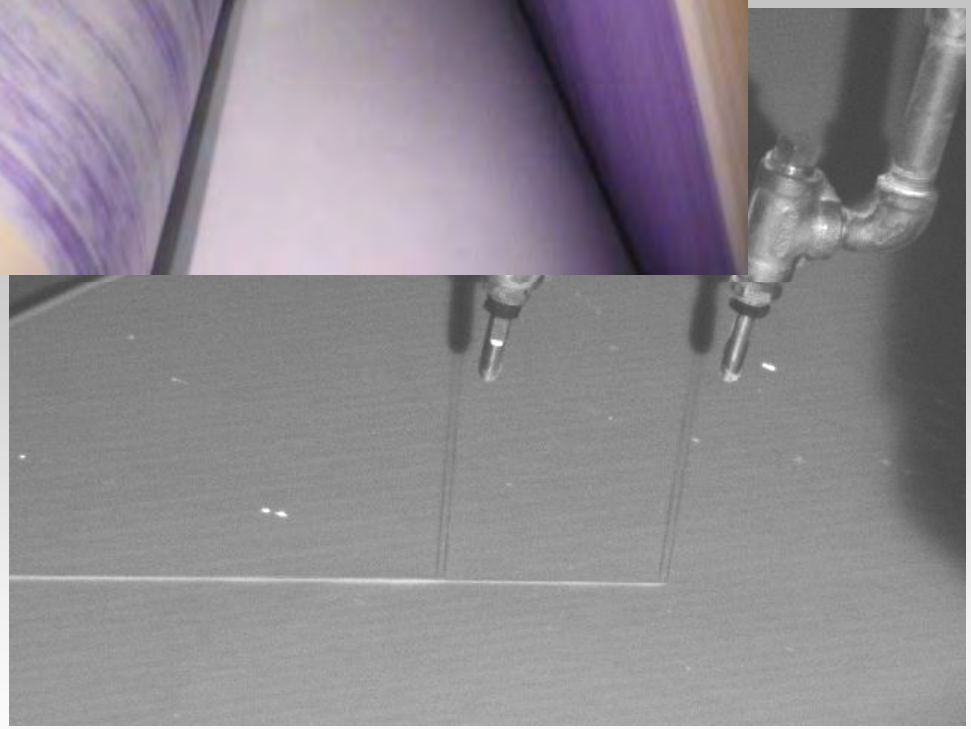


Image Comparison (continued)



Analog monochrome
640 x 240 x 60Hz



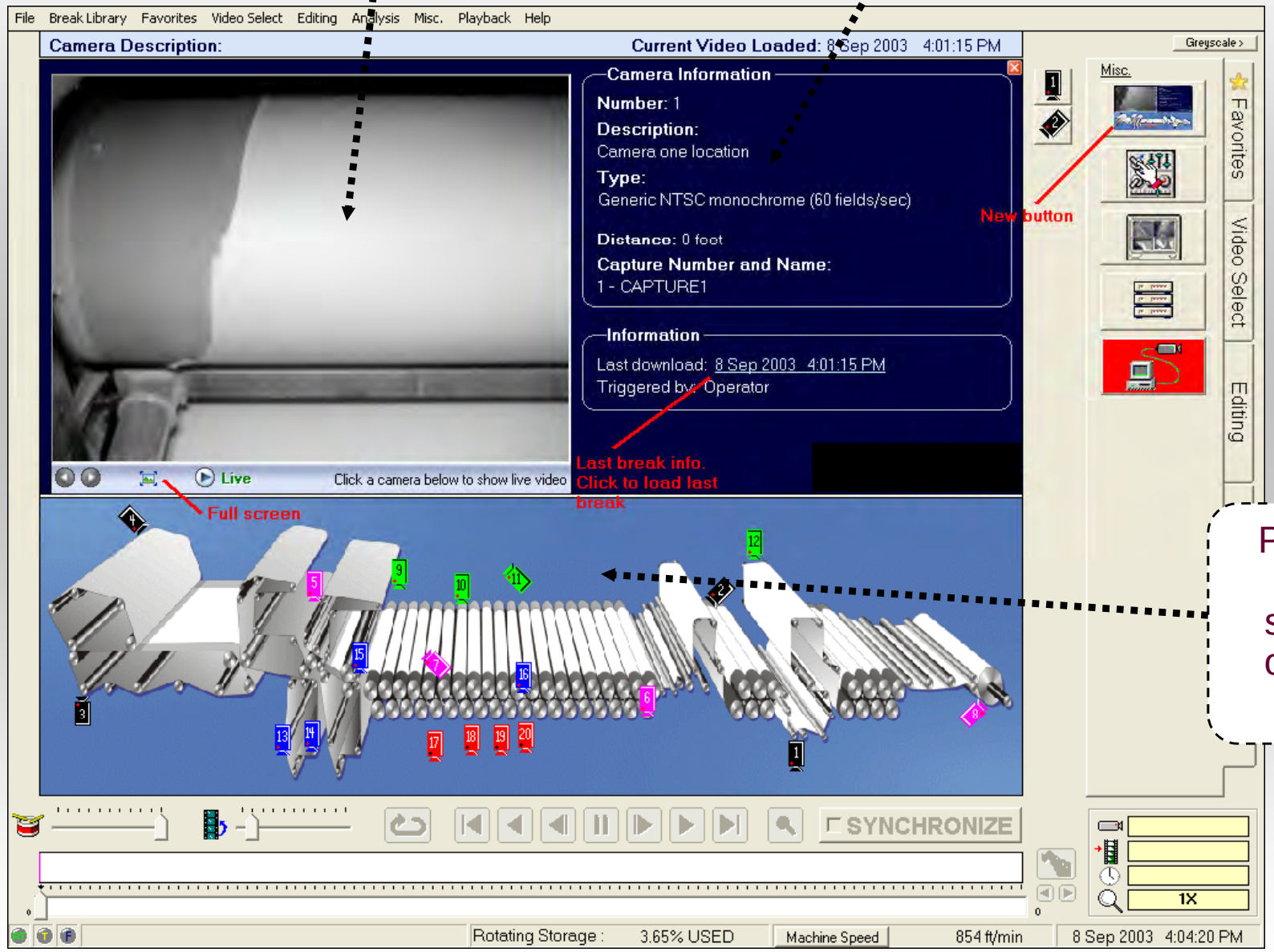


Digital monochrome
659 x 493 x 120Hz

Typical WMS Main Page

Real-time image

Details on camera being viewed

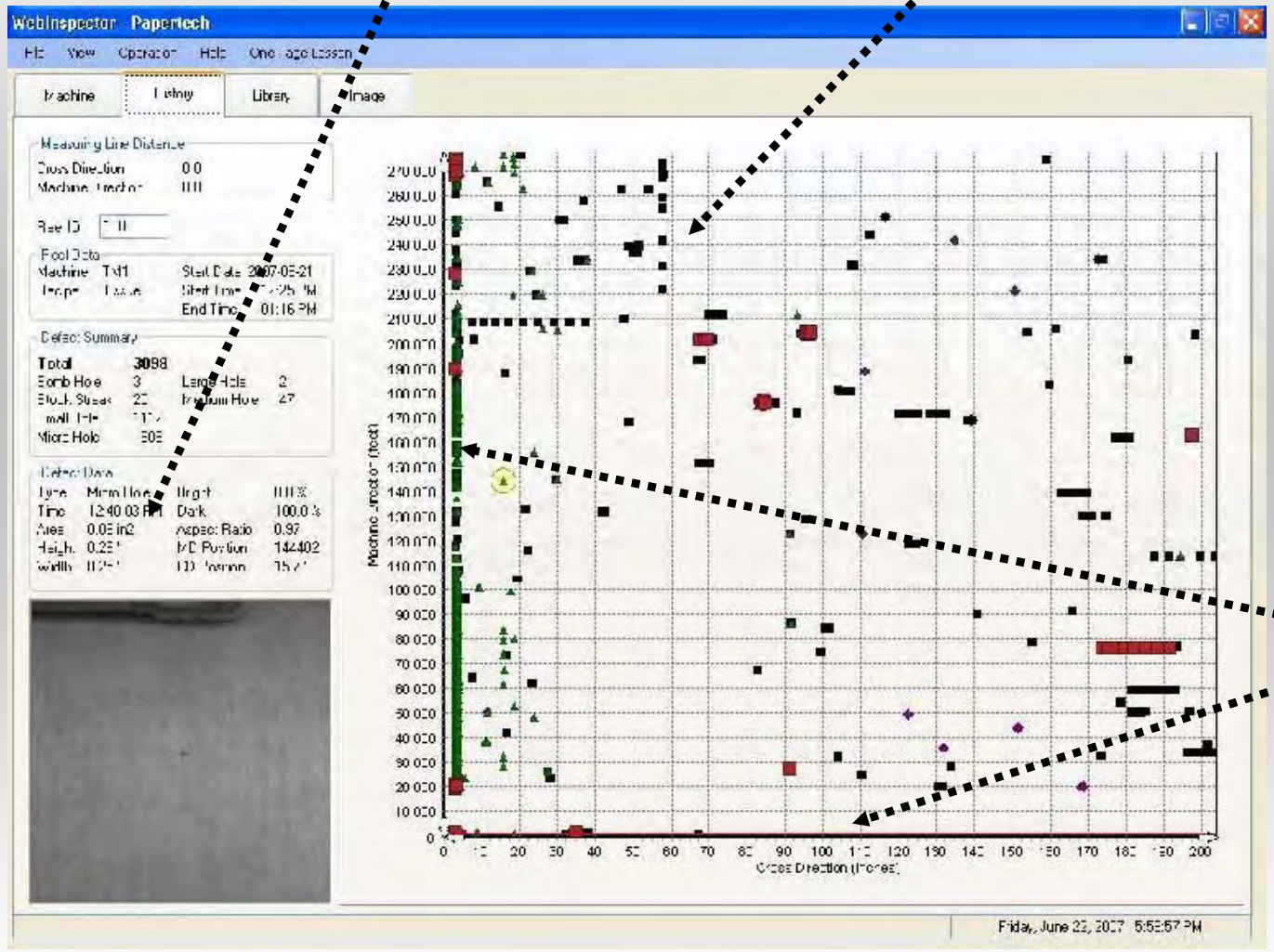


Paper machine view for easy switching from one camera to the next

Typical WIS Main Page

Defect details

Defects shown by size and type



Defect map showing paper cross direction and machine direction

Total vision combined WIS + WMS

Typical System Architecture

Ideal solution: WIS & WMS using same platform

- Same cameras, same housings, same processors
- Integrated for seamless functionality allowing full visibility of the process from end to end.

Interface Cabinet
Identical processors
Off-the-shelf throughout
Video Capture Units

OPC Server
Real-time Data Access

Microsoft Sequel Server

OPC
Client

Operator Station
WMS + WIS

Operator Station
WMS + WIS

Archive
Server

Additional modular
Interface Cabinets

Camera LAN
TCP/IP

MILL LAN

Open Network
Viewer

OPC Server
Quality Control System

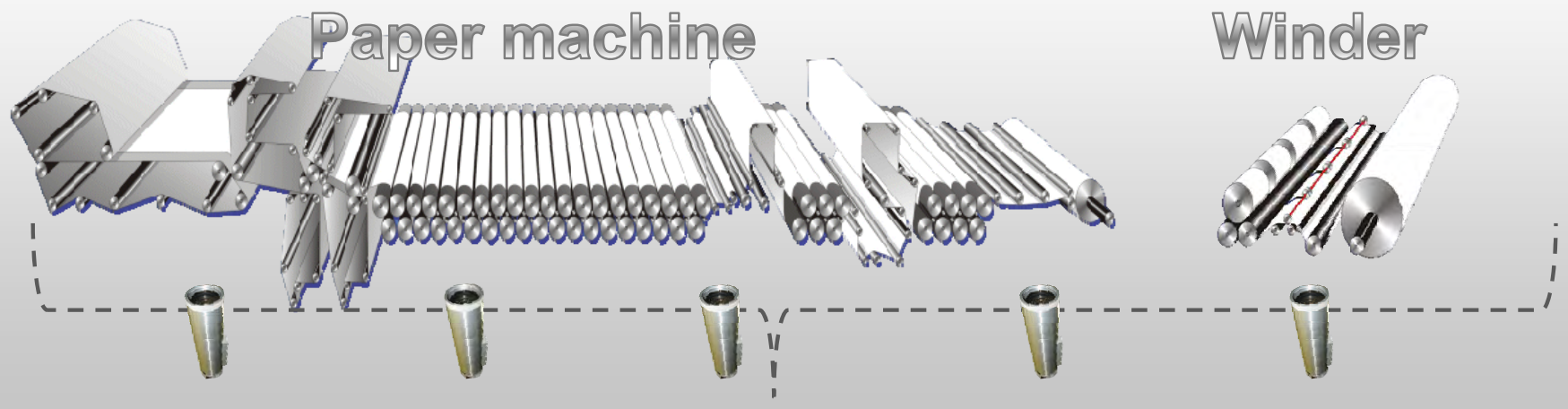
Millwide
Systems

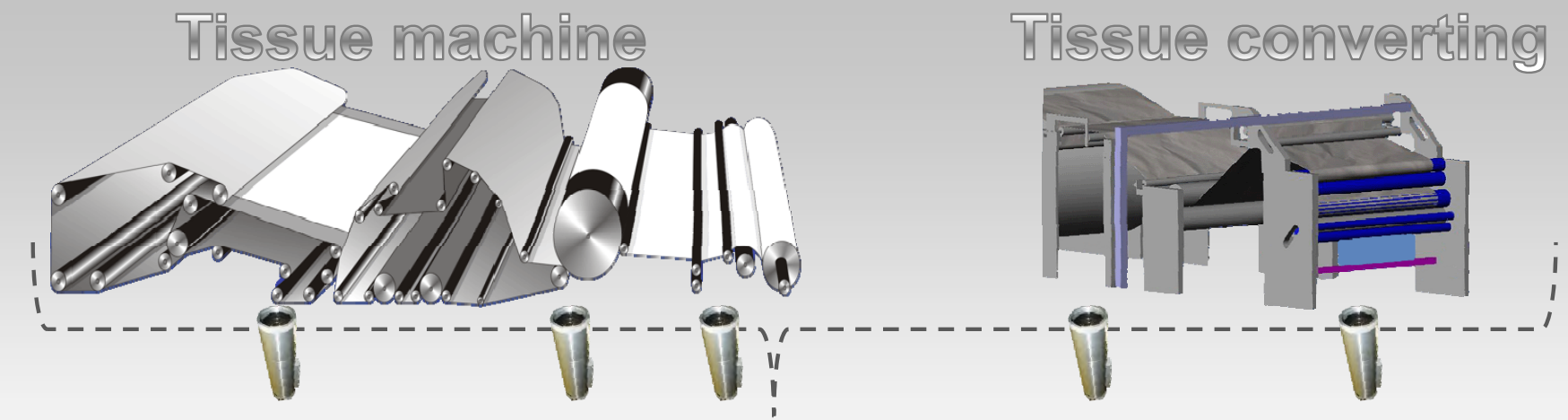
Open Network Viewer

OPC Client
Process Information System

Microsoft
Sequel
Server
(In house)

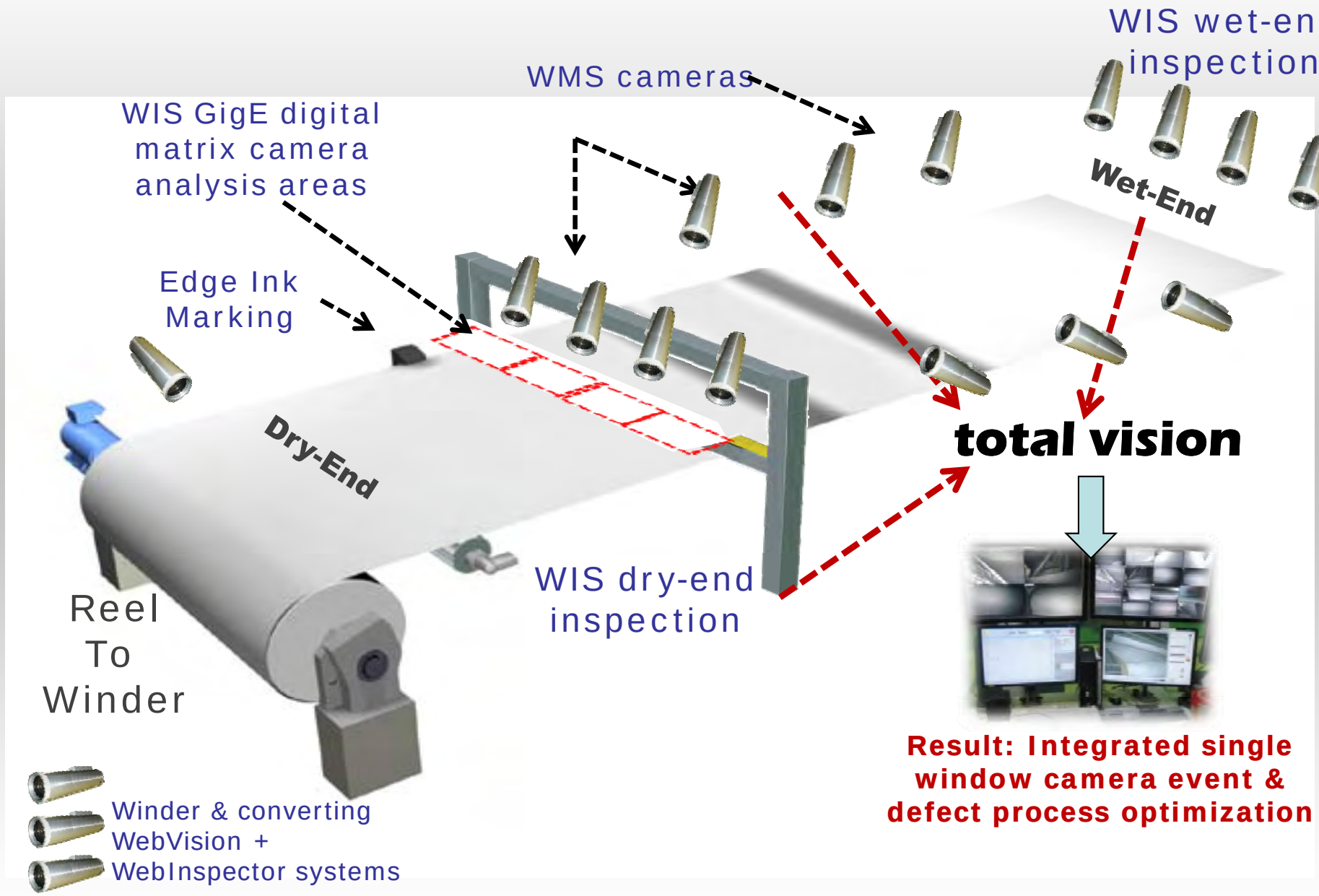
WMS + WIS = Total Vision





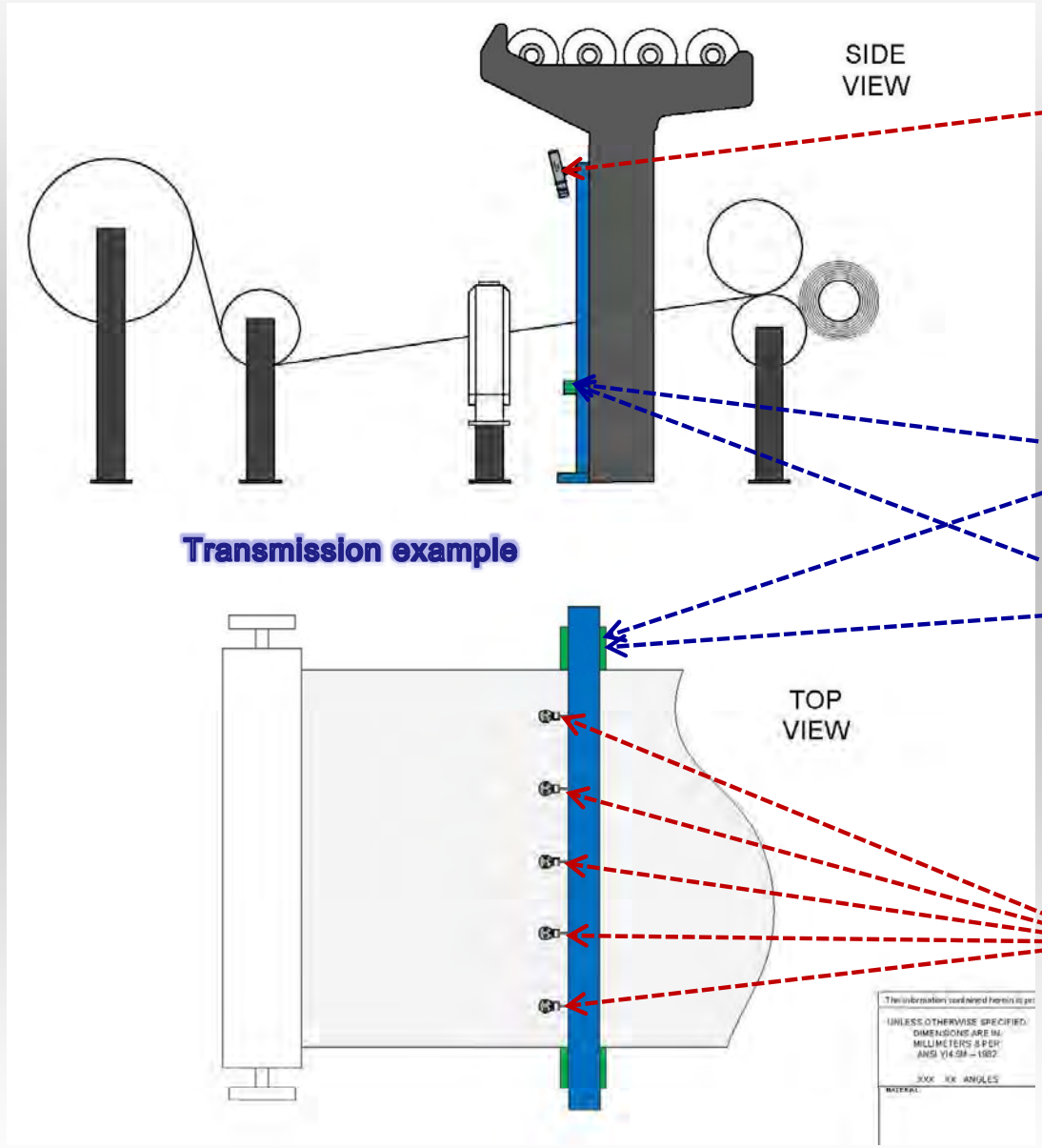
WMS + WIS = Total vision

Event Capturing & Web Inspection All-in-One



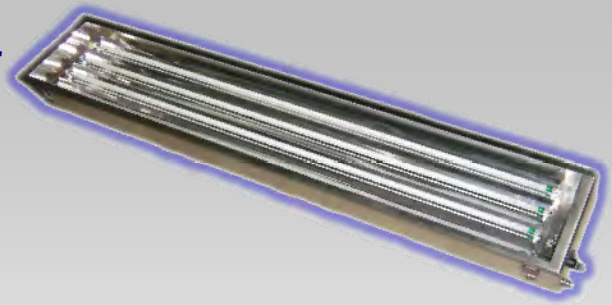
Result: Integrated single window camera event & defect process optimization

WIS typical layout at reel



High performance digital
GigE matrix camera

LED Strip or **Fluorescent**™
high performance lighting



High performance digital
GigE matrix camera

From Portable to Fixed solutions

- Ultra portable laptop solution – up to 2 digital cameras

- Components in rugged shipping cases designed for easy deployment & shipping from site to site

- On wheels with built-in air conditioner – up to 12 digital cameras

- Workstation using fanless solid state computers – 3 digital cameras per box, distributed solution uses multiple boxes

From Portable to Fixed solutions

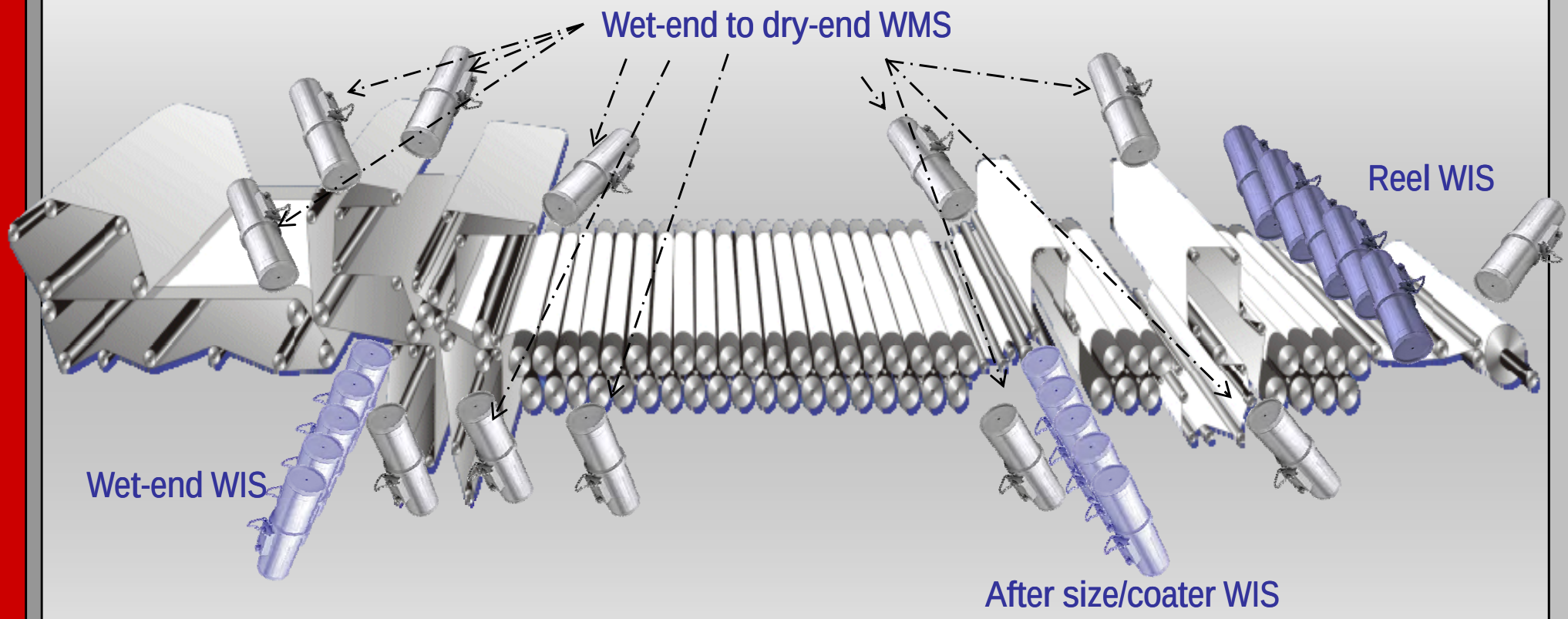
16 camera control

16 camera control

- Modular fixed cabinet – up to 16 cameras/cabinet
- Standard fixed cabinet – up to 48 cameras/cabinet

WMS + WIS = Total Vision

Event Capturing & Web Inspection All-in-One

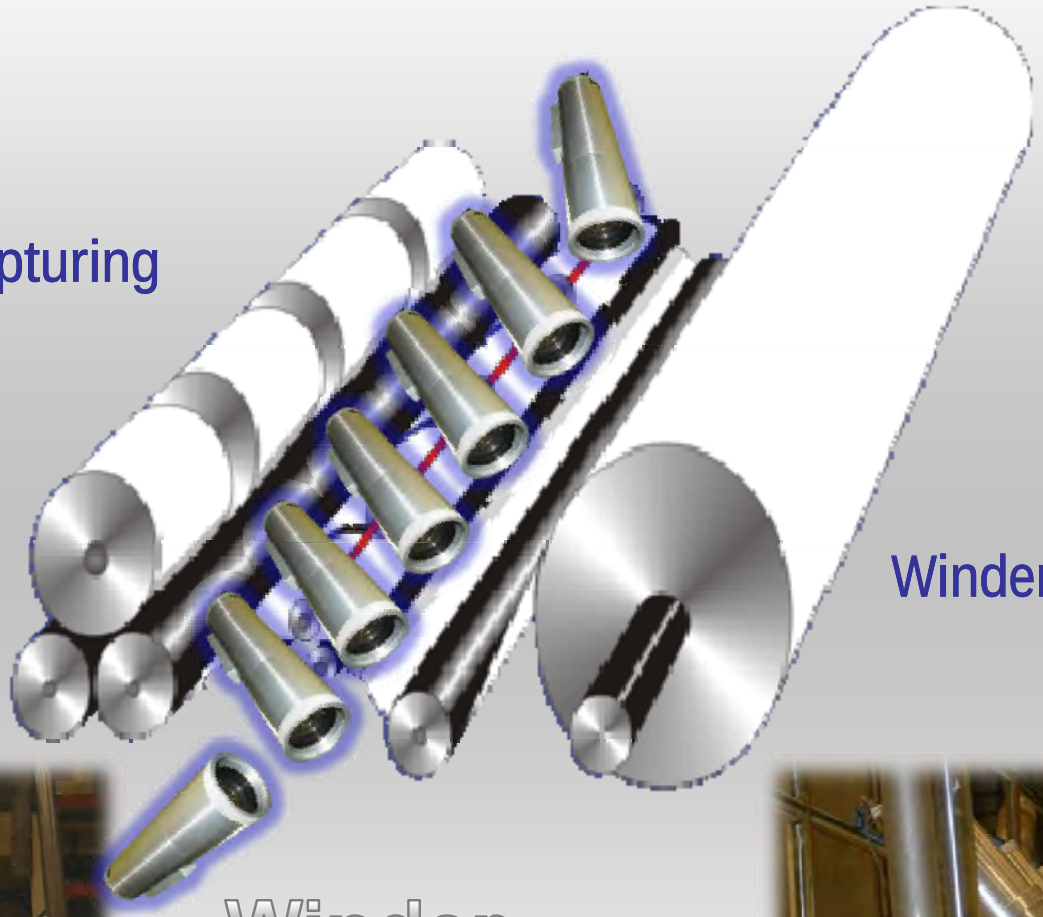


- **WMS** cameras in wet-end to dry-end capture events from breaks to defects & increase machine visibility = less breaks, higher efficiency, better quality
- **WIS** cameras in wet-end to dry-end capture defects = better downstream runnability & better quality

WMS + WIS = Total Vision

Event Capturing & Web Inspection All-in-One

Winder Event Capturing

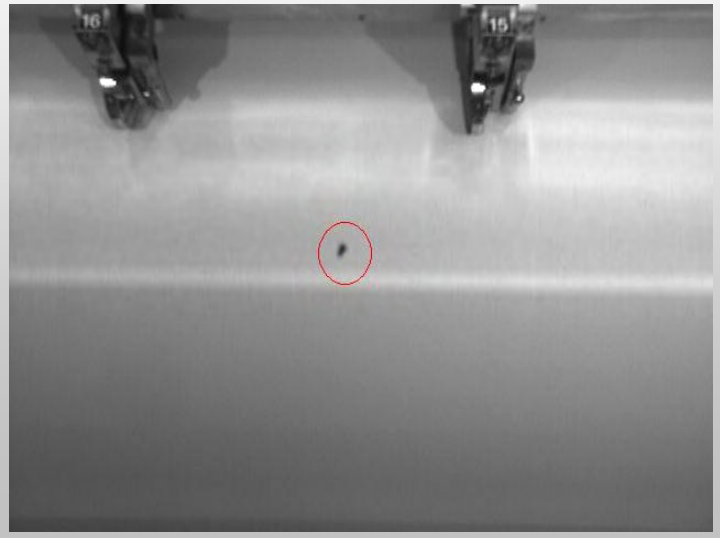


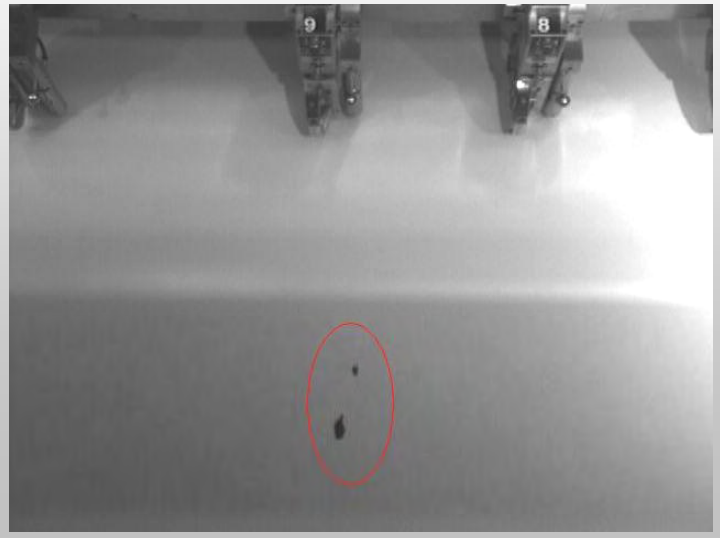
Winder Web Inspection

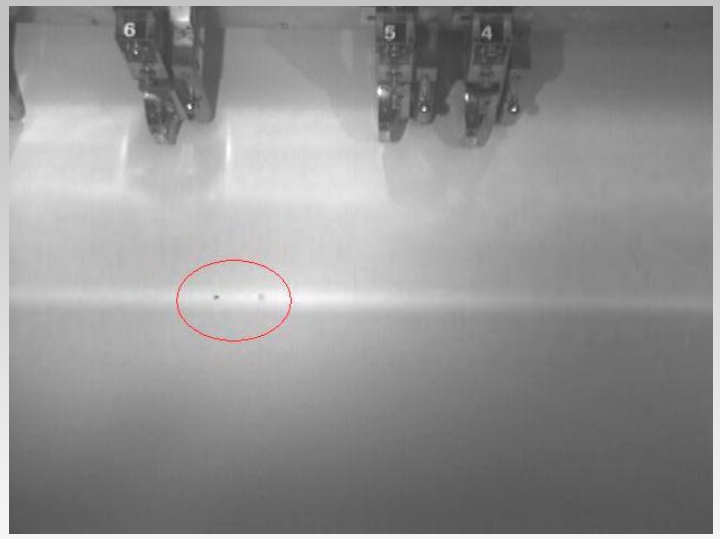
Winder

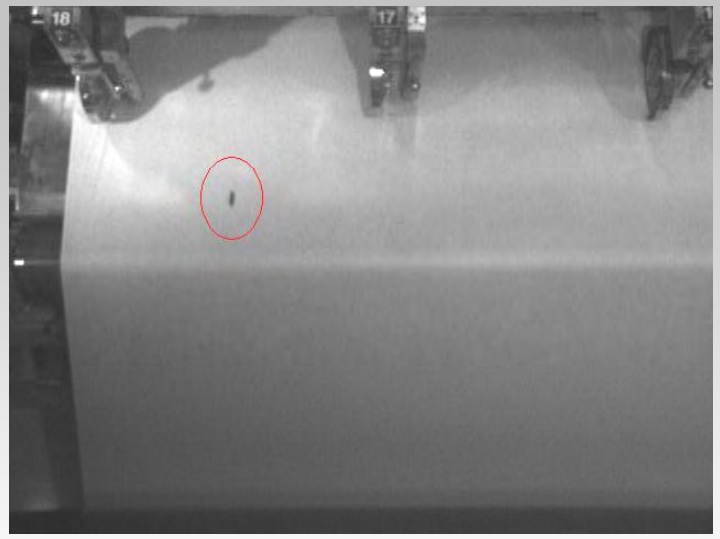
North Pacific Paper, Longview, WA, USA

Examples of Defect Detection







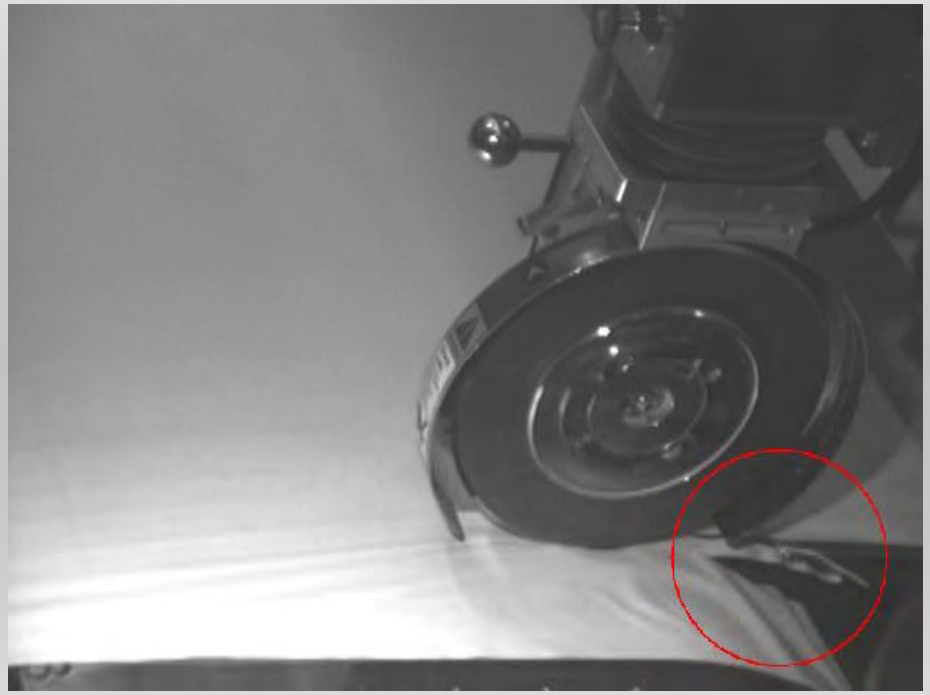


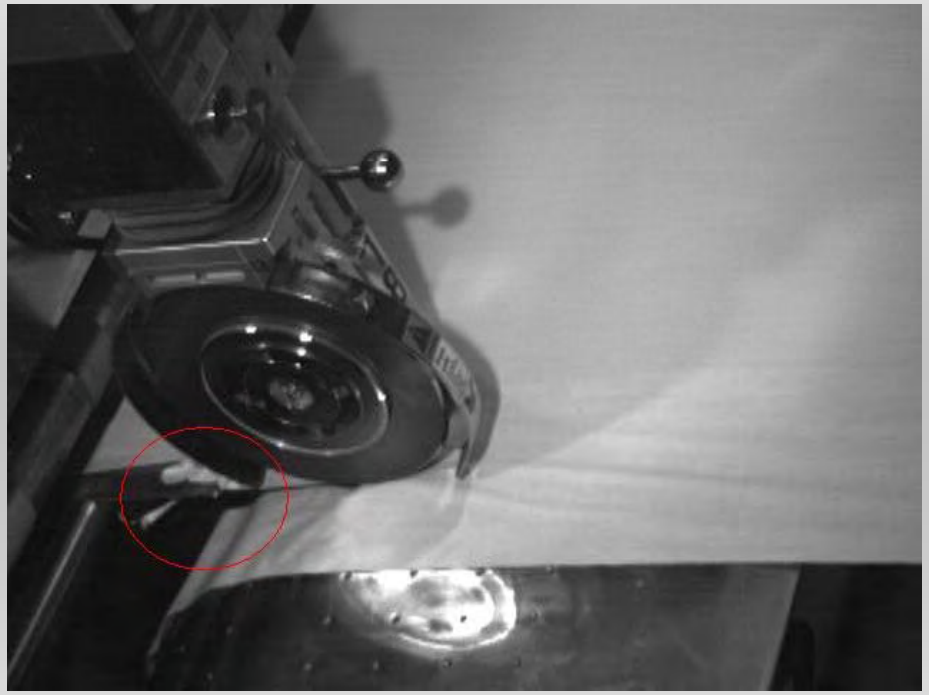
Examples of holes caught in the first few months using defect detection.

Hole sizes range from 2.0-5.0 mm

North Pacific Paper, Longview, WA, USA

Examples of Dryer Wrinkles

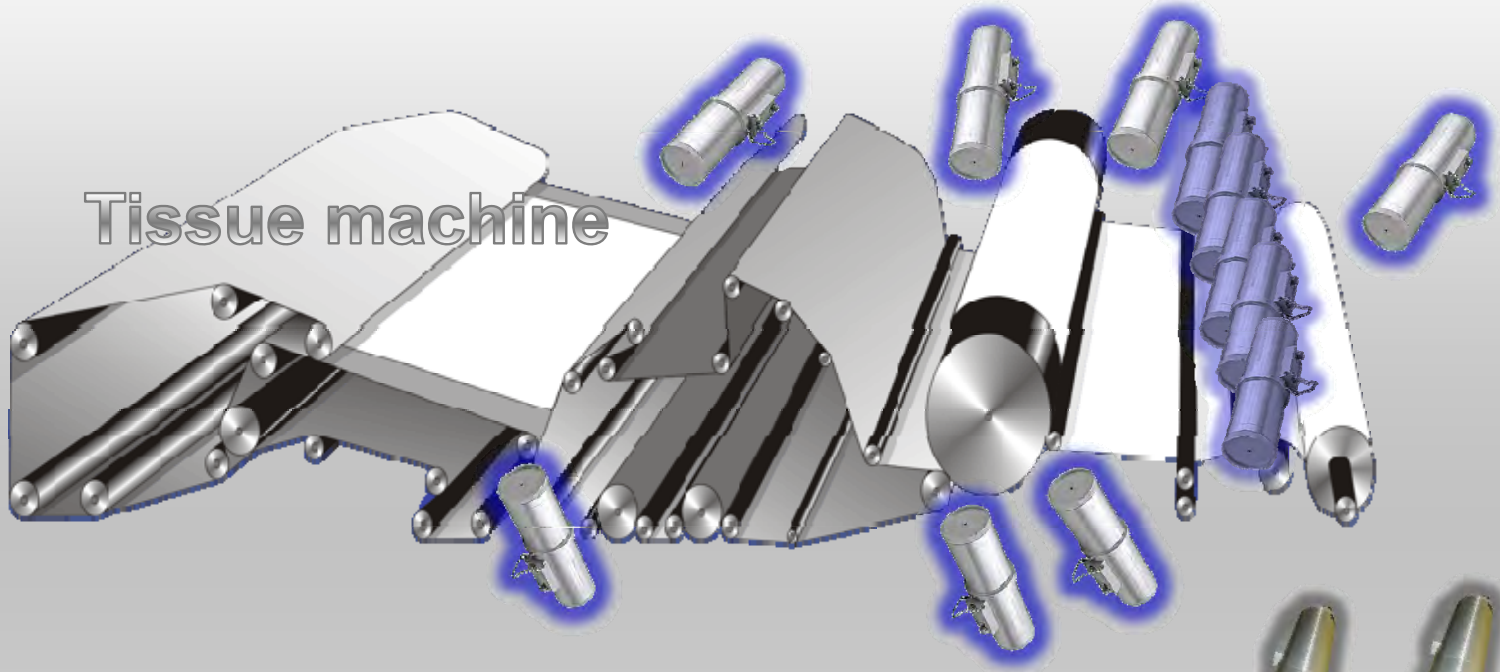




Shows winder edge slitter problem due to dryer wrinkles

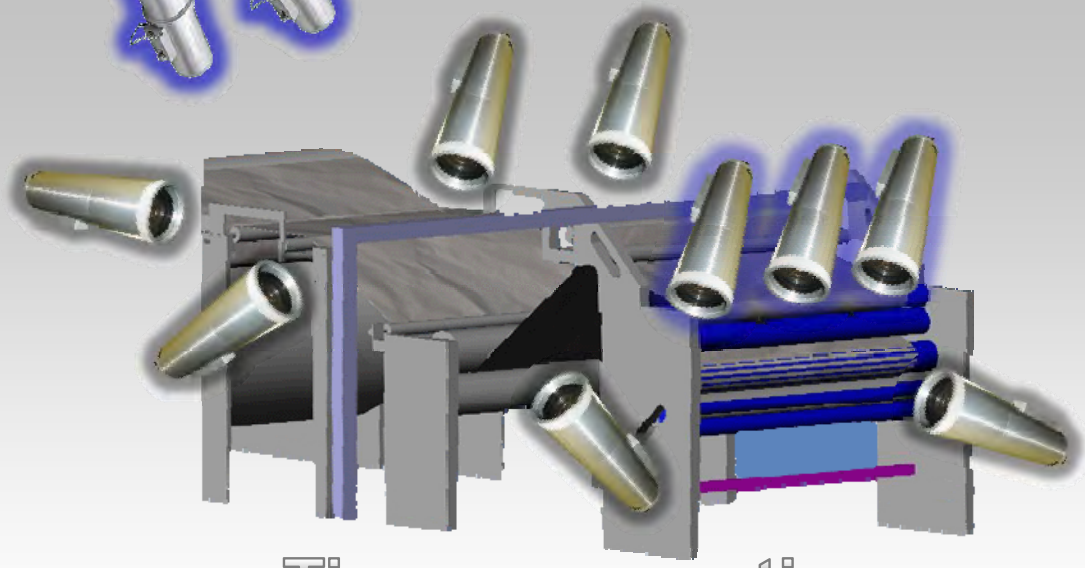
WMS + WIS = Total Vision

Event Capturing & Web Inspection All-in-One

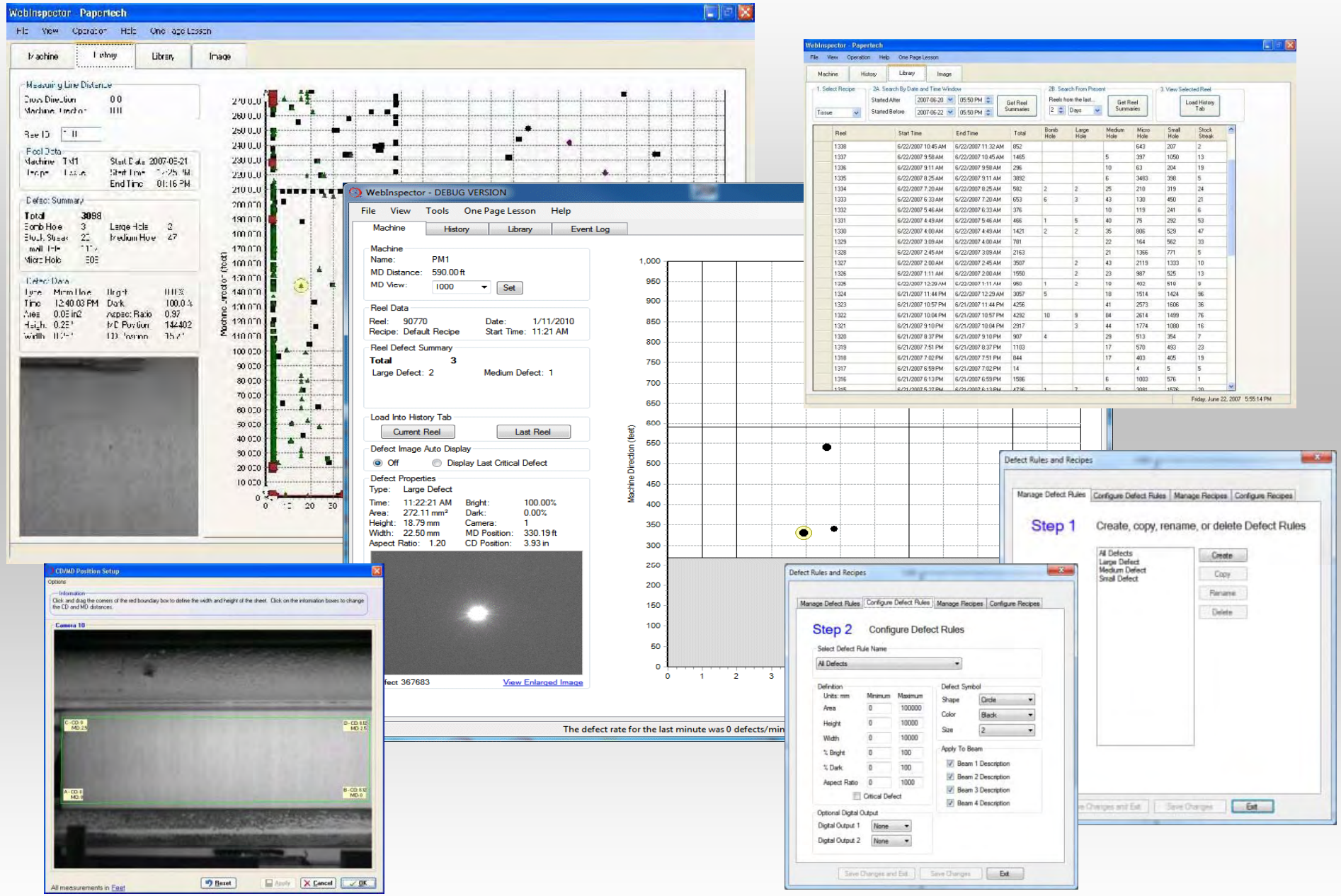


Tissue Machine & Converting
Event Capturing

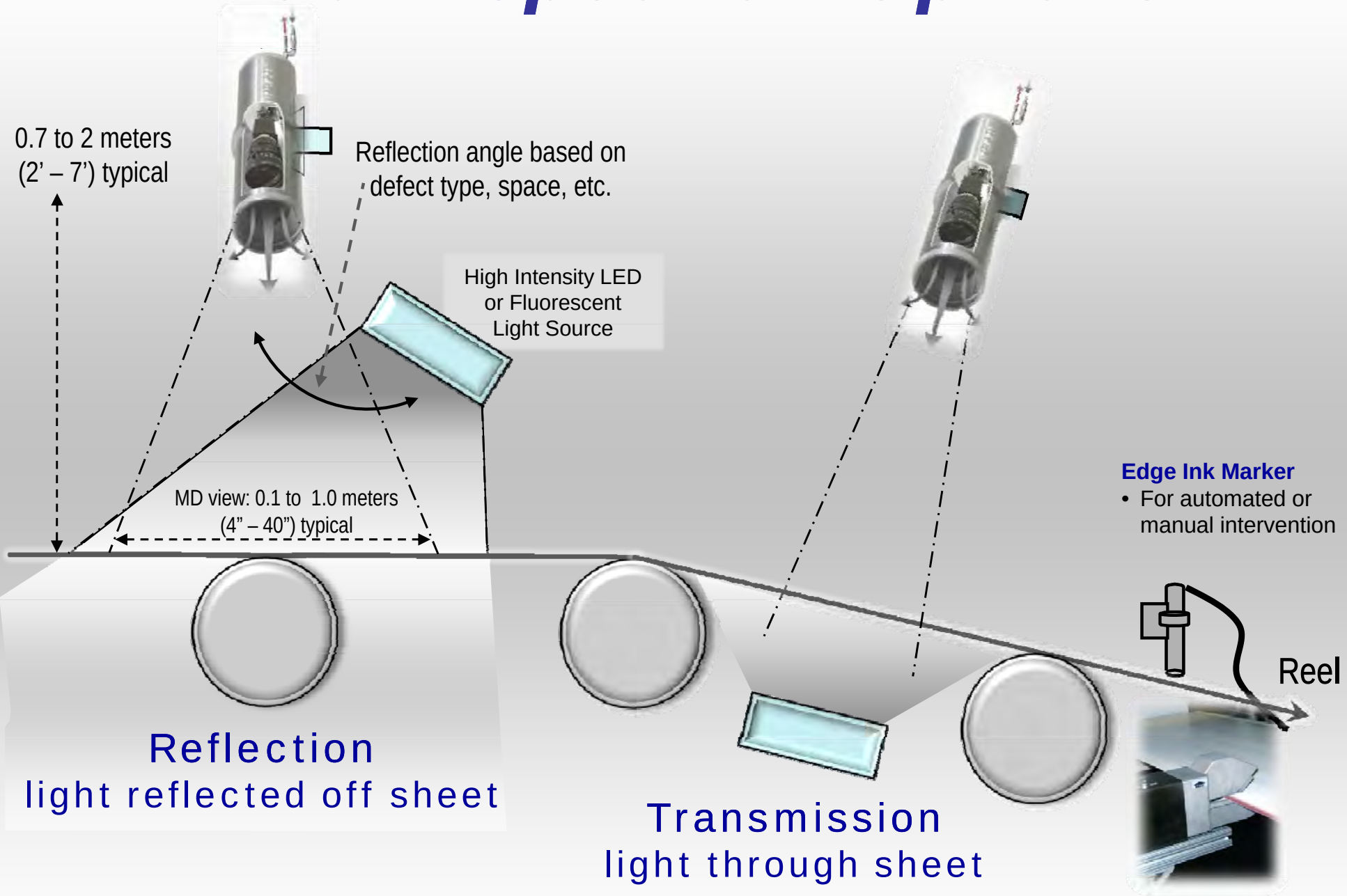
Tissue Machine & Converting
Web Inspection



WIS Operator Interface

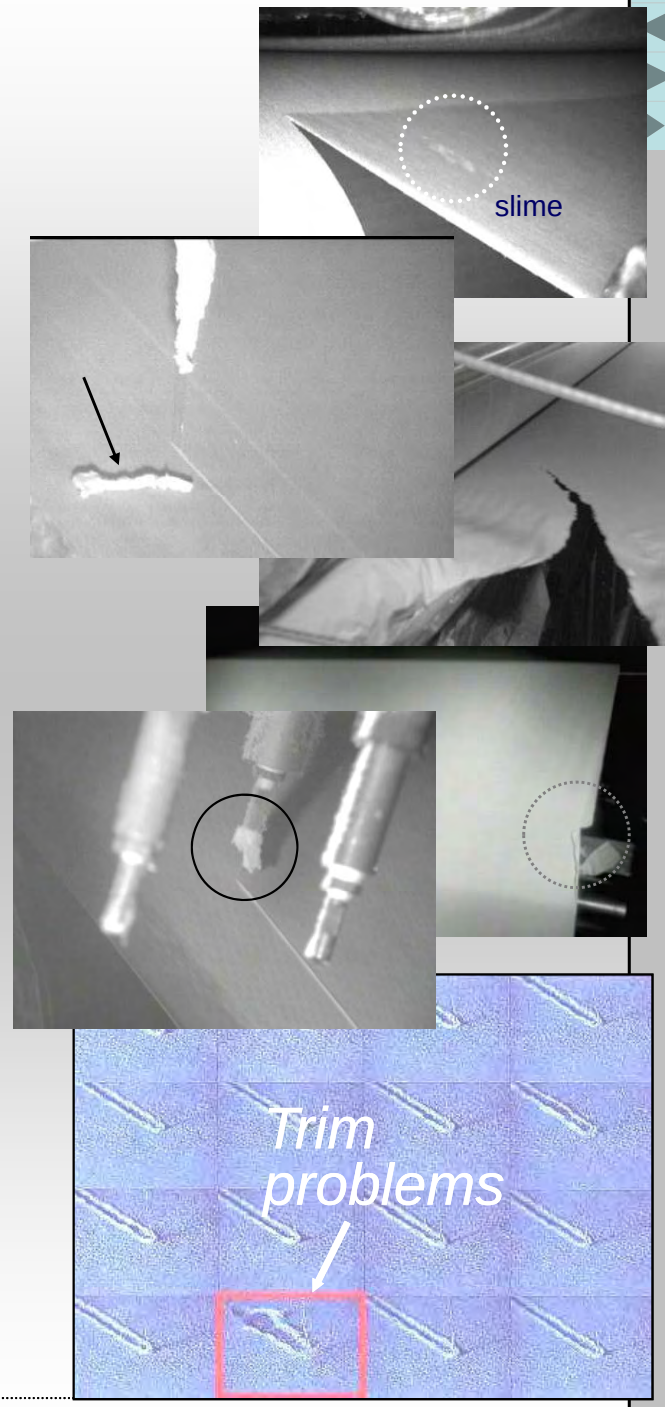


Web Inspection Options



Results in General

- **Allows the user to solve the break reason:**
  - Results range from 30% to over 80% break reduction, 2% to 5% efficiency increase.
  - Reduction potential based on: type of break, similarity of events, number of cameras, camera locations, user capabilities.
- **Real-time web inspection allows break preventive measures to be taken:**
  - Trim squirt build-up, sheet flutter, release angle, holes, slime, edge crack, condensation or any type of visual change seen by the camera
- **Provides an integrated WMS + WIS total machine visibility to rapidly find the source of the defect**
- **Rapid payback: from a couple of weeks to 6 months.**



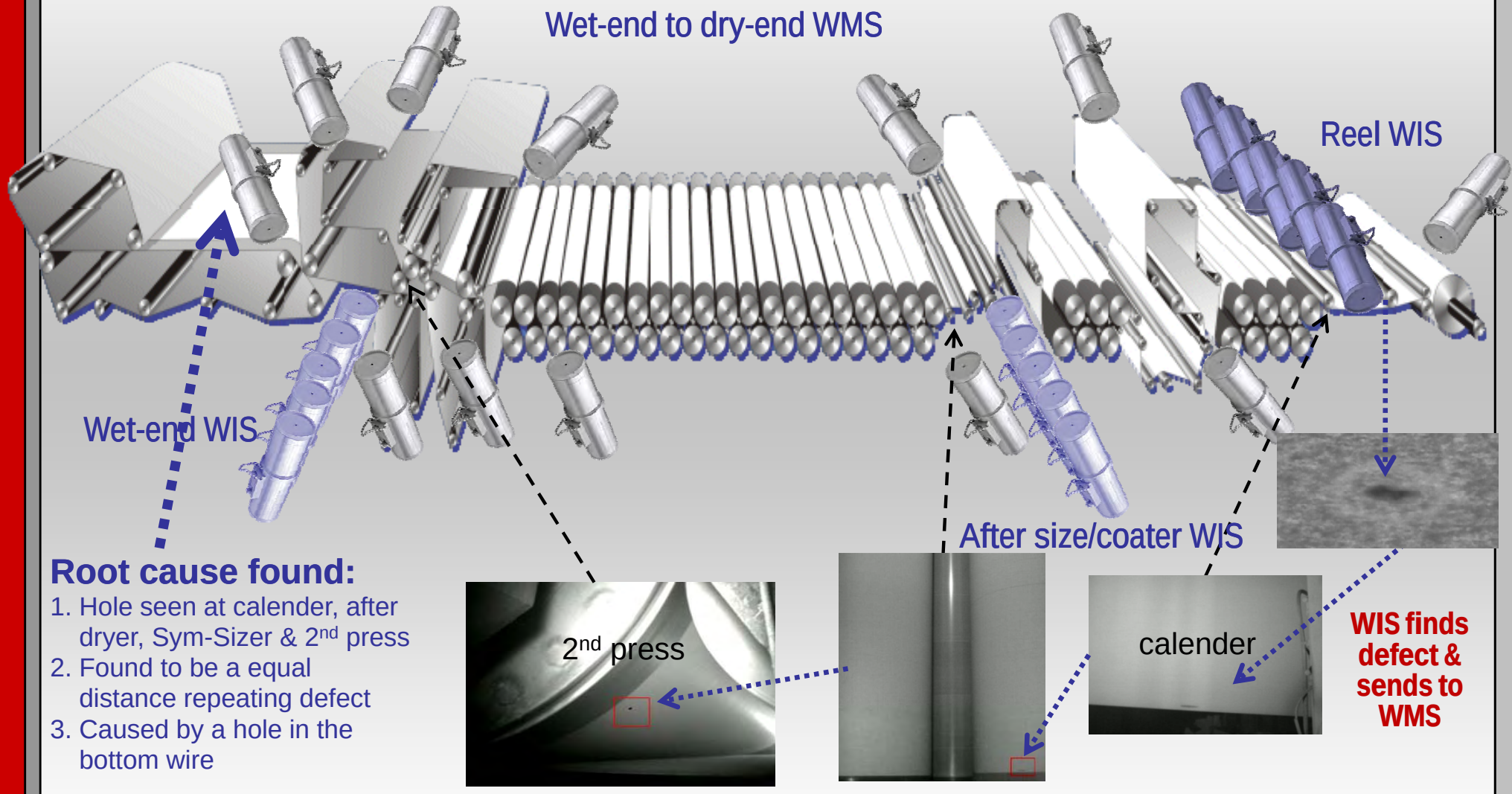
Results

✓2–6 month payback

Customer	% Unknown Break Reduction Cull Reduction	% Speedup & Payback
Weyerhaeuser, Longview, USA	50% less culls	14% speed-up
Australian Paper, Maryvale, Australia		< 3 month payback
Sappi Alfeld, Germany	28% less overall breaks	Best investment in 2 years
Georgia-Pacific, Halsey, USA	20% less breaks	+400-500 fpm
Rondo-Ganahl, Austria	15% less breaks	8% speed-up & new production record
Aylesford Newsprint, UK	58% less breaks	<3 month payback
StoraEnso, Anjala, Finland	37% less breaks	10 less breaks/month
Rand Whitney, USA	66% reduction in break lost time/day	<2.2 month payback
US Gypsum, California, USA	68% less breaks	

WMS + WIS = Total Vision

Event Capturing & Web Inspection All-in-One

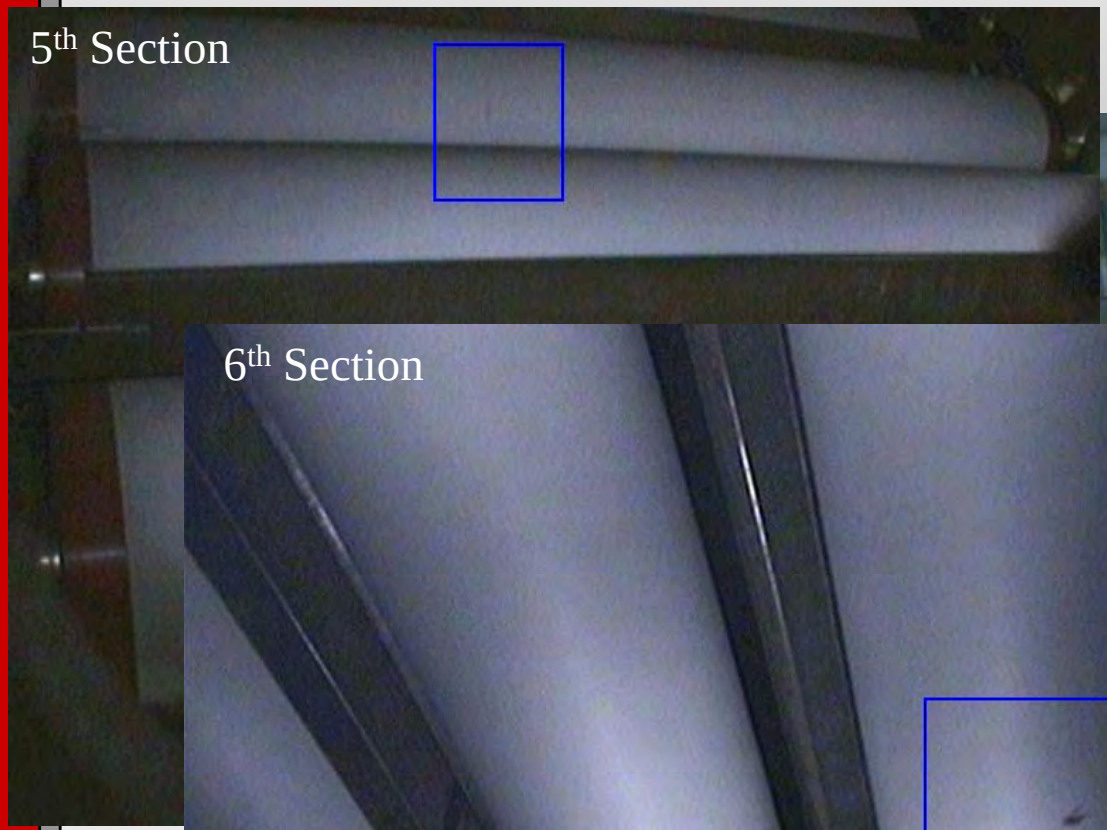


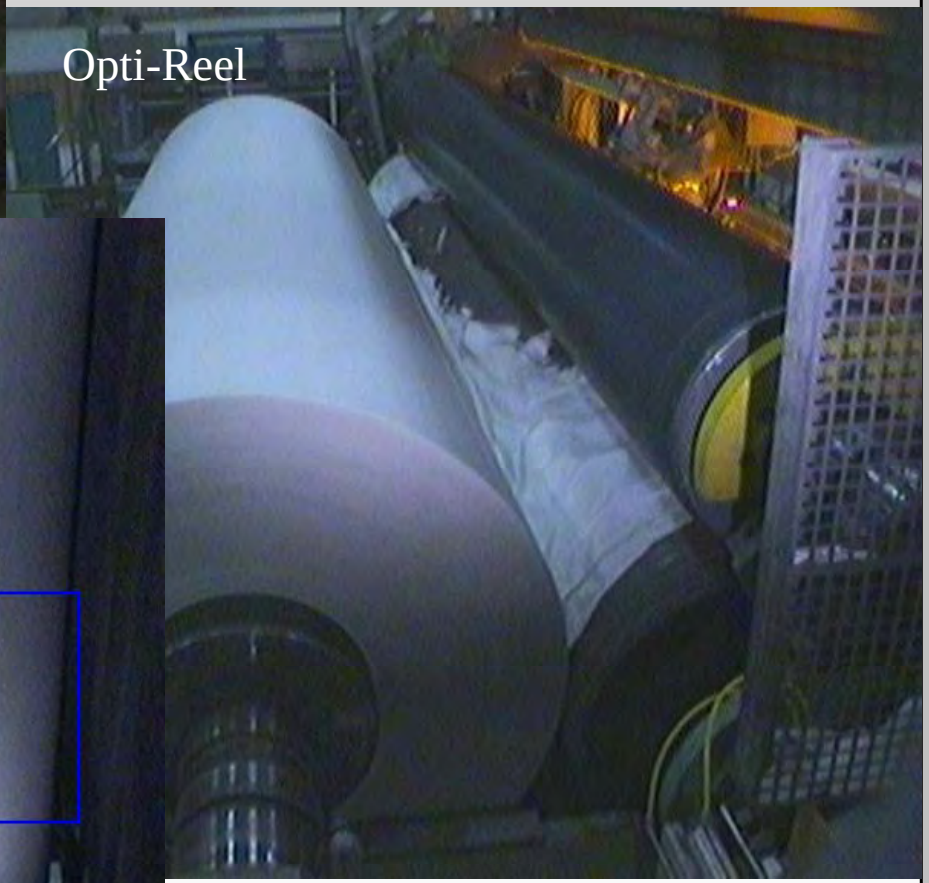
Root cause found:

1. Hole seen at calender, after dryer, Sym-Sizer & 2nd press
2. Found to be a equal distance repeating defect
3. Caused by a hole in the bottom wire

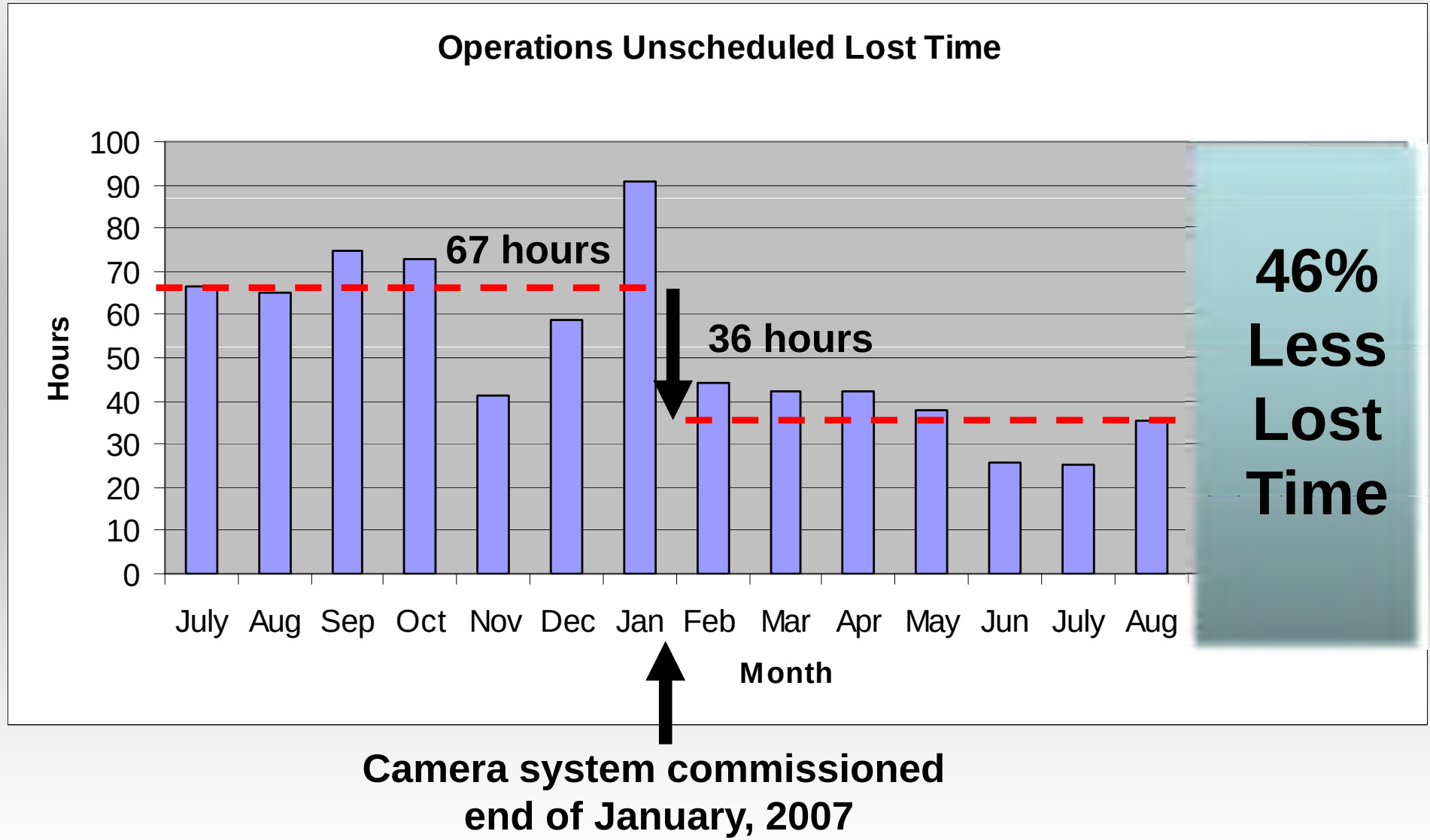
Break example due to hole

- Cameras: 5th section & 6th section & Opti-Reel
- Defect: hole seen at 5th section caused break at Opti-Reel

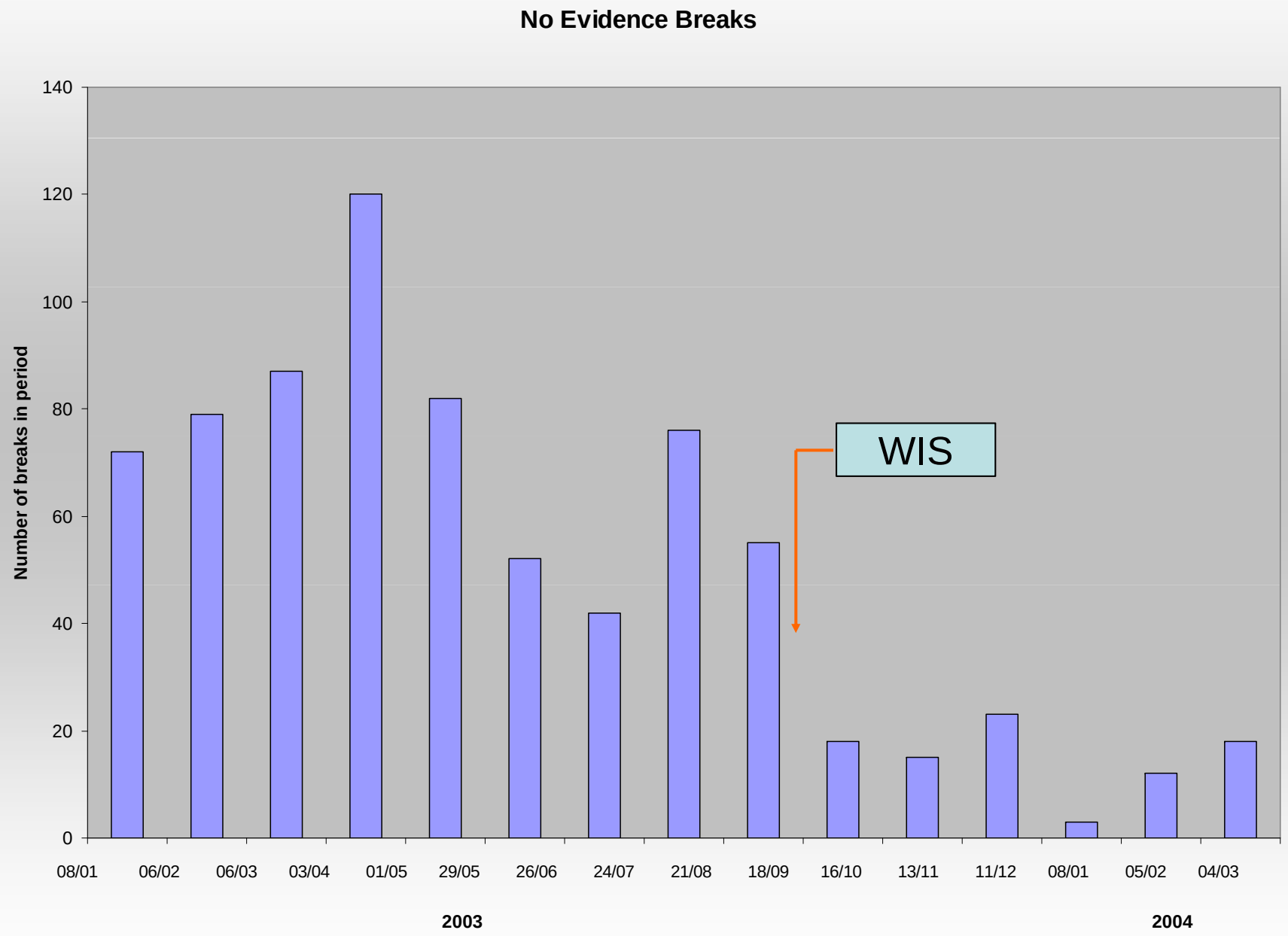




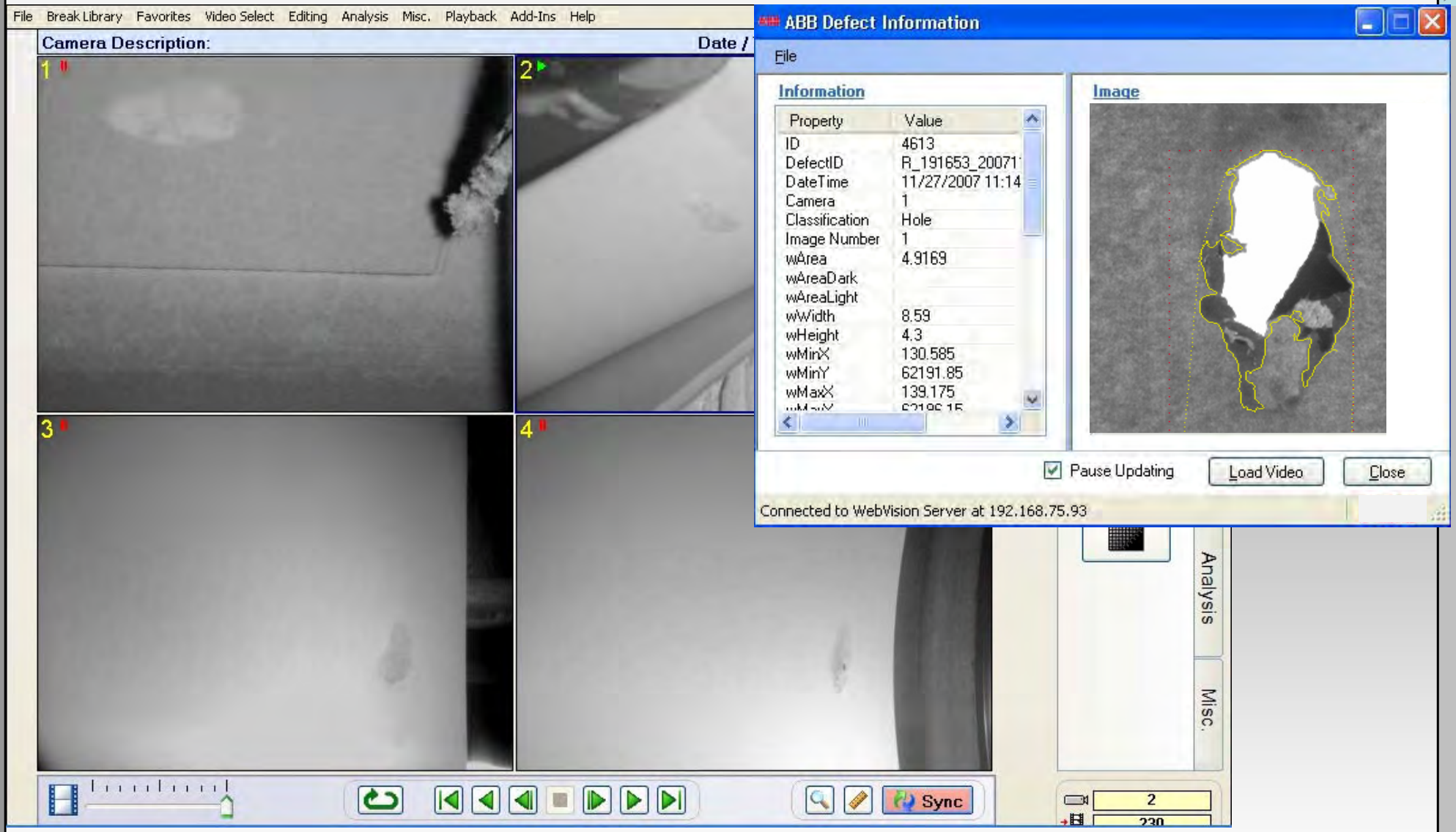
Rapid Increase in Efficiency



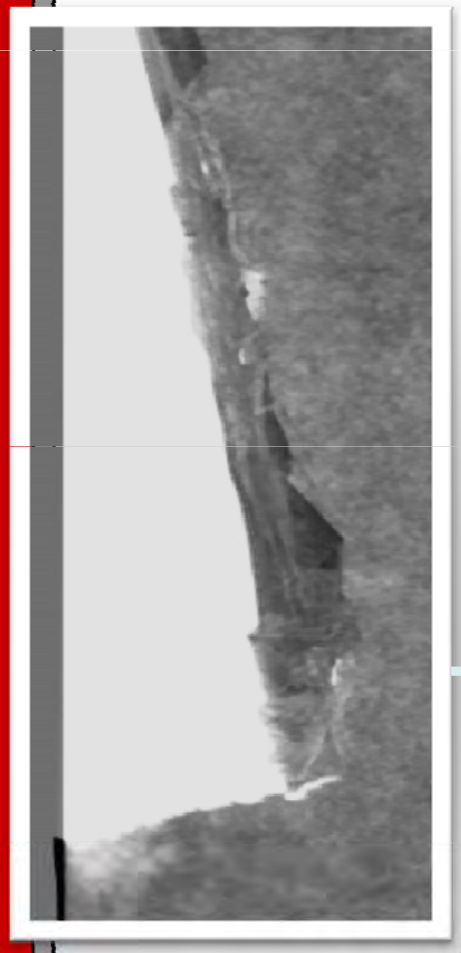
“No Evidence” Break Reduction



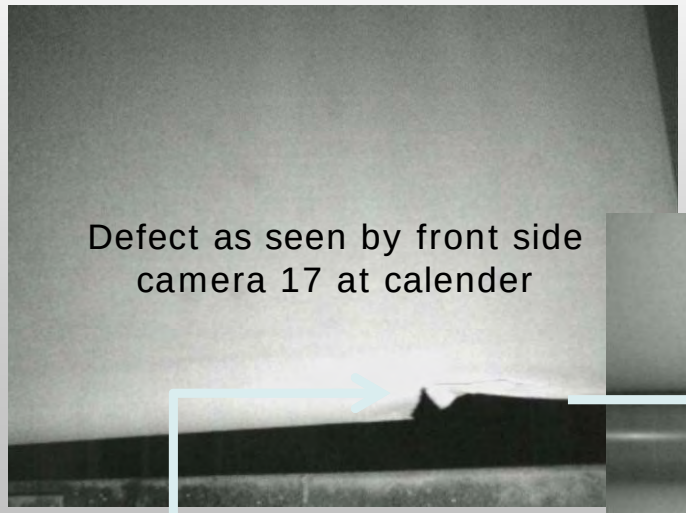
TotalVision Integration in Operation



Example TotalVision installation at Stora Enso, Nymöllä

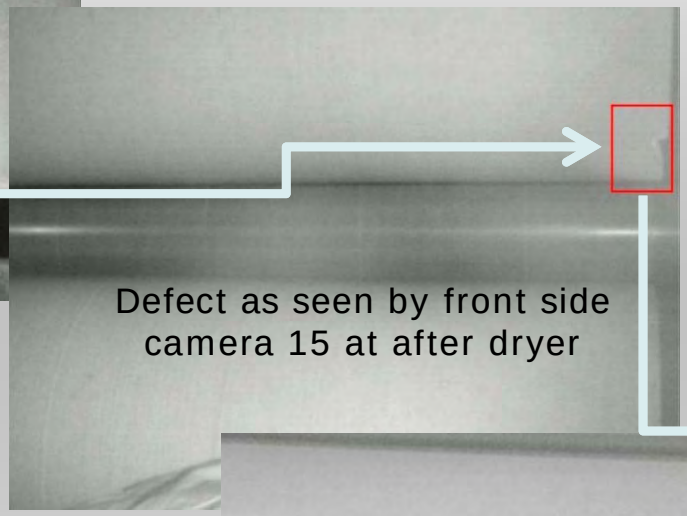


Front side edge defect detected by WIS

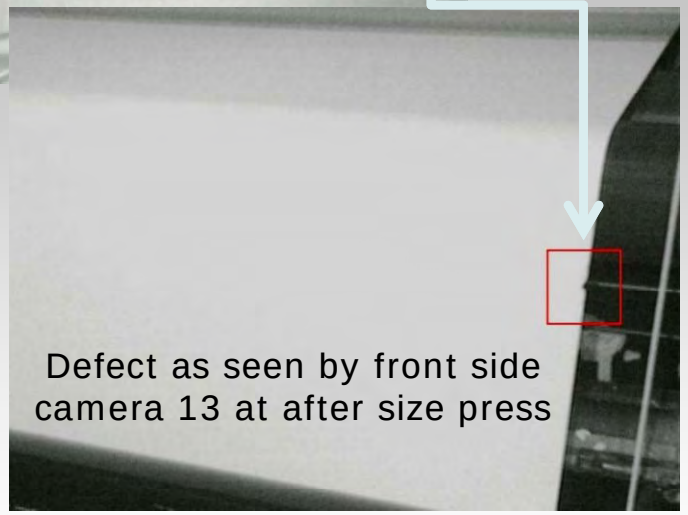


Defect as seen by front side camera 17 at calender

Defect auto transferred to WebVision



Defect as seen by front side camera 15 at after dryer



Defect as seen by front side camera 13 at after size press

Conclusion

WMS + WIS total vision today provides:

- Automatic real-time monitoring and recording of all critical locations using high resolution digital cameras
- Easy to use PC Windows® based software allowing operators to fully view and manipulate all of the image information
- Event videos that can be viewed immediately following a trigger and provide hours of history
- Defect to wet-end automatic root cause source detection
- Total real-time analysis allowing break preventive measures
- Interface to mill-wide systems for complete reporting using OPC and other high speed communications links