

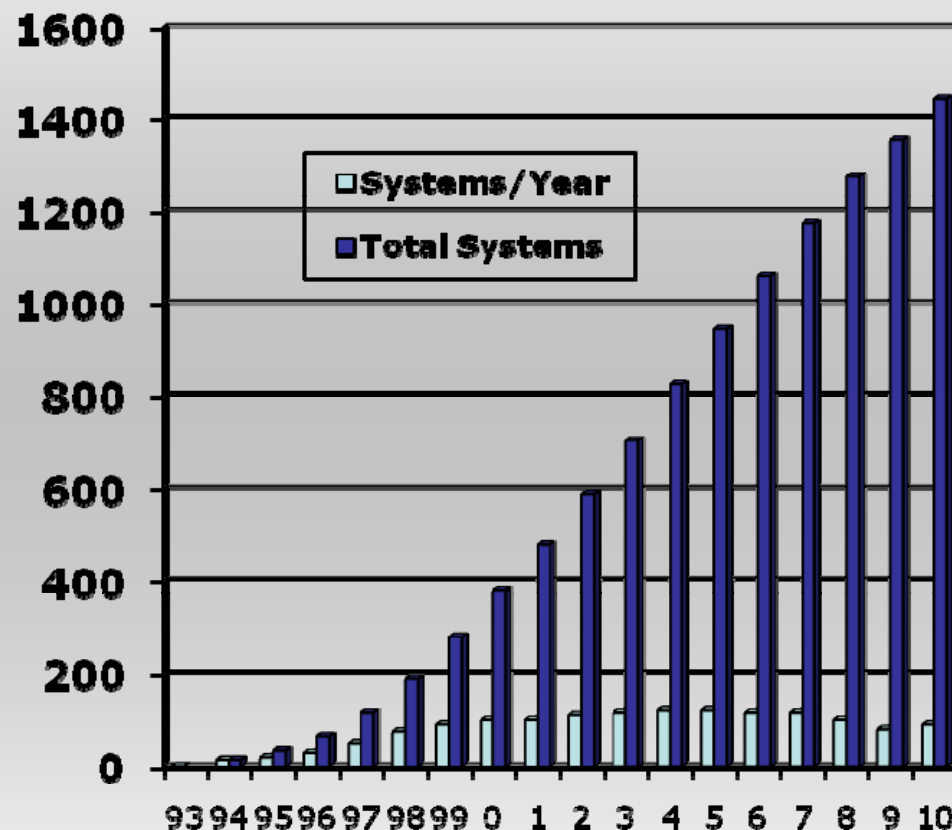
# Improving papermaking & coating efficiency with web inspection cameras

**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

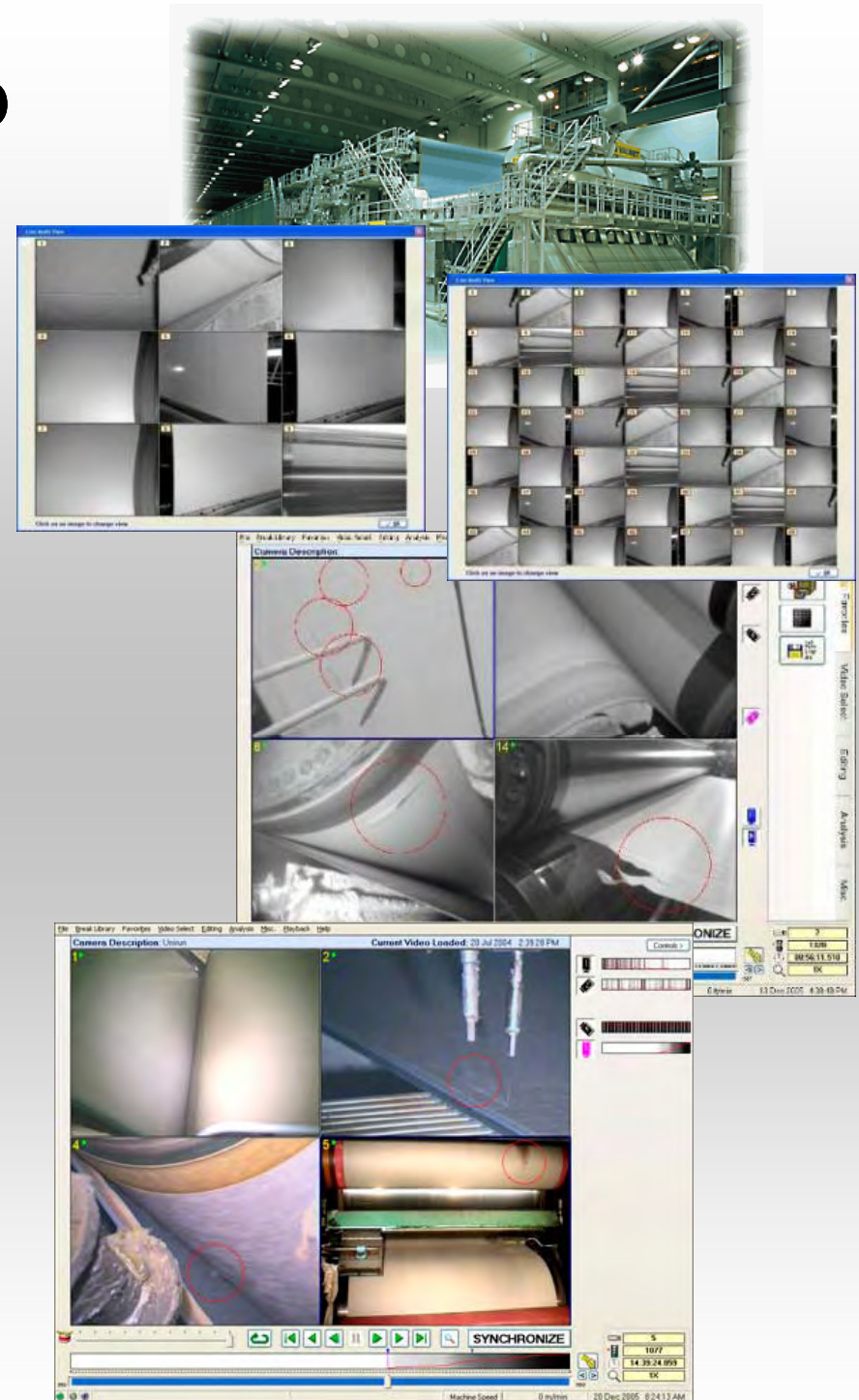


# Today's Must Have Capabilities

- 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.

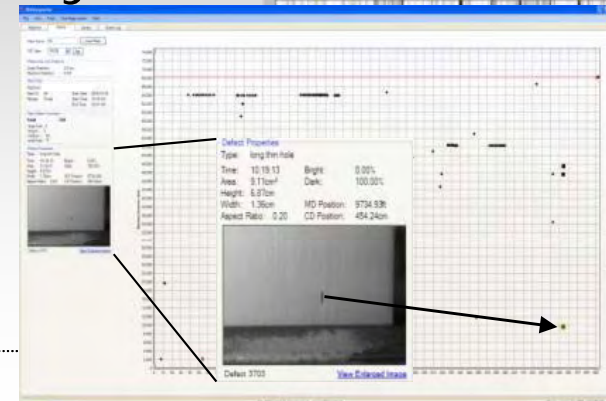
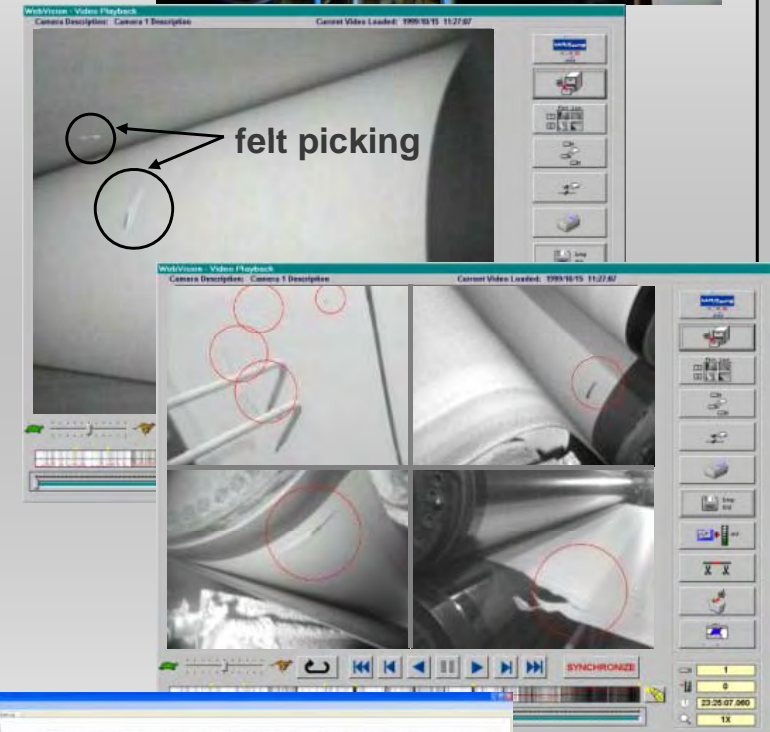
# What Can WMS Do

- 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

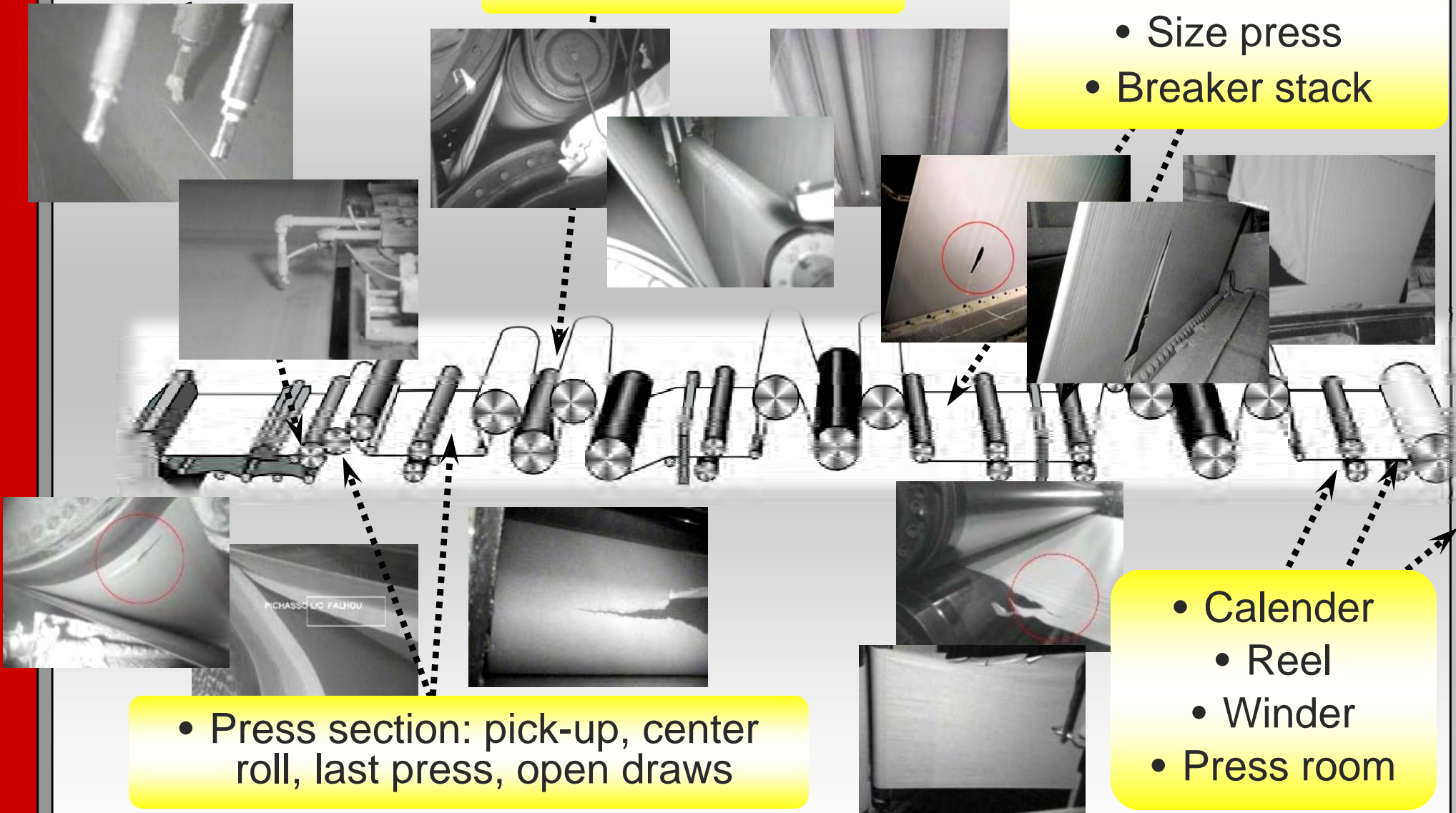
- Trim squirts

- Dryer first and second sections

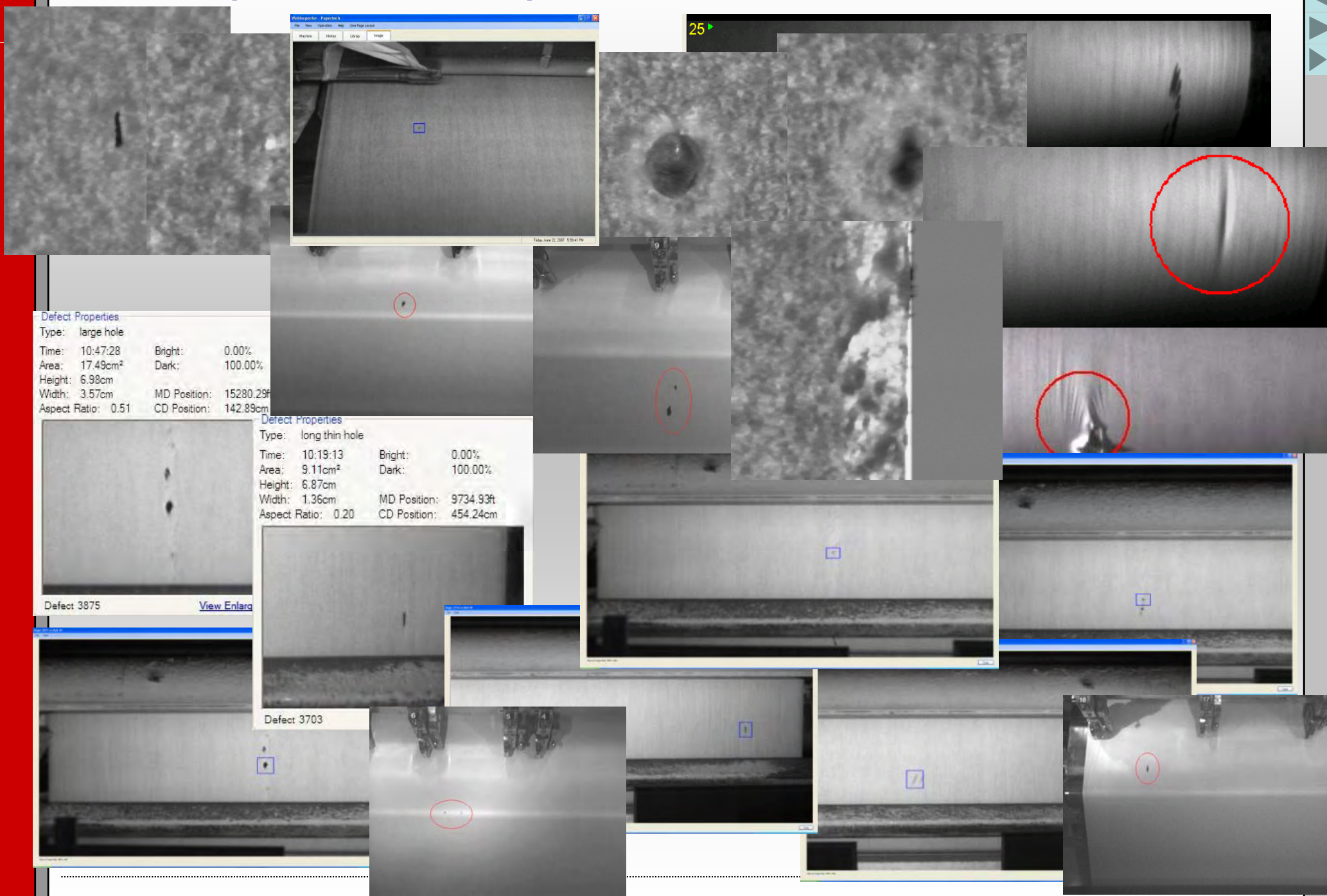
- Coaters (on & off machine)
- Size press
- Breaker stack

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

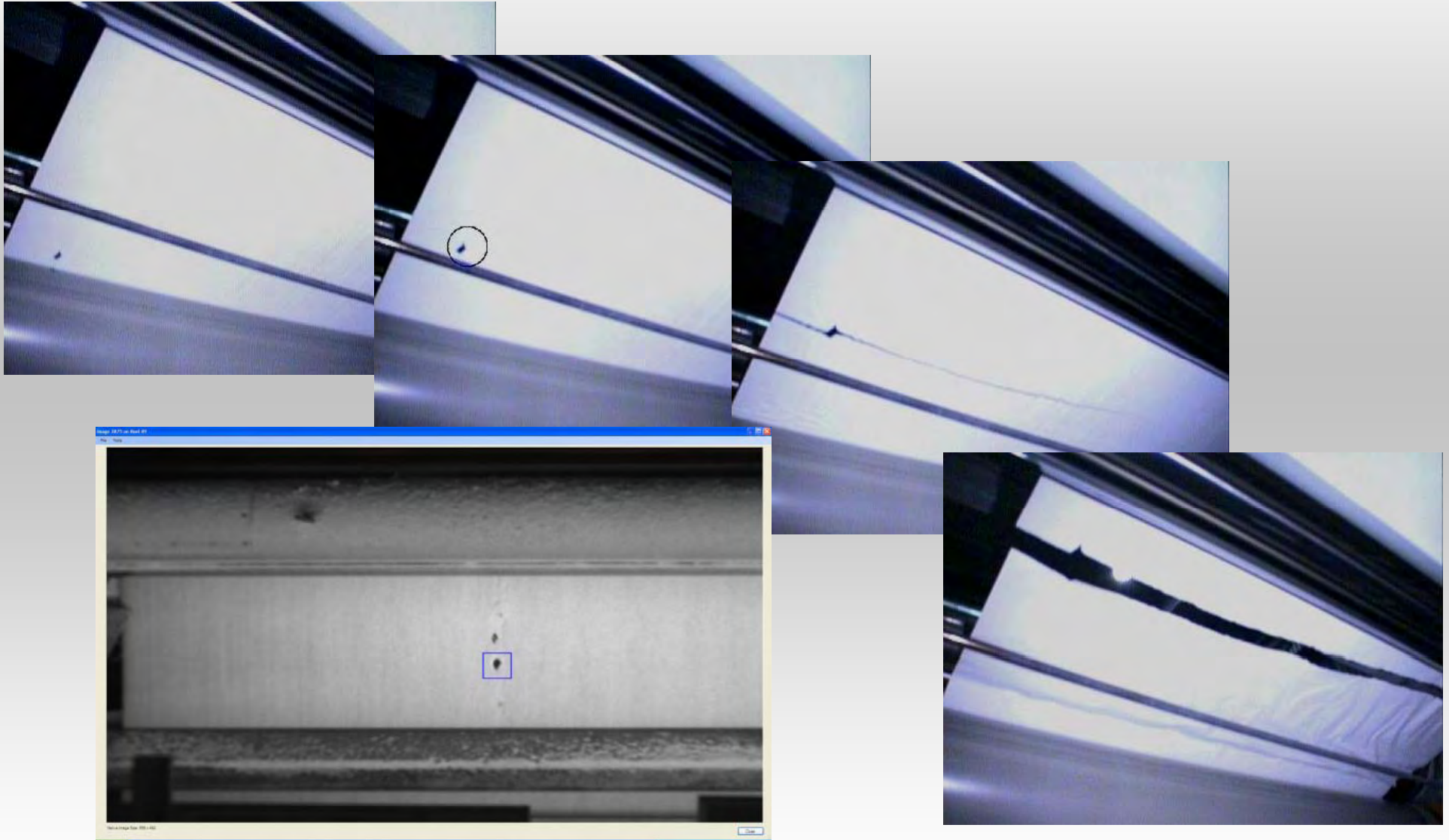
- Calender
- Reel
- Winder
- Press room



# 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

1.23  
megapixels

1280 pixels

**GC1290**  
**33Hz**

0.32  
megapixels

656 pixels

960 pixels

**GC660**  
**120Hz**

492 pixels

# How do digital cameras work

GC1290 cropped to ½ in vertical to produce higher image speed

0.61  
megapixels

1280 pixels

**GC1290**  
**60Hz**

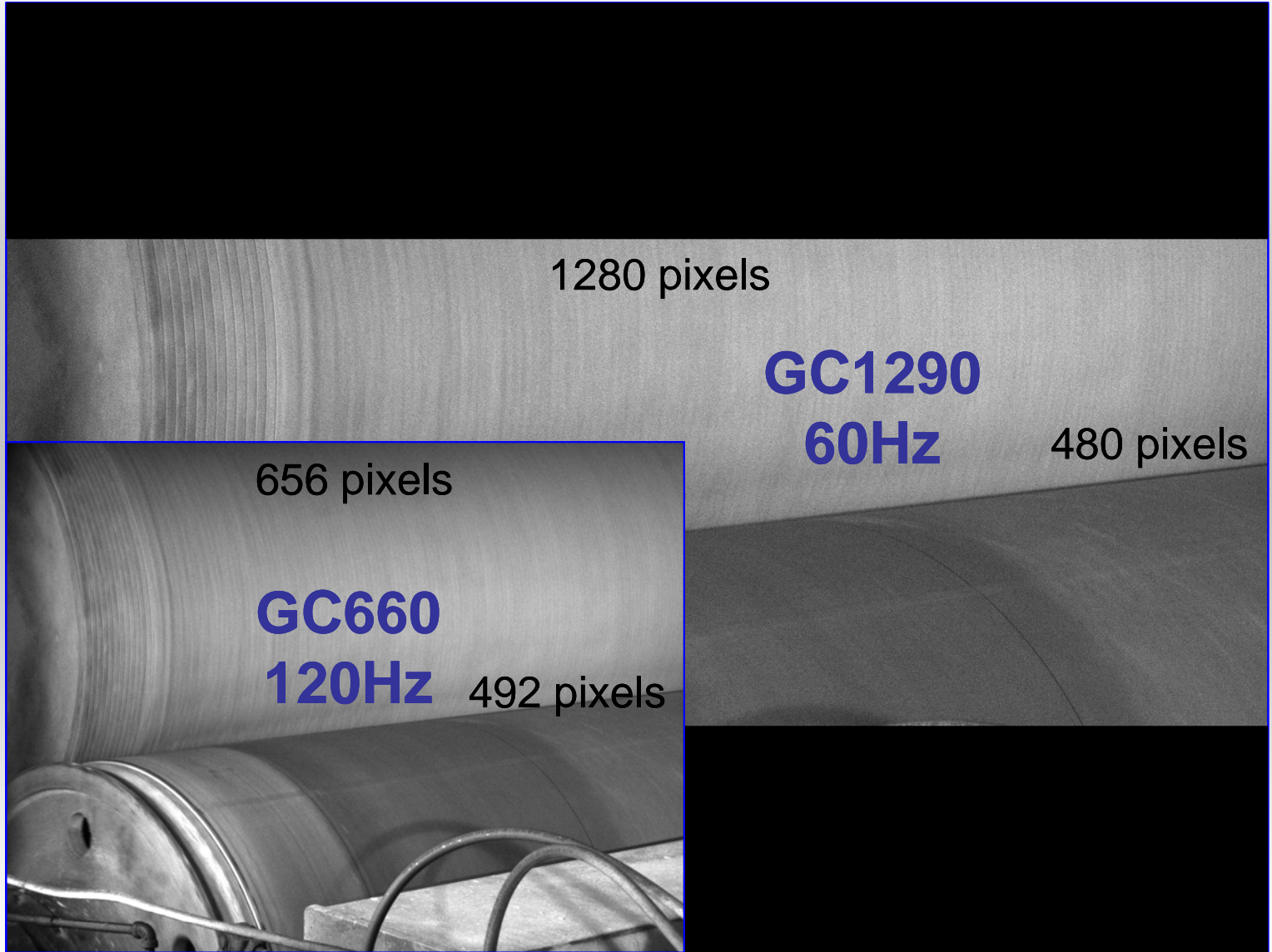
480 pixels

0.32  
megapixels

656 pixels

**GC660**  
**120Hz**

492 pixels

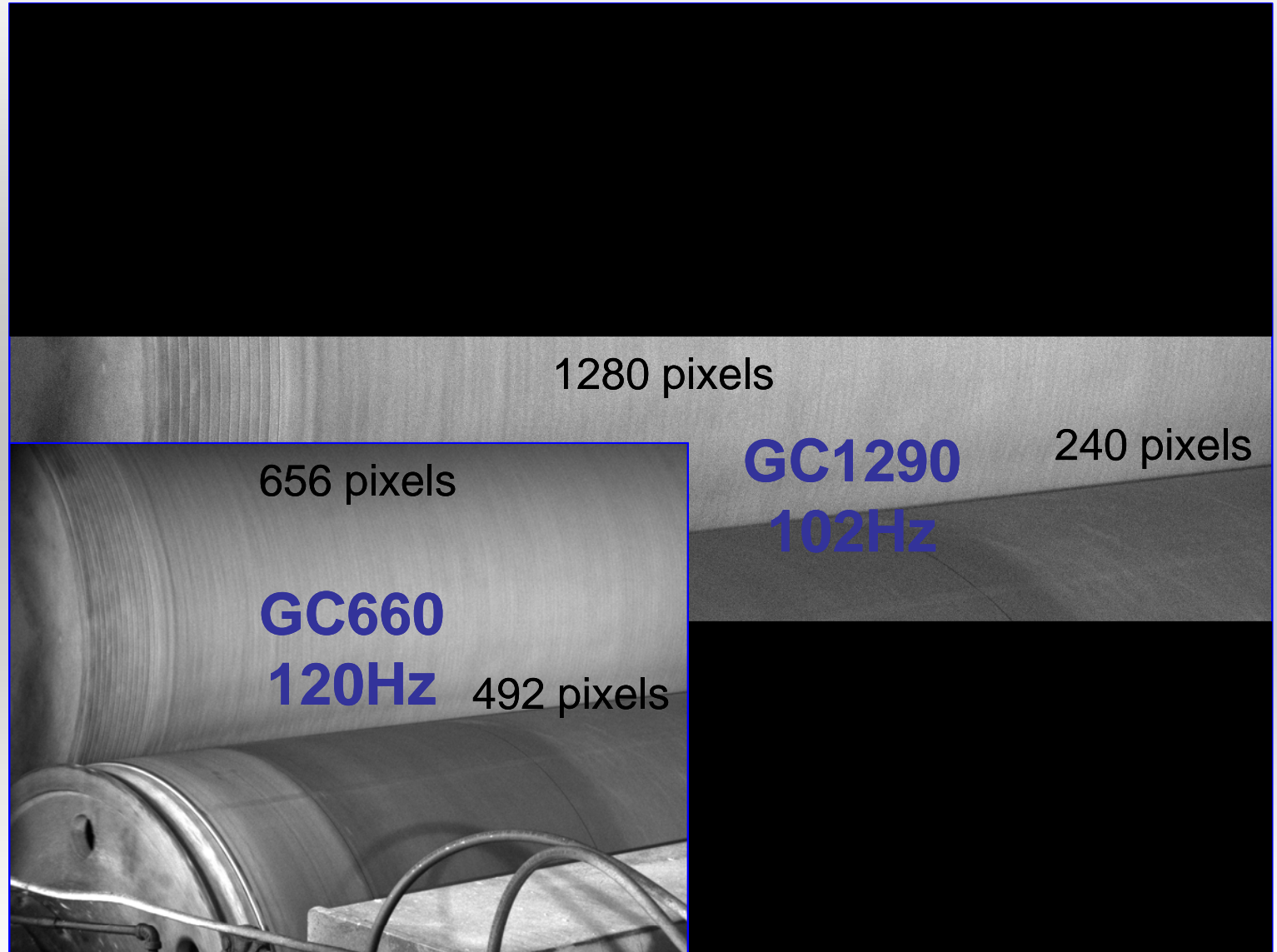


# How do digital cameras work

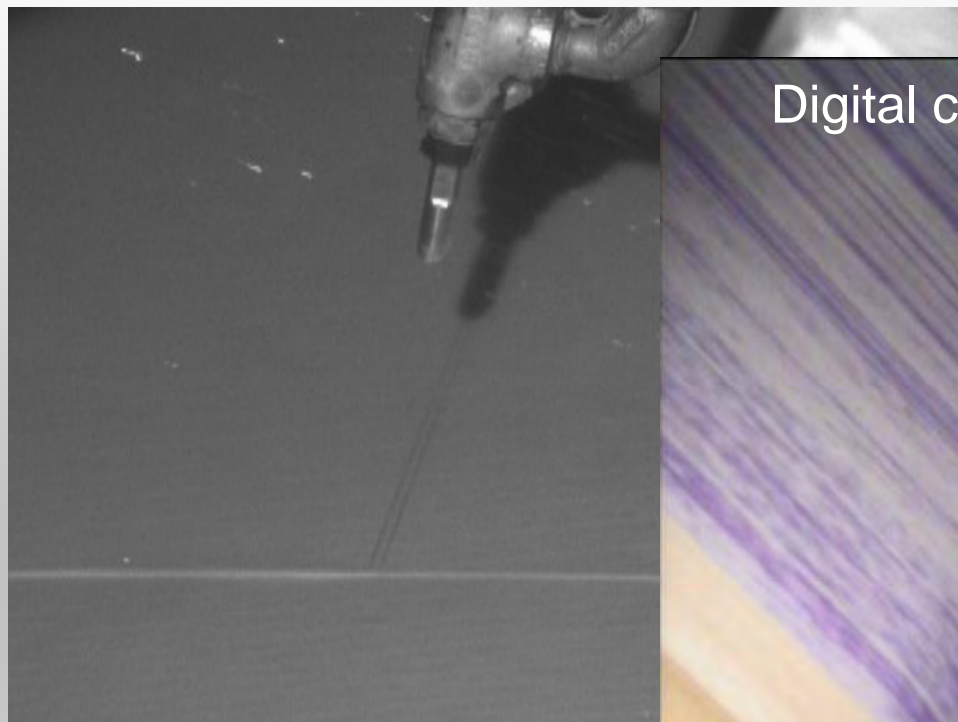
GC1290 cropped in vertical ¼ size to produce even higher image speed

0.31  
megapixels

0.32  
megapixels



# Image Comparison (continued)

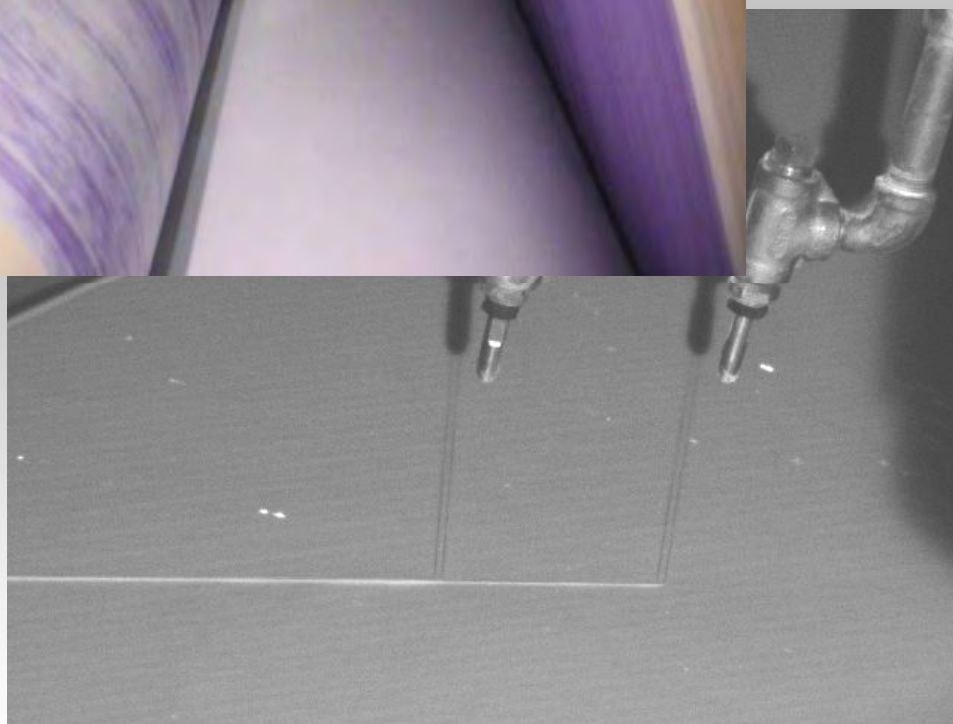


Analog monochrome  
640 x 240 x 60Hz



Digital colour 659 x 493 x 120Hz

Digital monochrome  
659 x 493 x 120Hz



# Typical WMS Main Page

Real-time image

Details on camera being viewed

The screenshot displays the WMS Main Page interface. At the top, a menu bar includes File, Break Library, Favorites, Video Select, Editing, Analysis, Misc., Playback, and Help. The main content area is divided into several sections:

- Camera Description:** A large video window showing a real-time image of a paper machine. A dashed arrow points from the "Real-time image" label to this window.
- Current Video Loaded:** 8 Sep 2003 4:01:15 PM.
- Camera Information:** A panel on the right containing details about the camera being viewed. A dashed arrow points from the "Details on camera being viewed" label to this panel.
  - Number:** 1
  - Description:** Camera one location
  - Type:** Generic NTSC monochrome (60 fields/sec)
  - Distance:** 0 feet
  - Capture Number and Name:** 1 - CAPTURE1
  - Information:**
    - Last download: 8 Sep 2003 4:01:15 PM
    - Triggered by: Operator
- Information:** A panel below the camera information, containing:
  - Last download: 8 Sep 2003 4:01:15 PM
  - Triggered by: Operator
- Full screen:** A button labeled "Full screen" with a red arrow pointing to it.
- Click a camera below to show live video:** A text label with a red arrow pointing to a "Live" button.
- 3D Paper Machine Model:** A large 3D model of a paper machine with various components labeled with numbers (1-20). A dashed arrow points from the "Paper machine view for easy switching from one camera to the next" label to this model.

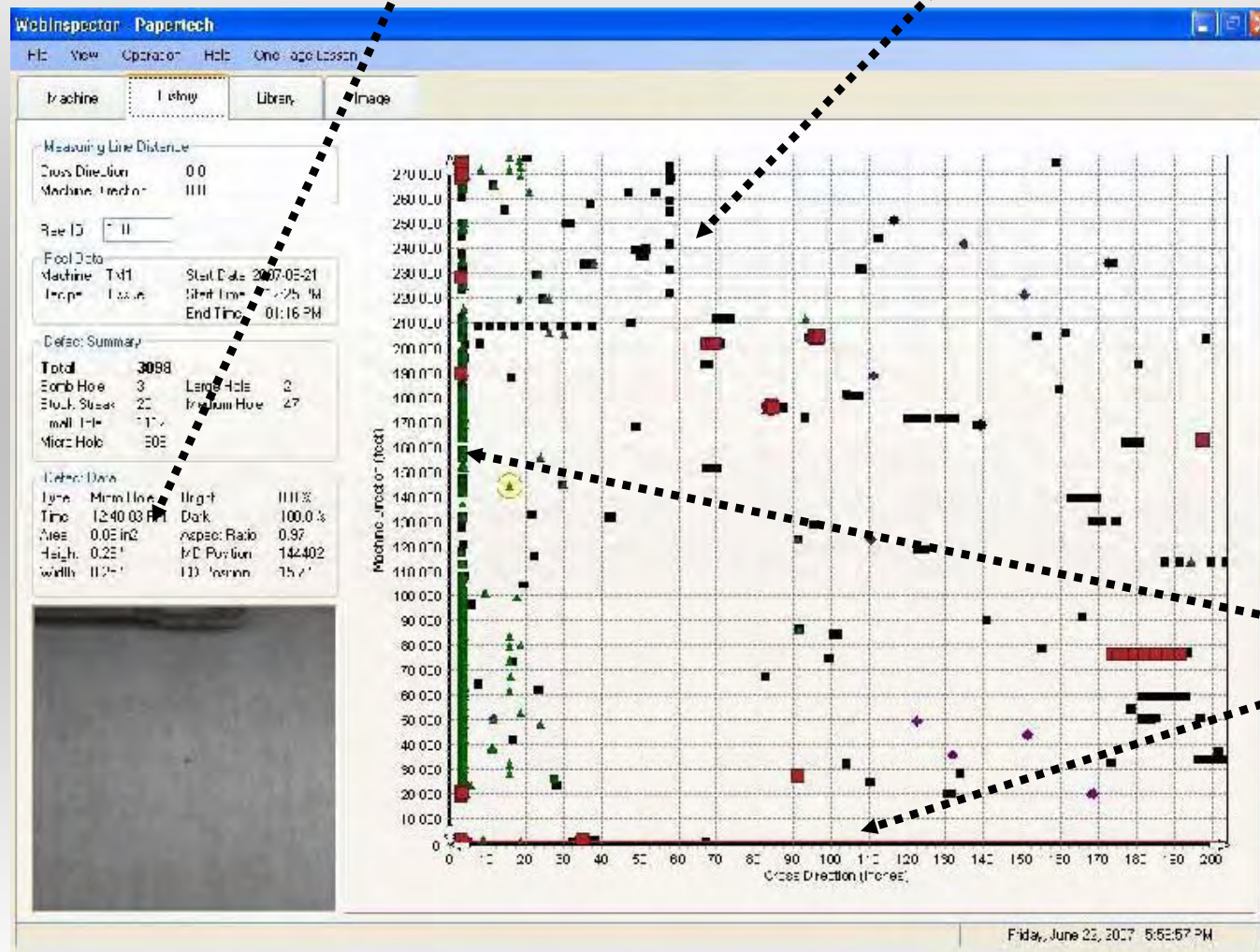
At the bottom, there is a control bar with a timeline, playback controls (stop, play, pause, etc.), and a "SYNCHRONIZE" button. The status bar at the very bottom shows "Rotating Storage: 3.65% USED", "Machine Speed: 854 ft/min", and the date/time "8 Sep 2003 4:04:20 PM".

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

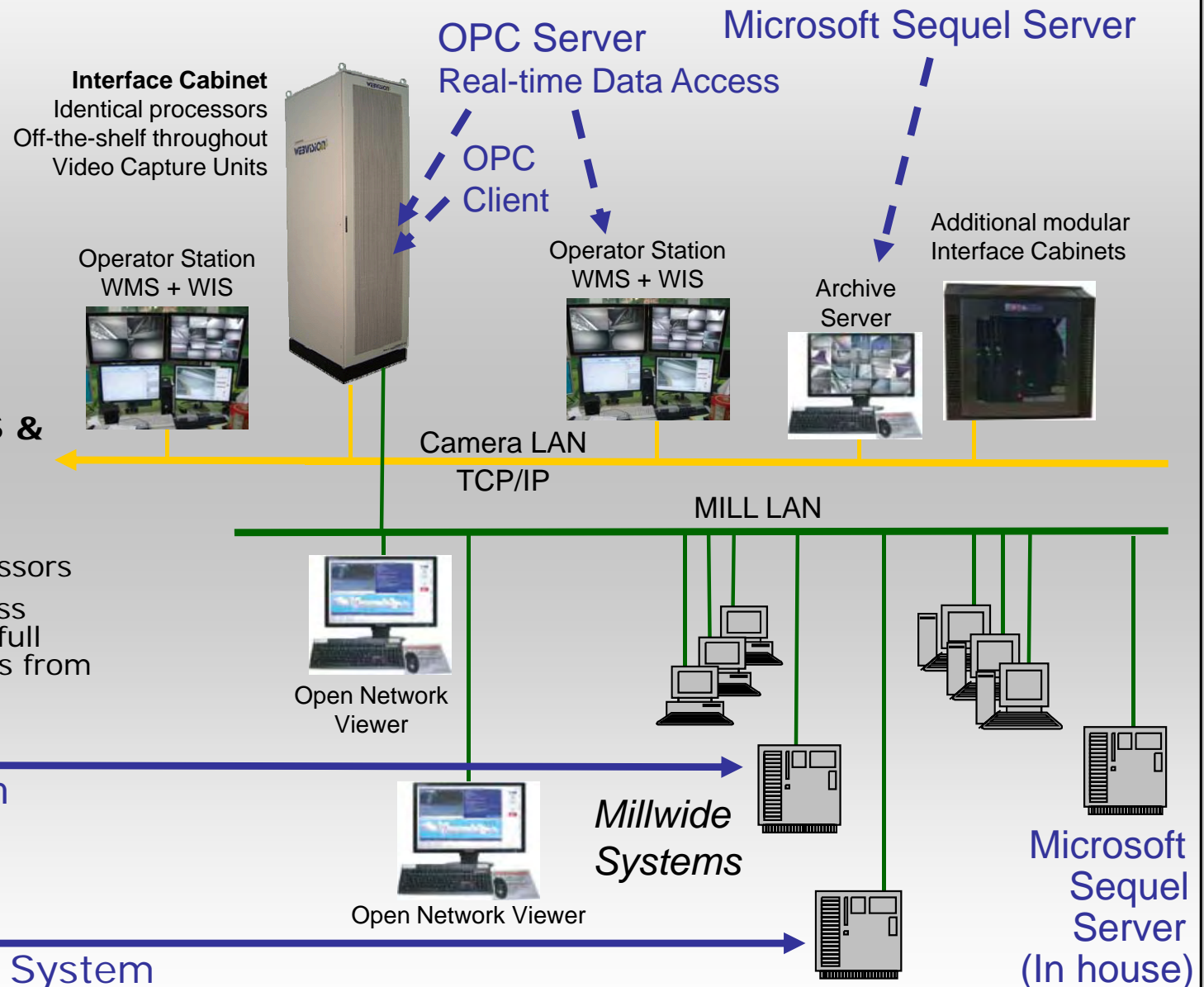


## Ideal solution: WIS & WMS using same platform

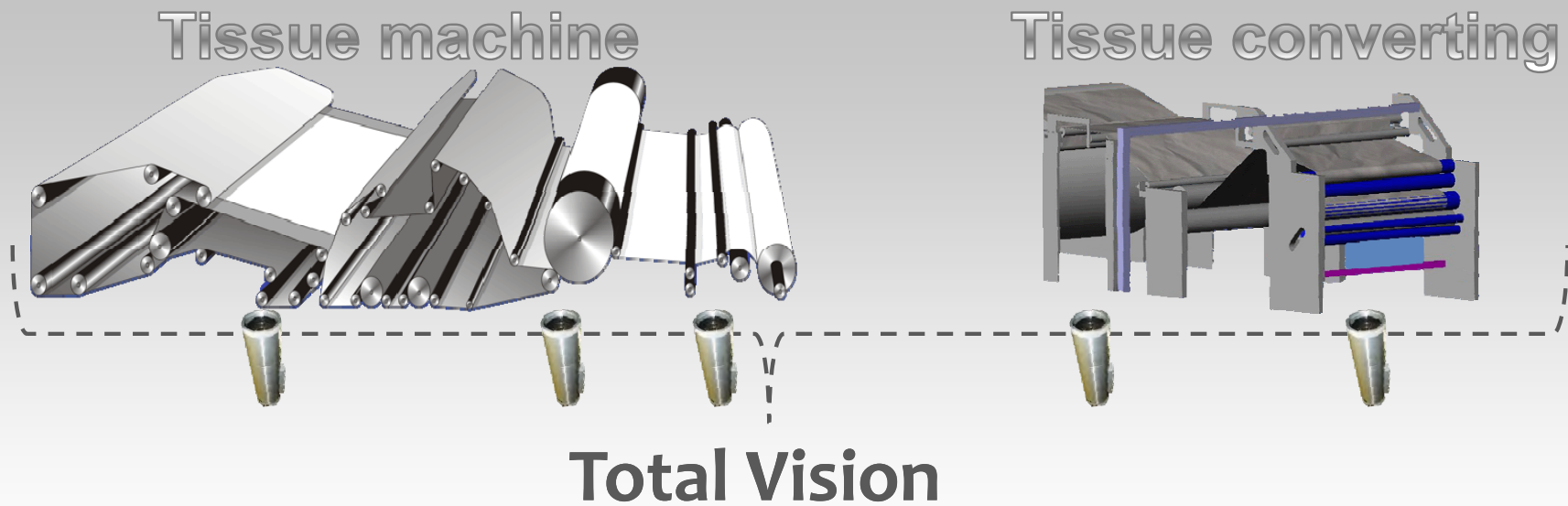
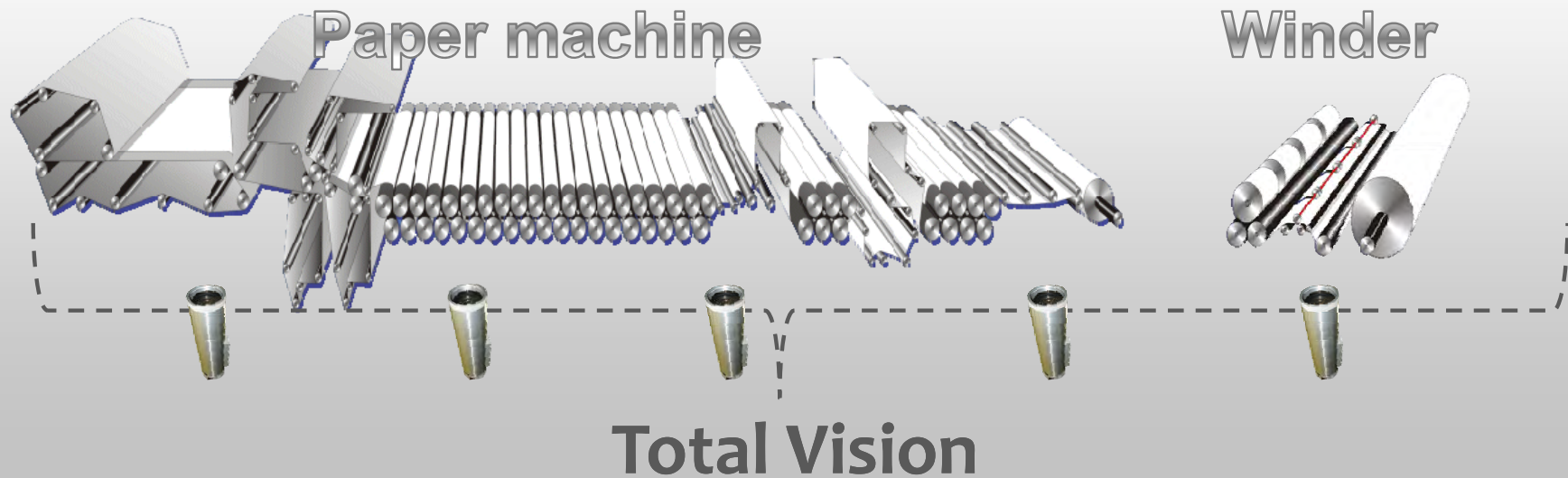
- Same cameras, same housings, same processors
- Integrated for seamless functionality allowing full visibility of the process from end to end.

OPC Server  
Quality Control System

OPC Client  
Process Information System

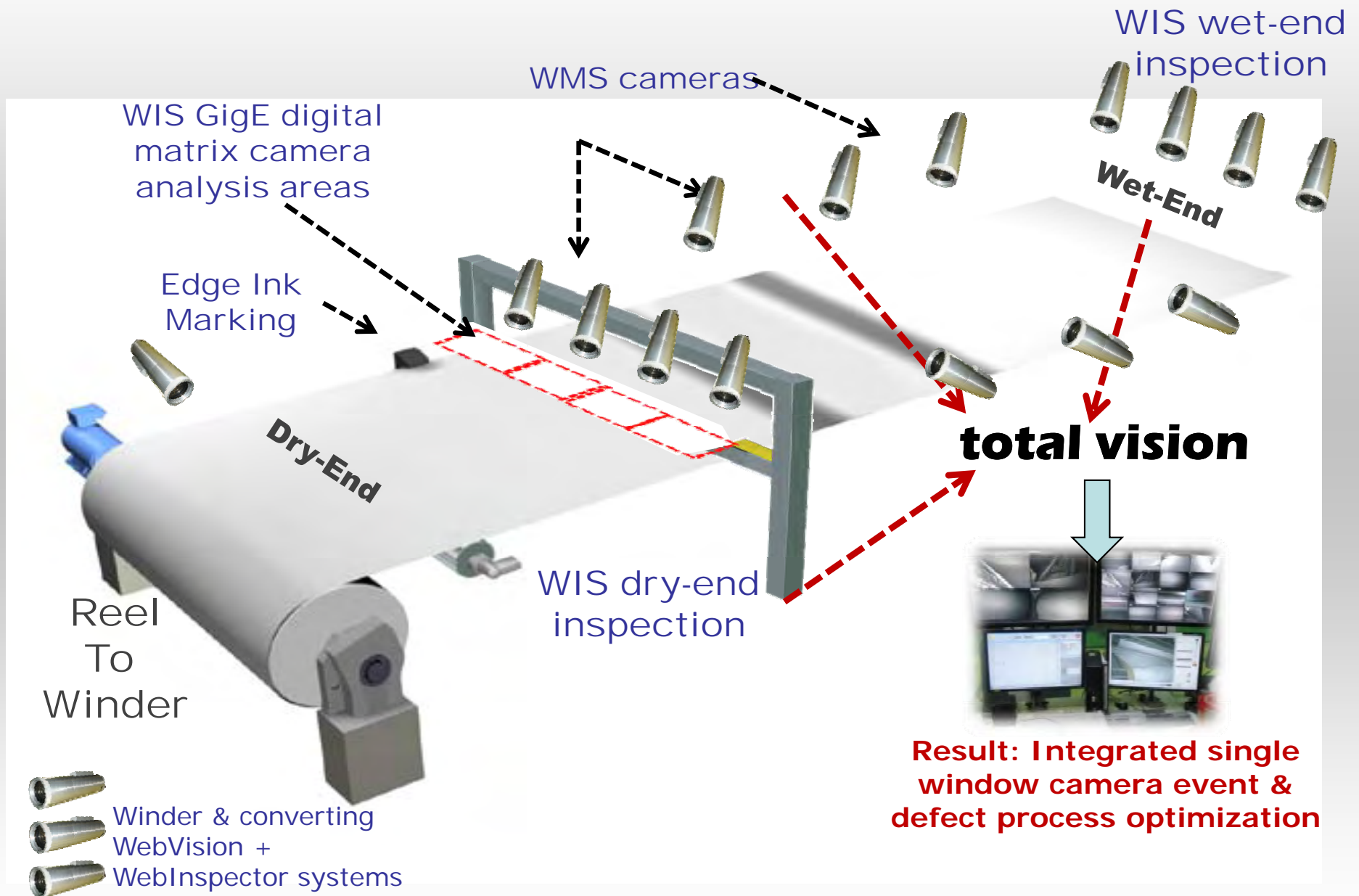


# ***WMS + WIS = Total Vision***

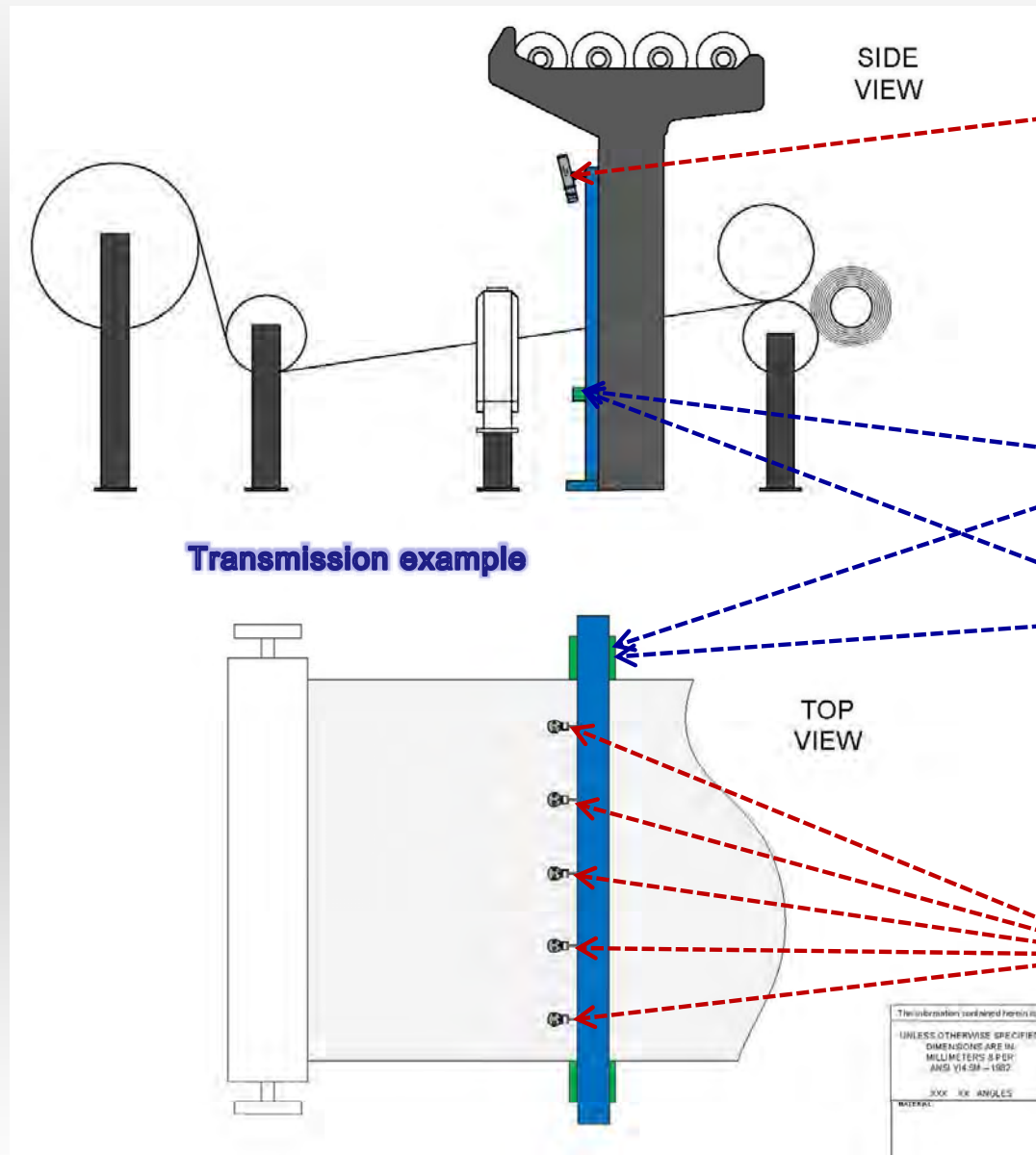


# ***WMS + WIS = Total vision***

**Event Capturing & Web Inspection All-in-One**



# WIS typical layout at reel



Transmission example

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

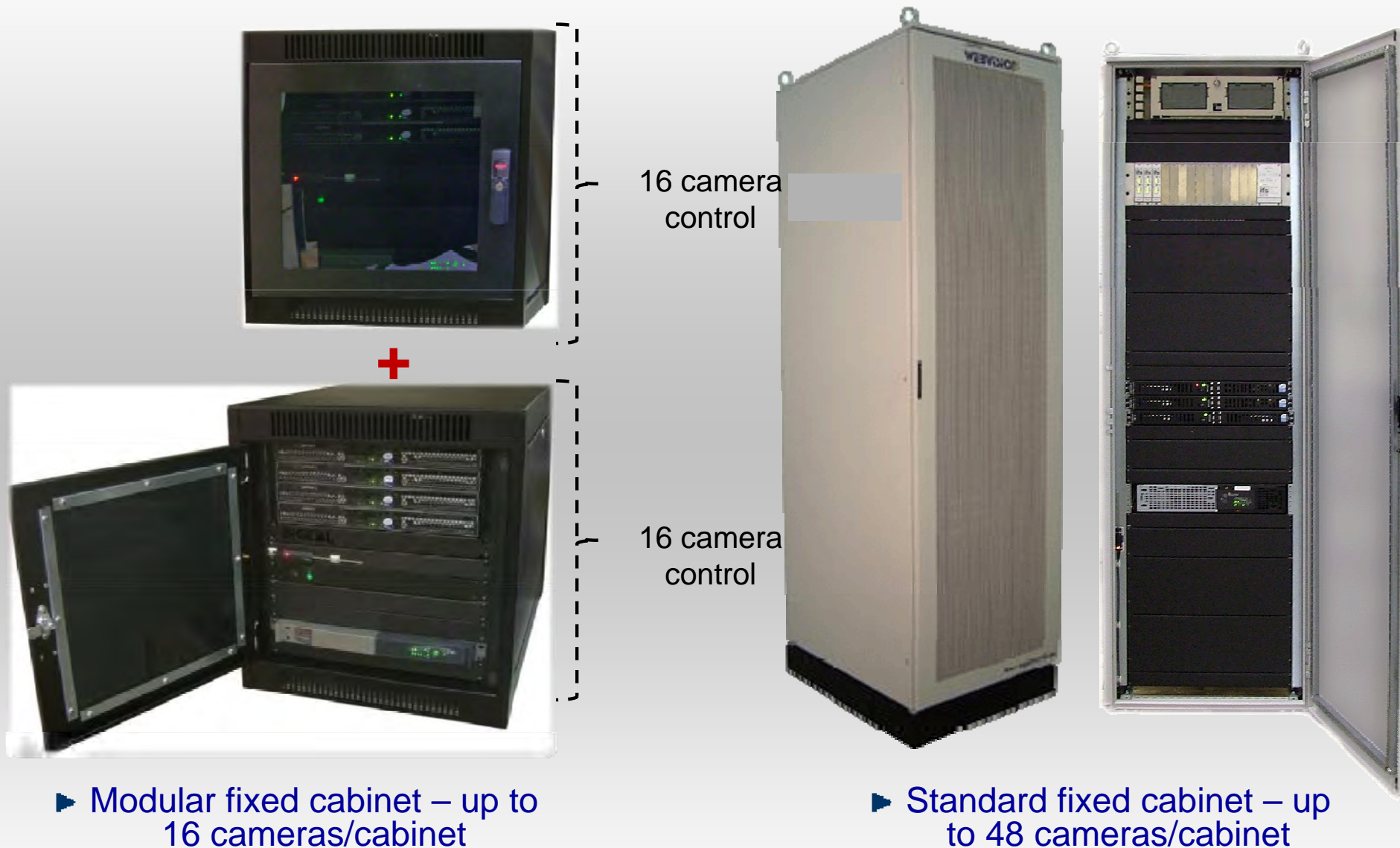


- ▶ On wheels with built-in air conditioner – up to 12 digital cameras



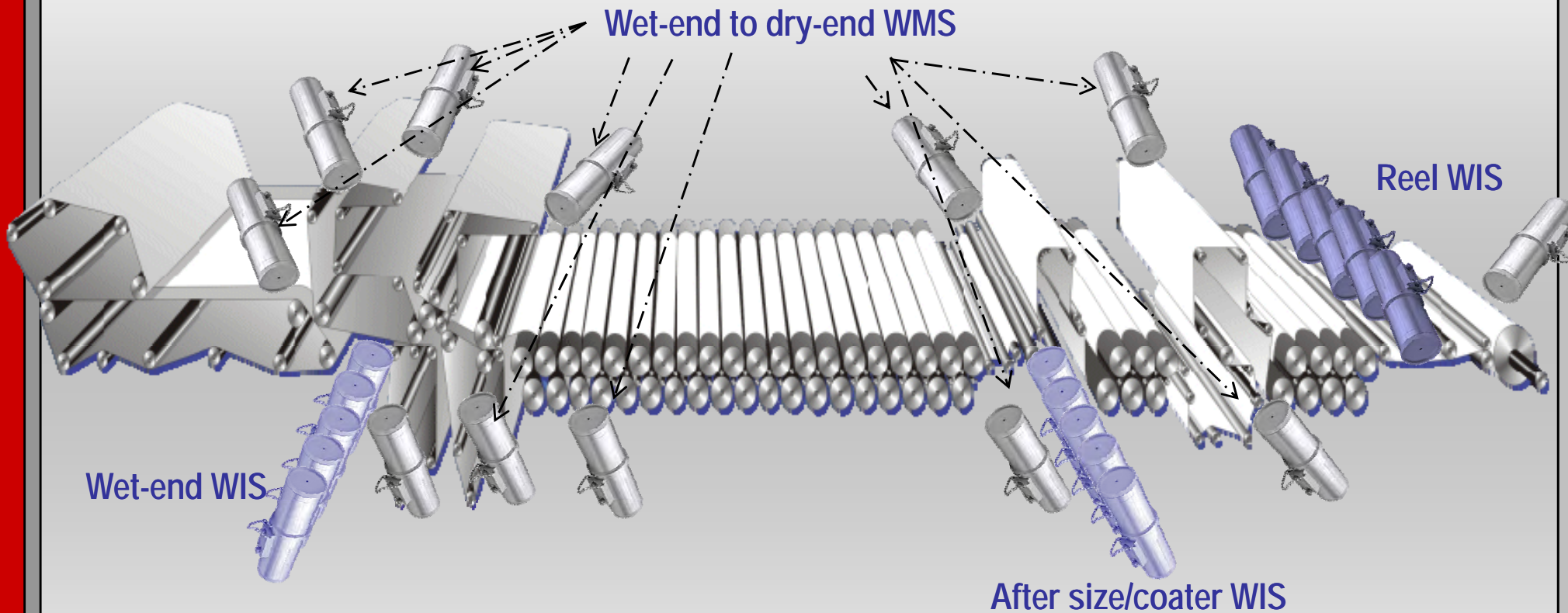
- ▶ Workstation using fanless solid state computers – 3 digital cameras per box, distributed solution uses multiple boxes

# From Portable to Fixed solutions



# *WMS + WIS = Total Vision*

## Event Capturing & Web Inspection All-in-One

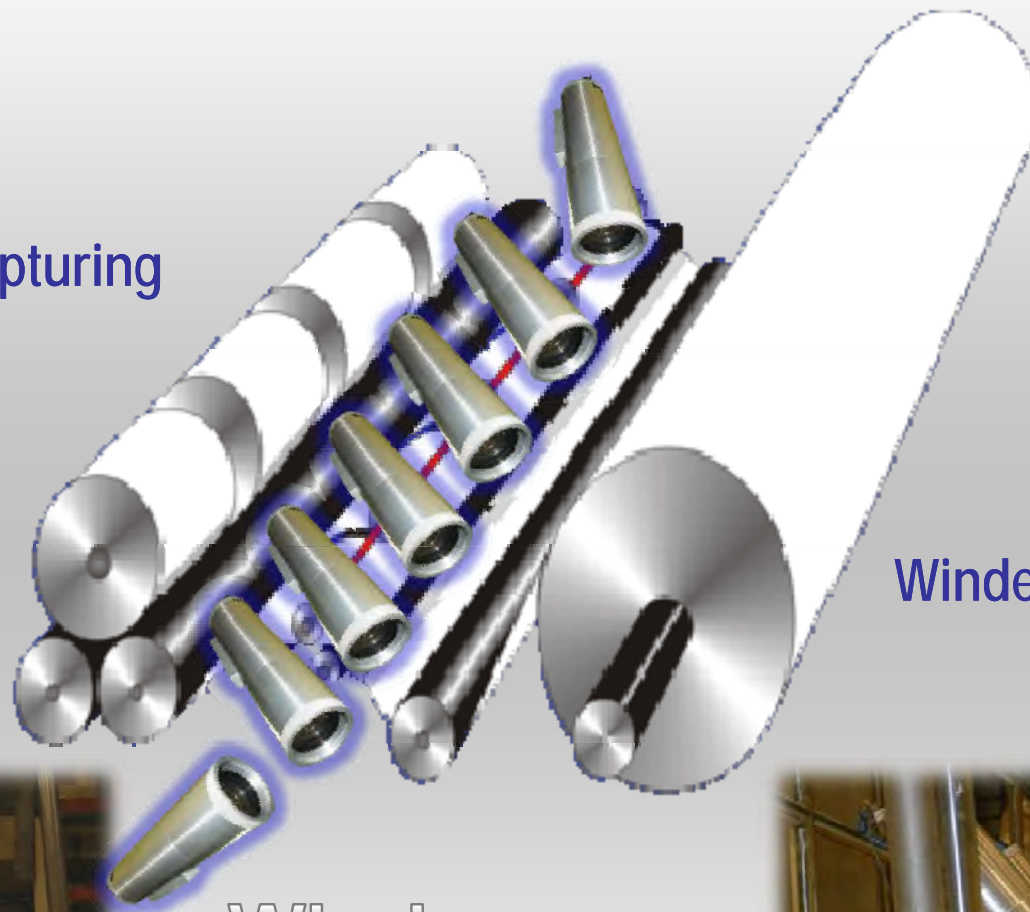


- **WMS** cameras in wet-end to dry-end capture events from breaks to defects & increase machine visibility = less breaks, higher efficiency, better quality
- **WIS** cameras in wet-end to dry-end capture defects = better downstream runnability & better quality

# ***WMS + WIS = Total Vision***

## **Event Capturing & Web Inspection All-in-One**

Winder Event Capturing



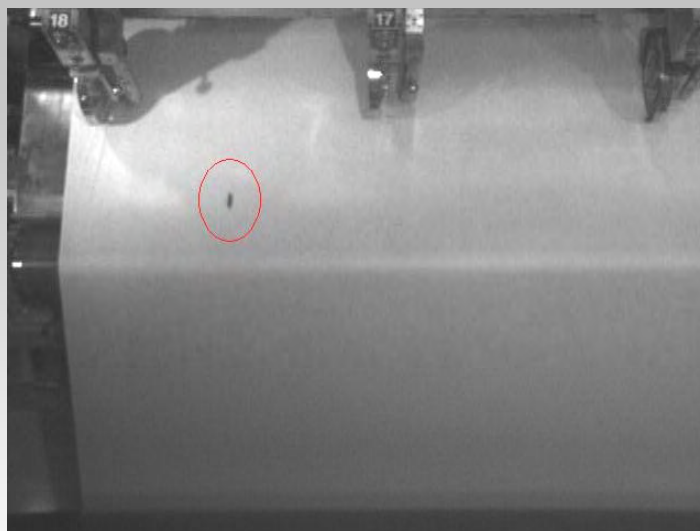
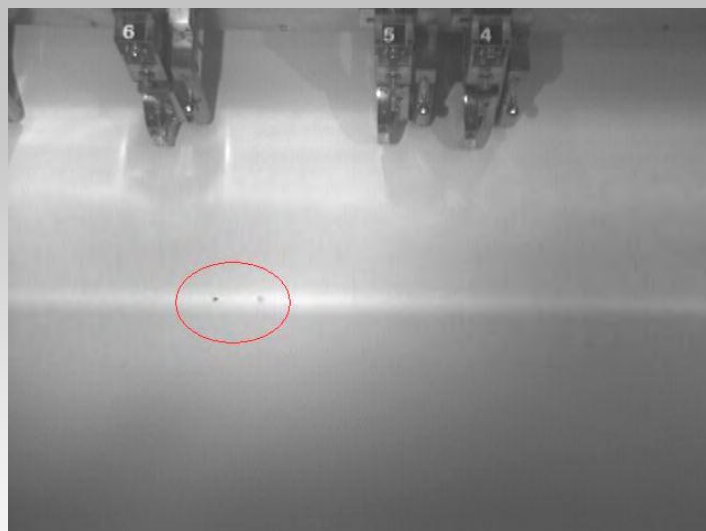
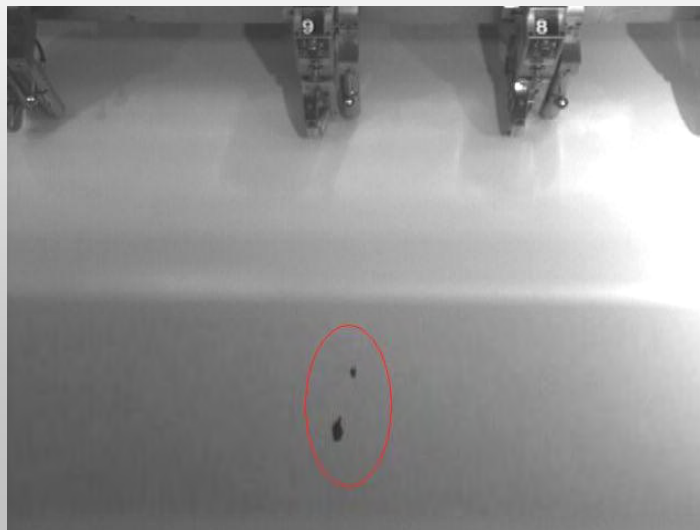
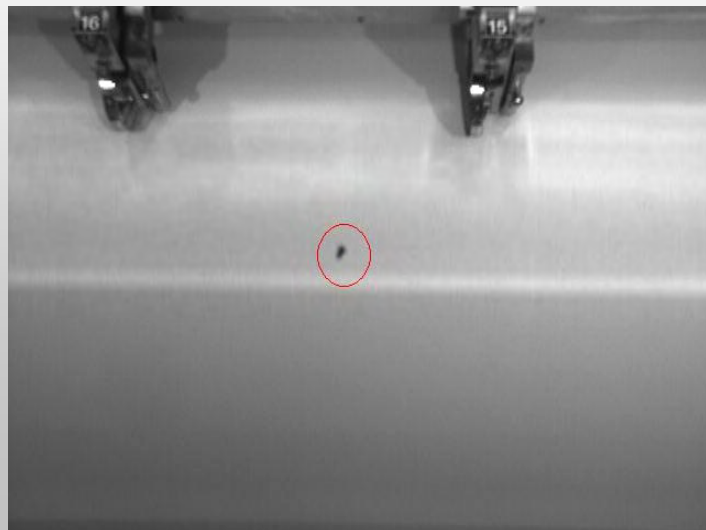
Winder Web Inspection

Winder



**North Pacific Paper**, Longview, WA, USA

# Examples of Defect Detection

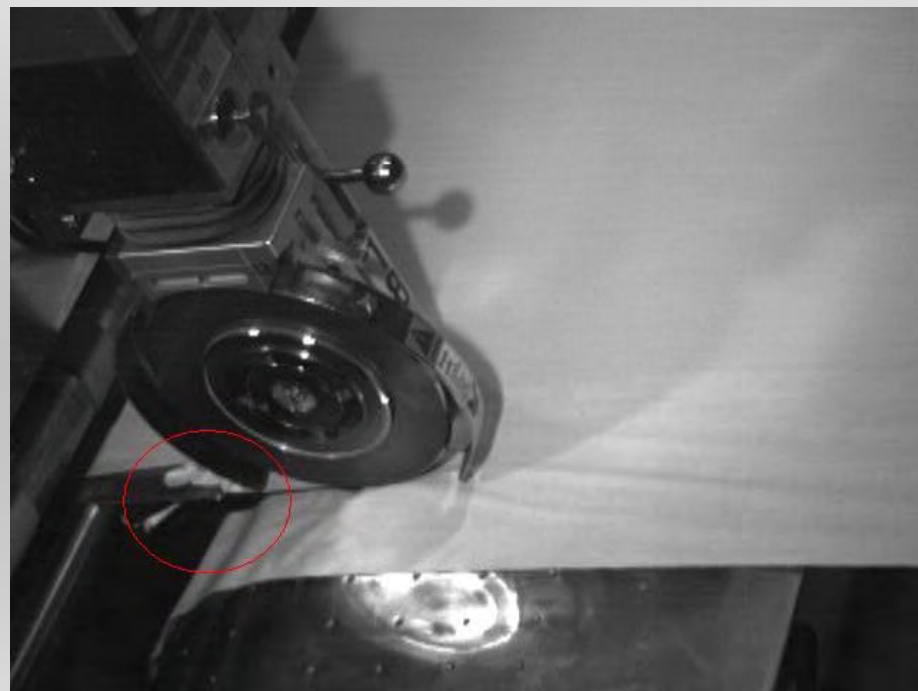
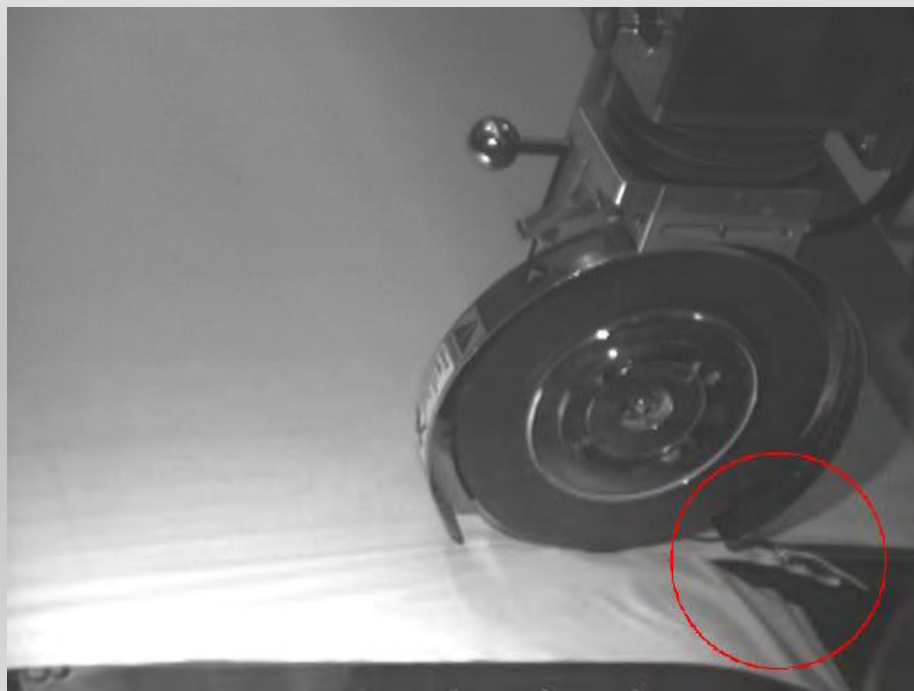


Examples of holes caught in the first few months using defect detection.

Hole sizes range from 2.0-5.0 mm

***North Pacific Paper***, Longview, WA, USA

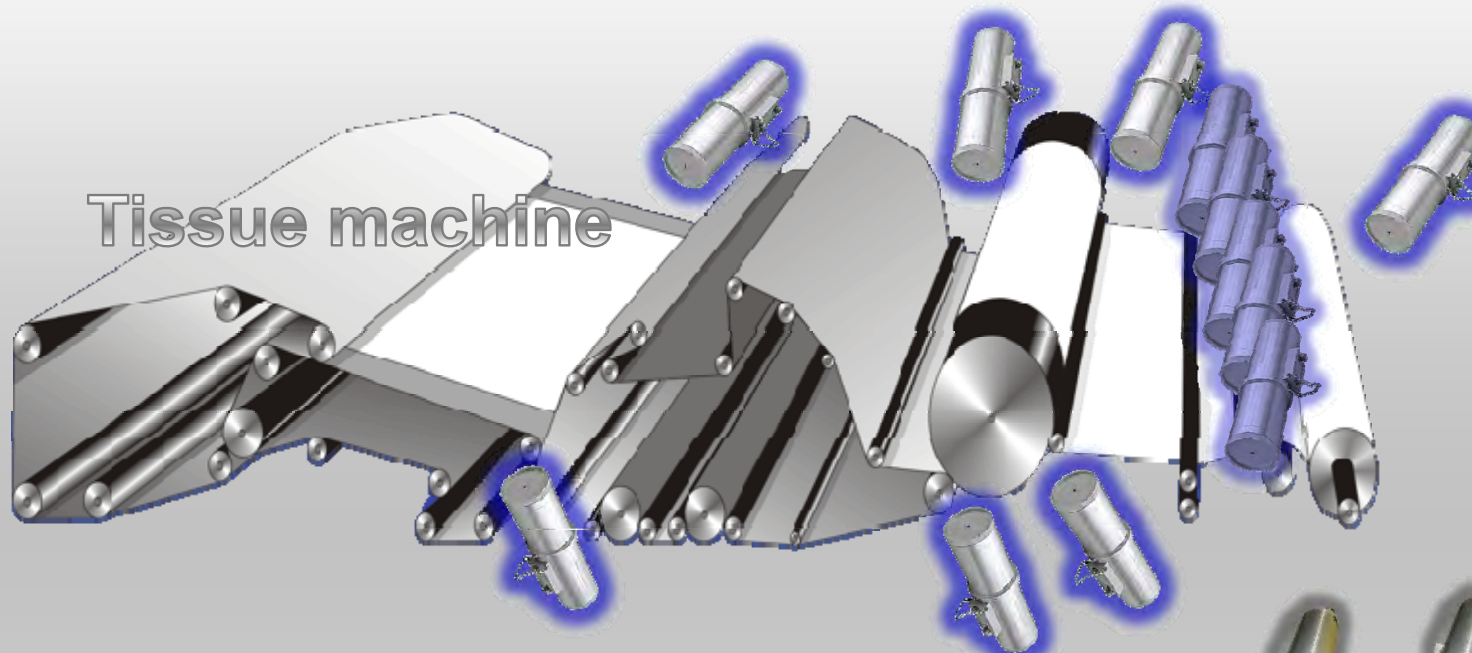
# Examples of Dryer Wrinkles



**Shows winder edge slitter problem due to dryer wrinkles**

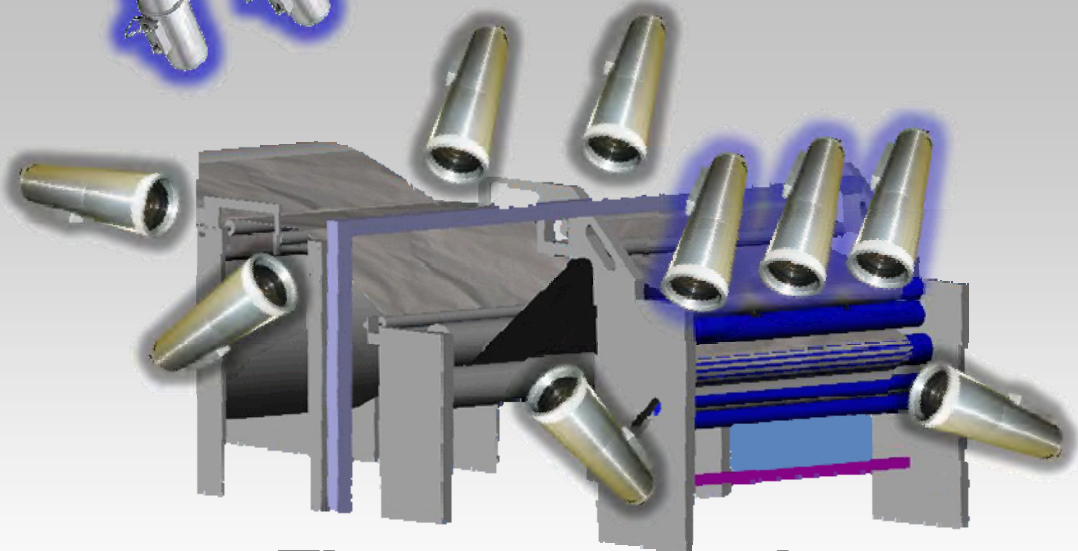
# ***WMS + WIS = Total Vision***

## **Event Capturing & Web Inspection All-in-One**



**Tissue machine**

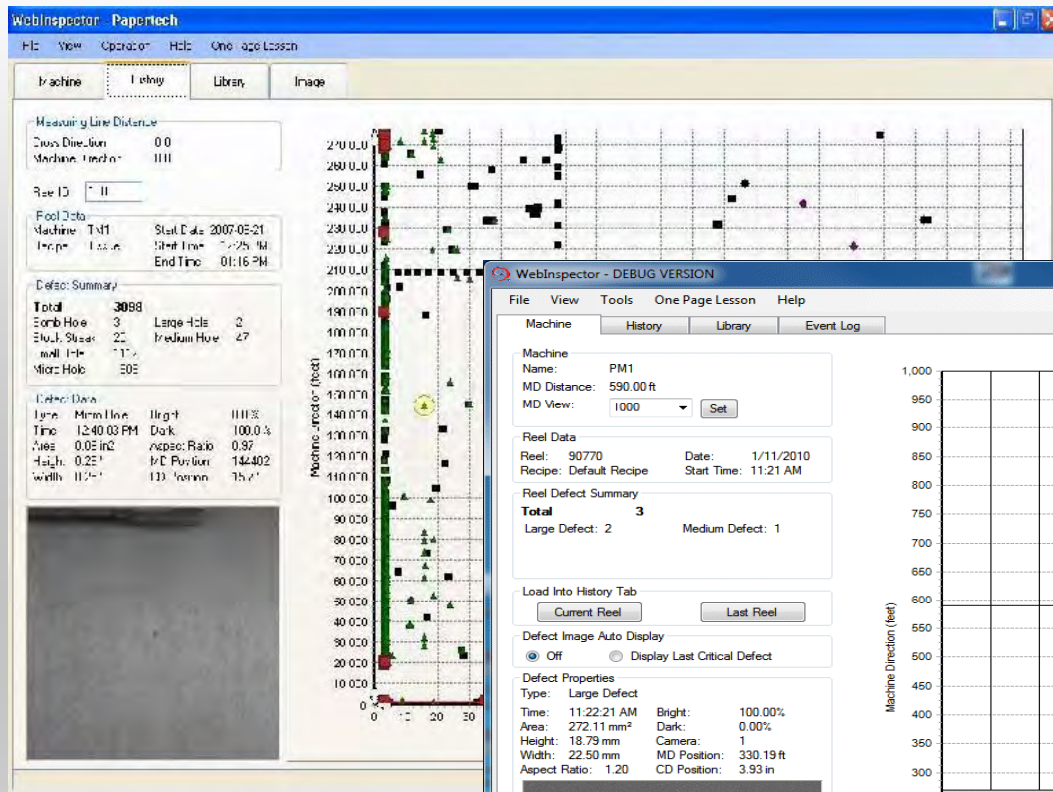
**Tissue Machine & Converting  
Event Capturing**



**Tissue Machine & Converting  
Web Inspection**

**Tissue converting**

# WIS Operator Interface



**WebInspector - Papertech**

File View Operation Help One Page Lesson

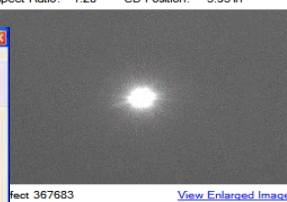
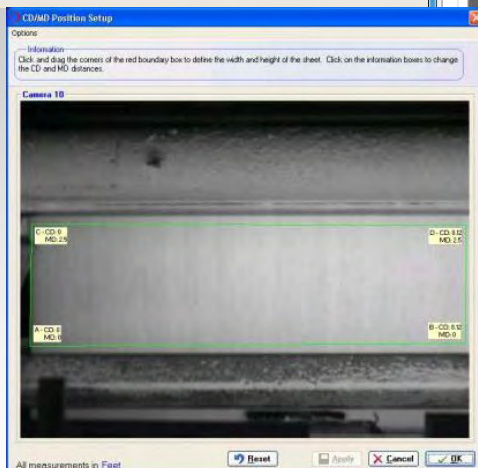
Machine History Library Image

1. Select Recipe 2A. Search By Date and Time Window 2B. Search From Present 3. View Selected Reel

Started After 2007-05-20 05:50 PM  
Started Before 2007-05-22 05:50 PM  
Reels from the last 2 Days  
Get Reel Summaries Load History Tab

Reel	Start Time	End Time	Total	Bomb Hole	Large Hole	Medium Hole	Micro Hole	Small Hole	Stock Streak
1338	6/22/2007 10:45 AM	6/22/2007 11:32 AM	652				643	207	2
1337	6/22/2007 9:58 AM	6/22/2007 10:45 AM	1465			5	397	1050	13
1336	6/22/2007 9:11 AM	6/22/2007 9:58 AM	296			10	63	204	19
1335	6/22/2007 8:25 AM	6/22/2007 9:11 AM	3892			6	3483	398	5
1334	6/22/2007 7:30 AM	6/22/2007 8:25 AM	182	2	2	25	210	319	24
1333	6/22/2007 6:33 AM	6/22/2007 7:30 AM	653	6	3	43	130	450	21
1332	6/22/2007 5:46 AM	6/22/2007 6:33 AM	376			10	119	241	6
1331	6/22/2007 4:49 AM	6/22/2007 5:46 AM	466	1	5	40	75	292	53
1330	6/22/2007 4:00 AM	6/22/2007 4:49 AM	1421	2	2	35	806	529	47
1329	6/22/2007 3:09 AM	6/22/2007 4:00 AM	781			22	164	562	33
1328	6/22/2007 2:45 AM	6/22/2007 3:09 AM	2163			21	1366	771	5
1327	6/22/2007 2:00 AM	6/22/2007 2:45 AM	3907		2	43	2119	1333	10
1326	6/22/2007 1:11 AM	6/22/2007 2:00 AM	1950		1	23	987	525	13
1325	6/22/2007 12:29 AM	6/22/2007 1:11 AM	960	1	2	19	402	516	9
1324	6/21/2007 11:44 PM	6/22/2007 12:29 AM	3057	5		18	1514	1424	96
1323	6/21/2007 10:57 PM	6/21/2007 11:44 PM	4256			41	2573	1606	36
1322	6/21/2007 10:04 PM	6/21/2007 10:57 PM	4292	10	9	84	2614	1499	76
1321	6/21/2007 9:10 PM	6/21/2007 10:04 PM	2917		3	44	1774	1080	16
1320	6/21/2007 8:37 PM	6/21/2007 9:10 PM	907	4		29	913	364	7
1319	6/21/2007 7:59 PM	6/21/2007 8:37 PM	1103			17	570	493	23
1318	6/21/2007 7:02 PM	6/21/2007 7:59 PM	944			17	403	405	19
1317	6/21/2007 6:59 PM	6/21/2007 7:02 PM	14			4	5	5	5
1316	6/21/2007 6:13 PM	6/21/2007 6:59 PM	1586			6	1003	576	1
1315	6/21/2007 6:23 PM	6/21/2007 6:13 PM	4236	1	2	61	2081	1678	30

Friday, June 22, 2007 5:55:14 PM



The defect rate for the last minute was 0 defects/min

**Defect Rules and Recipes**

Manage Defect Rules Configure Defect Rules Manage Recipes Configure Recipes

**Step 2 Configure Defect Rules**

Select Defect Rule Name  
All Defects

Definition  
Units: mm Minimum Maximum  
Area 0 100000  
Height 0 10000  
Width 0 10000  
% Bright 0 100  
% Dark 0 100  
Aspect Ratio 0 1000

Defect Symbol  
Shape Circle  
Color Black  
Size 2

Apply To Beam  
☒ Beam 1 Description  
☒ Beam 2 Description  
☒ Beam 3 Description  
☒ Beam 4 Description

Optional Digital Output  
Digital Output 1 None  
Digital Output 2 None

Save Changes and Exit Save Changes Exit

**Defect Rules and Recipes**

Manage Defect Rules Configure Defect Rules Manage Recipes Configure Recipes

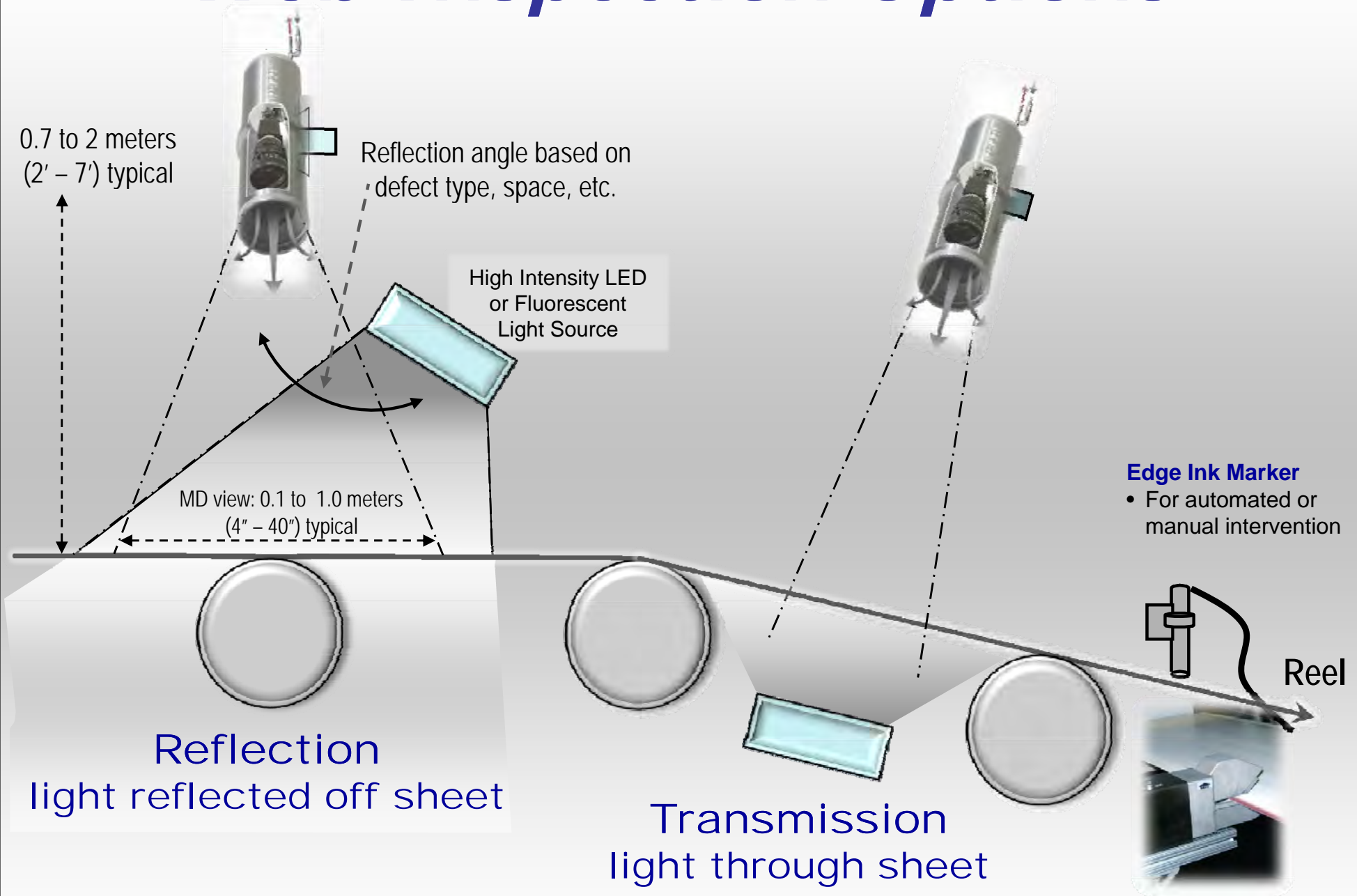
**Step 1 Create, copy, rename, or delete Defect Rules**

All Defects  
Large Defect  
Medium Defect  
Small Defect

Create  
Copy  
Rename  
Delete

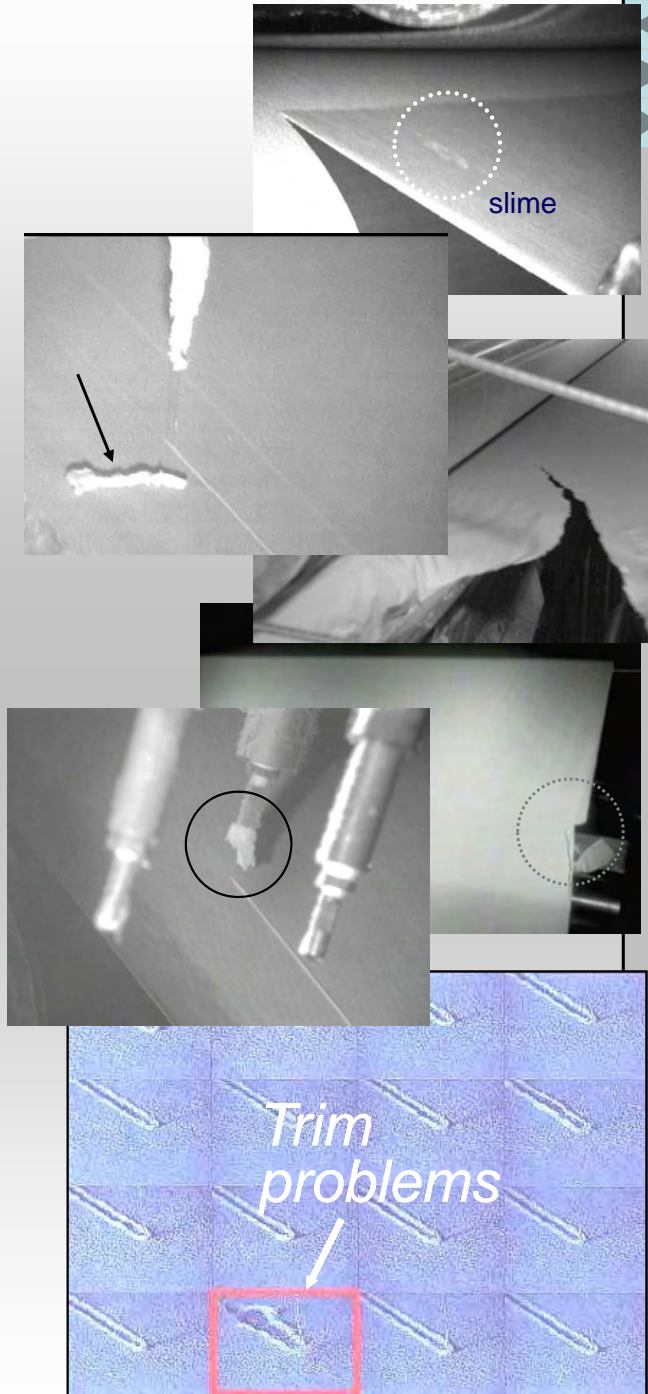
Save Changes and Exit Save Changes Exit

# 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.**



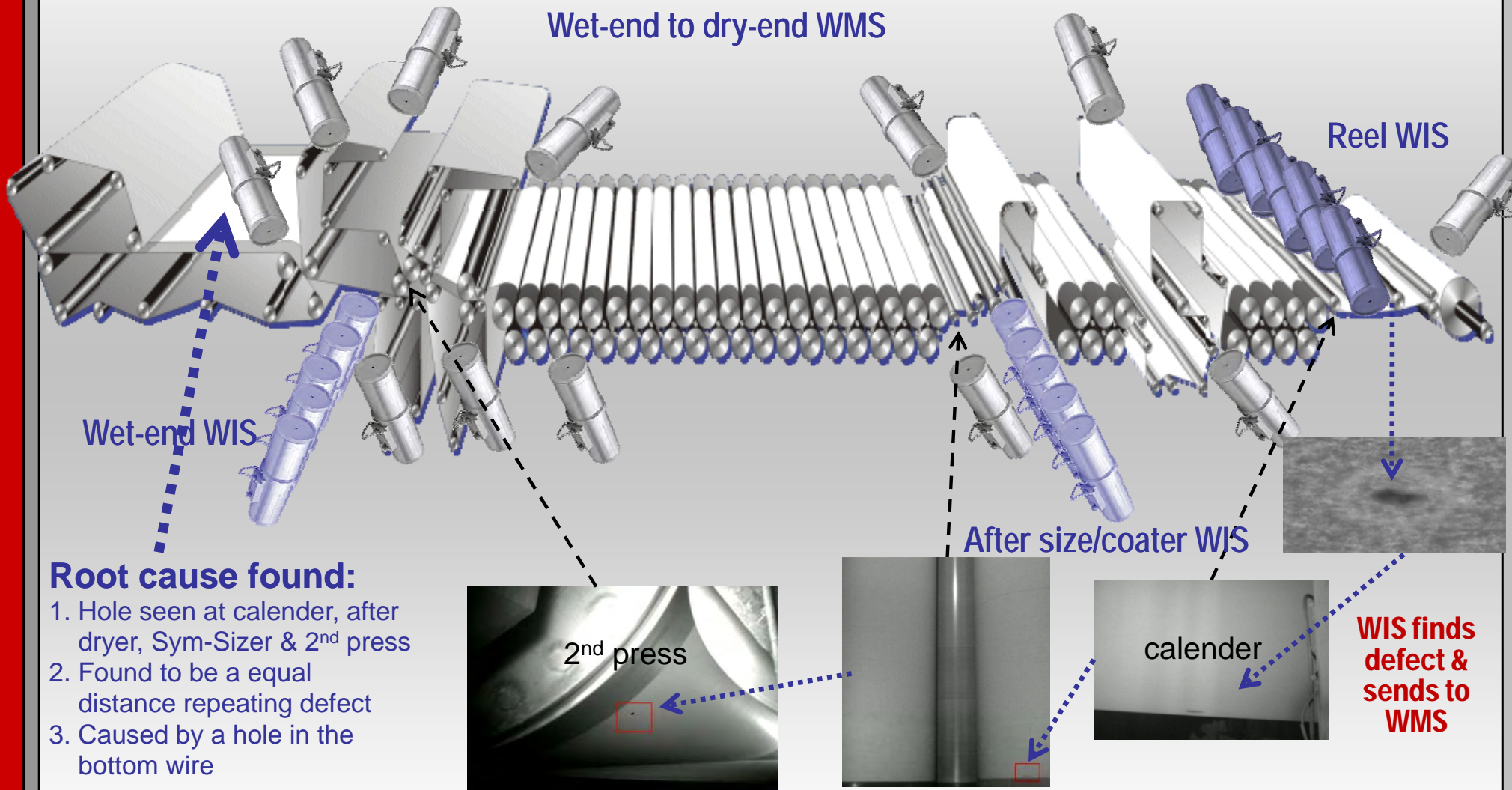
# Results

## ✓ 2–6 month payback

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

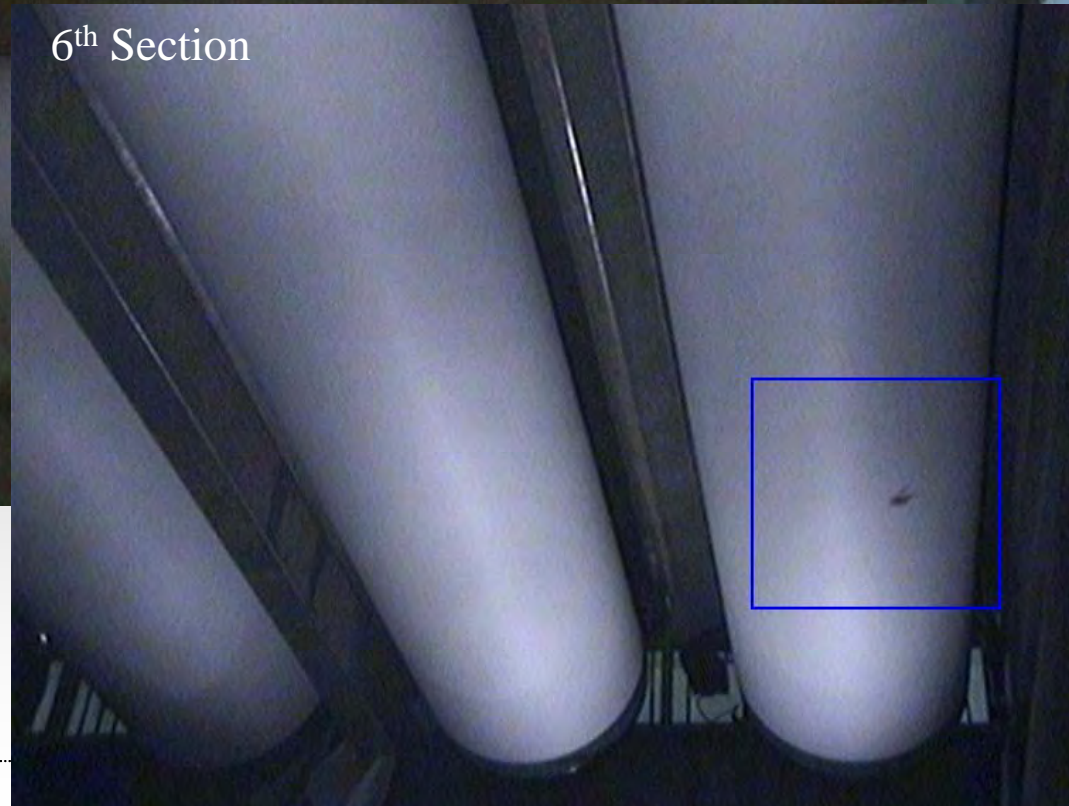
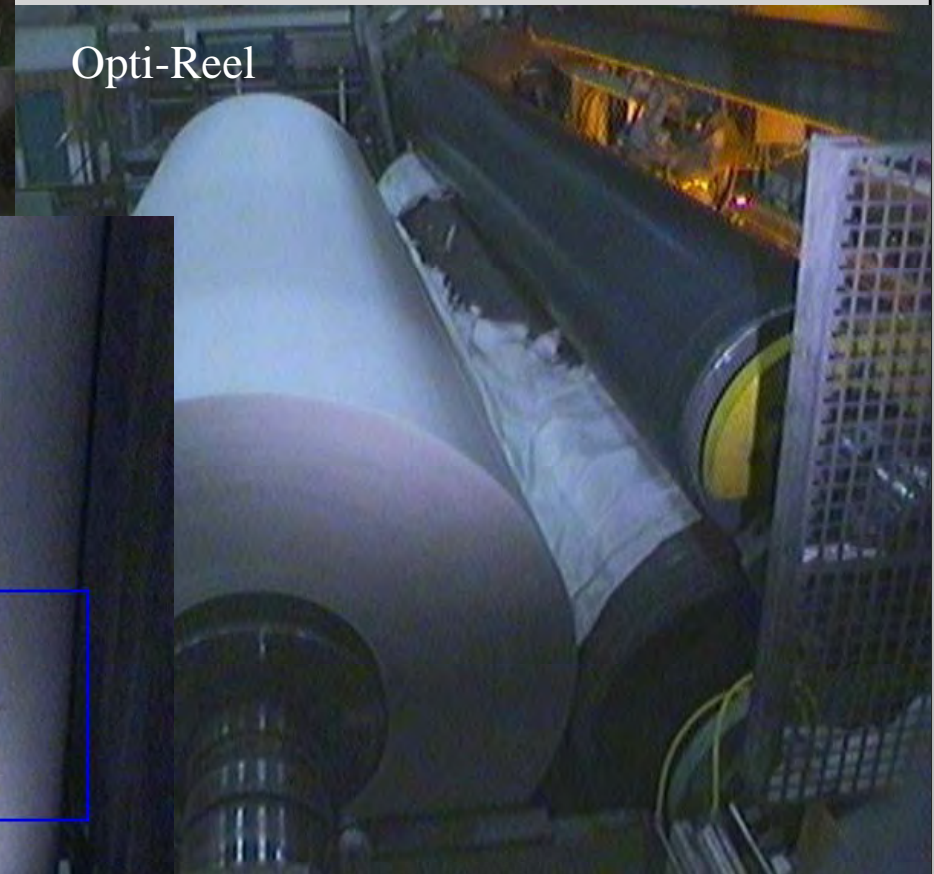
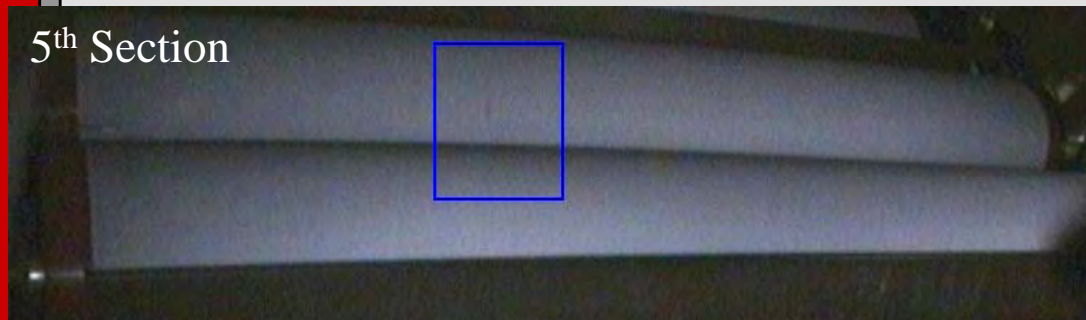
# *WMS + WIS = Total Vision*

## Event Capturing & Web Inspection All-in-One

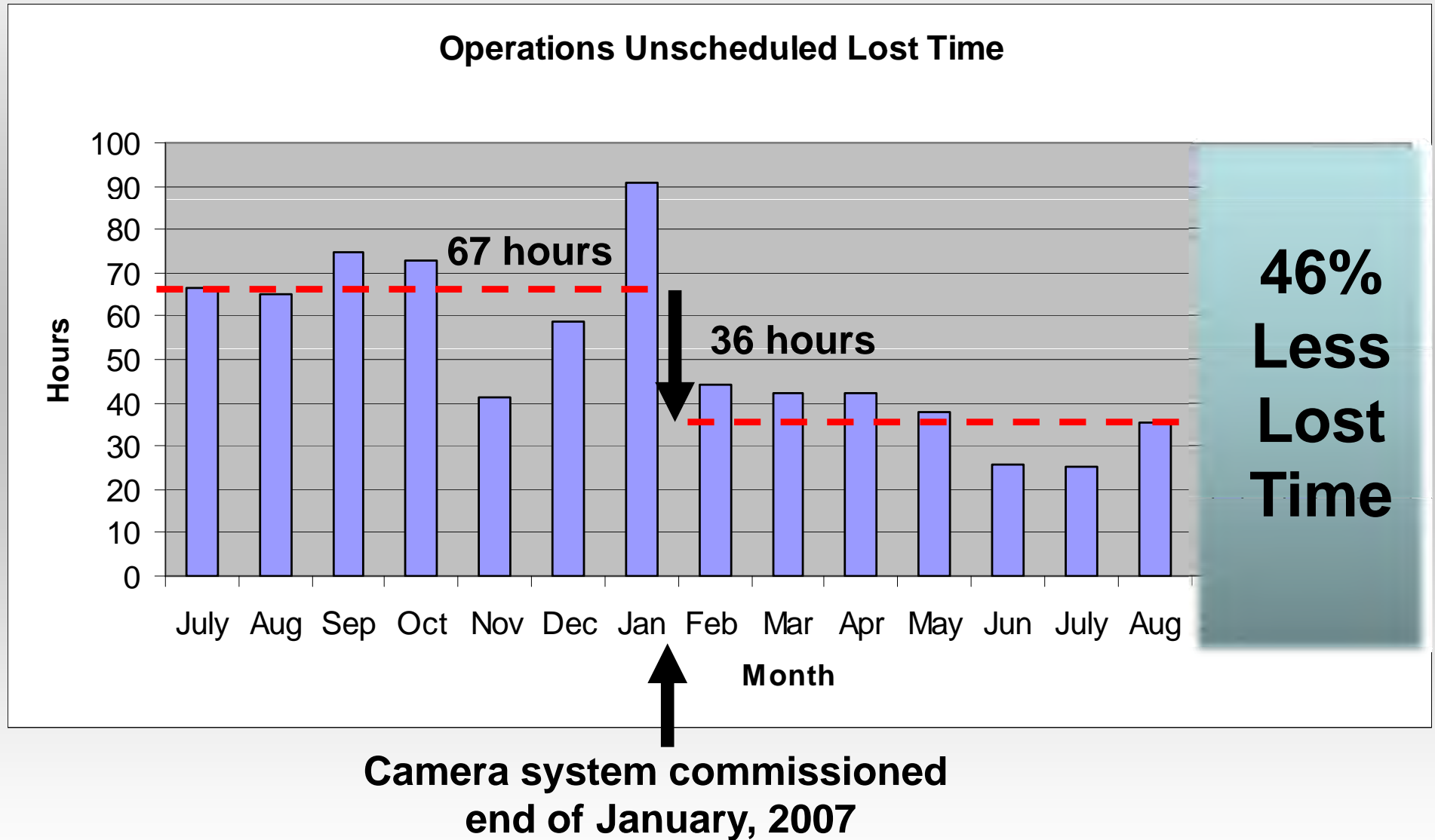


# Break example due to hole

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

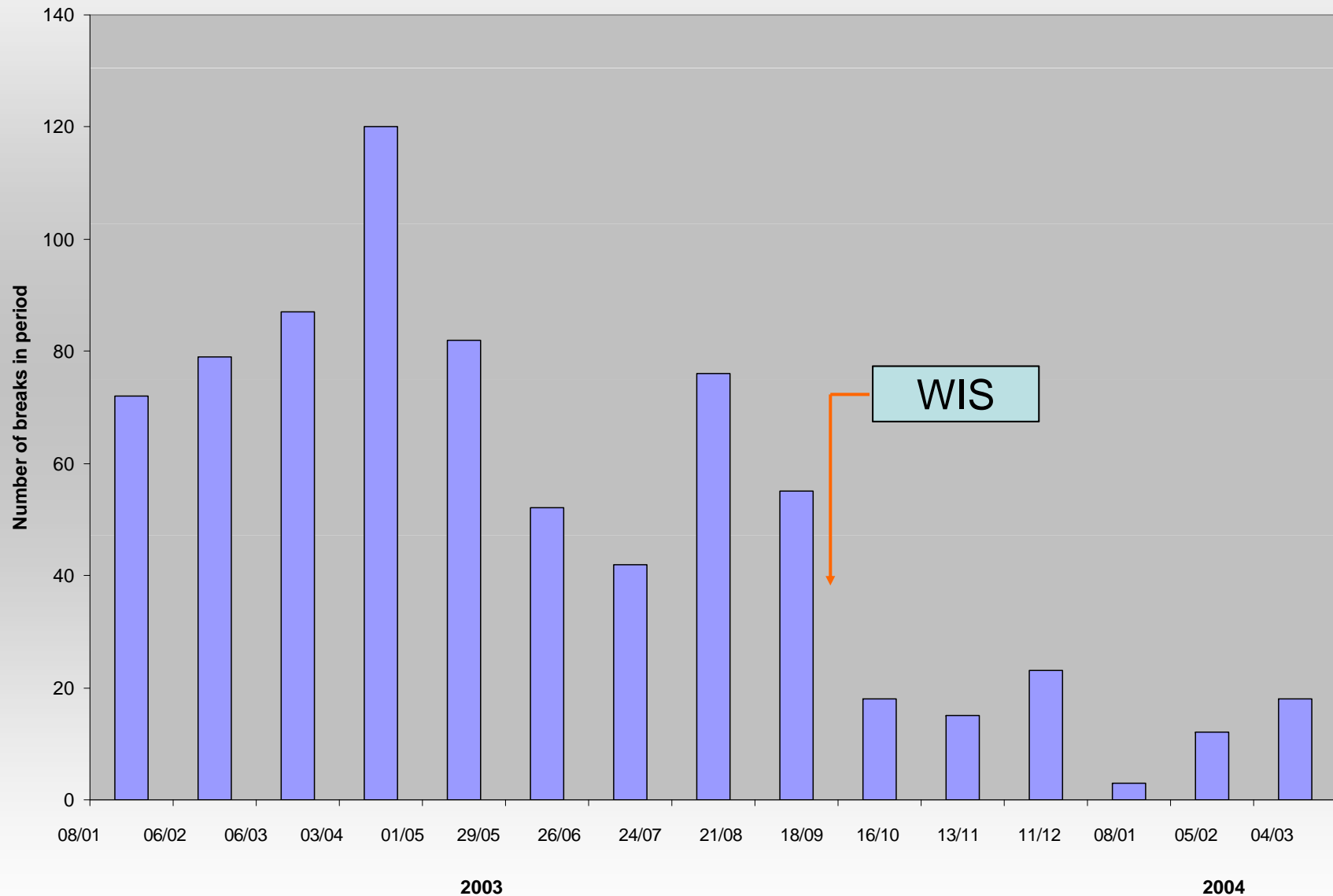


# ***Rapid Increase in Efficiency***



# "No Evidence" Break Reduction

No Evidence Breaks



# TotalVision Integration in Operation

File Break Library Favorites Video Select Editing Analysis Misc. Playback Add-Ins Help

**Camera Description:** Date /

1 2 3 4

**ABB Defect Information**

File

**Information**

Property	Value
ID	4613
DefectID	R_191653_20071
DateTime	11/27/2007 11:14
Camera	1
Classification	Hole
Image Number	1
wArea	4.9169
wAreaDark	
wAreaLight	
wWidth	8.59
wHeight	4.3
wMinX	130.585
wMinY	62191.85
wMaxX	139.175
wMaxY	62196.15

**Image**

☒ Pause Updating Load Video Close

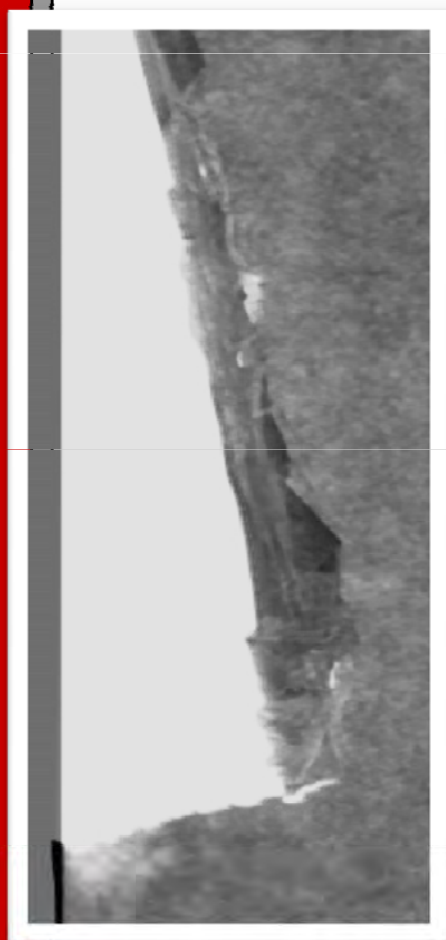
Connected to WebVision Server at 192.168.75.93

Analysis Misc.

2 230

Sync

# Example TotalVision installation at Stora Enso, Nymölla

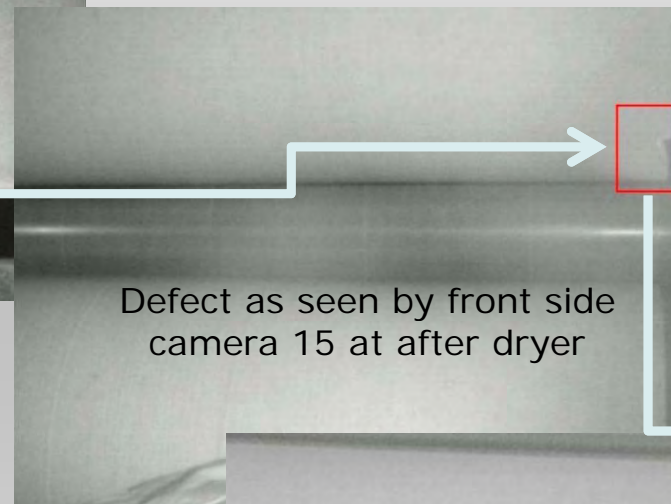


Front side edge defect  
detected by WIS

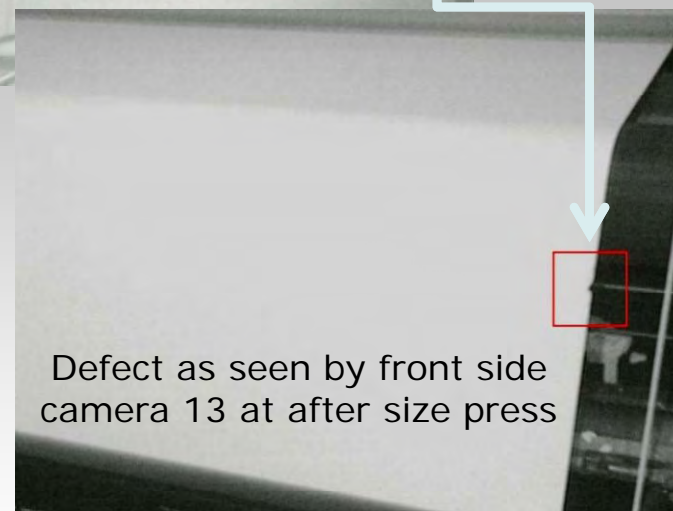


Defect as seen by front side  
camera 17 at calender

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