

# New Operational Frontiers in Big Data

Vic Uzumeri

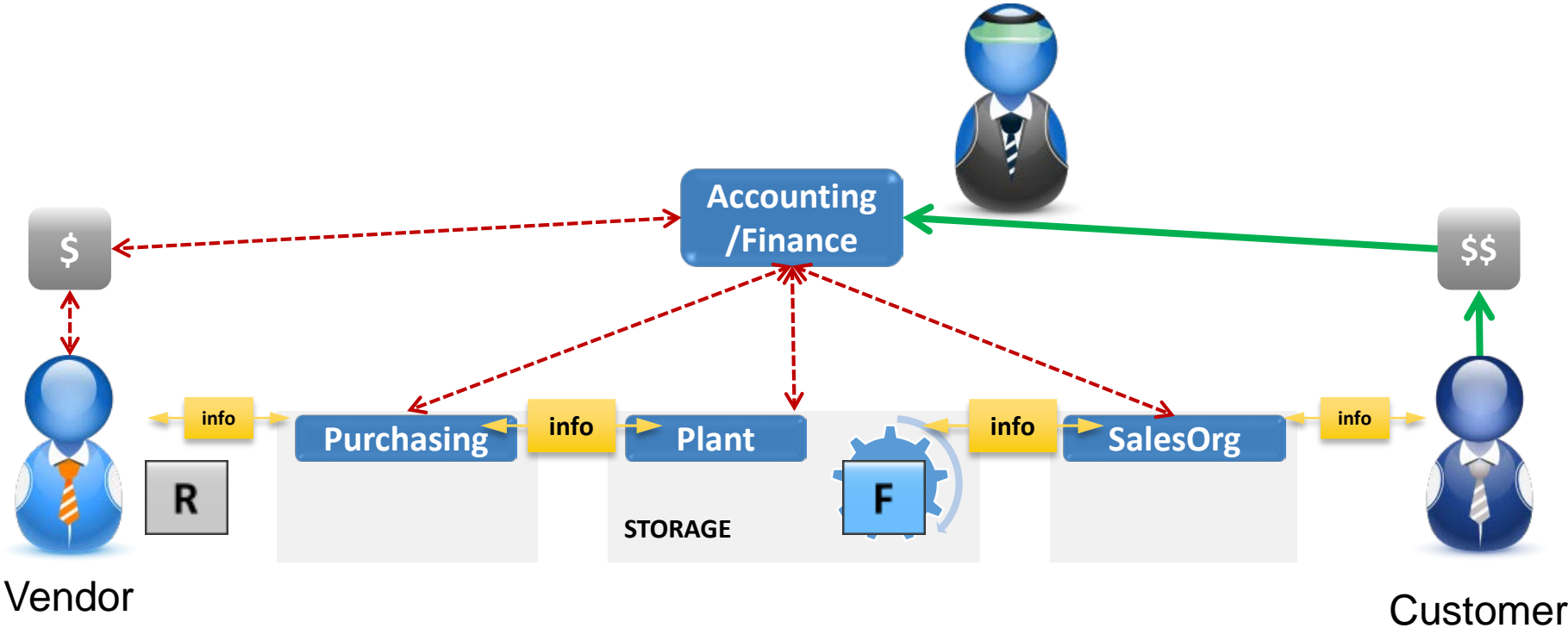
DeeperPoint LLP

# Vic Uzumeri, PhD

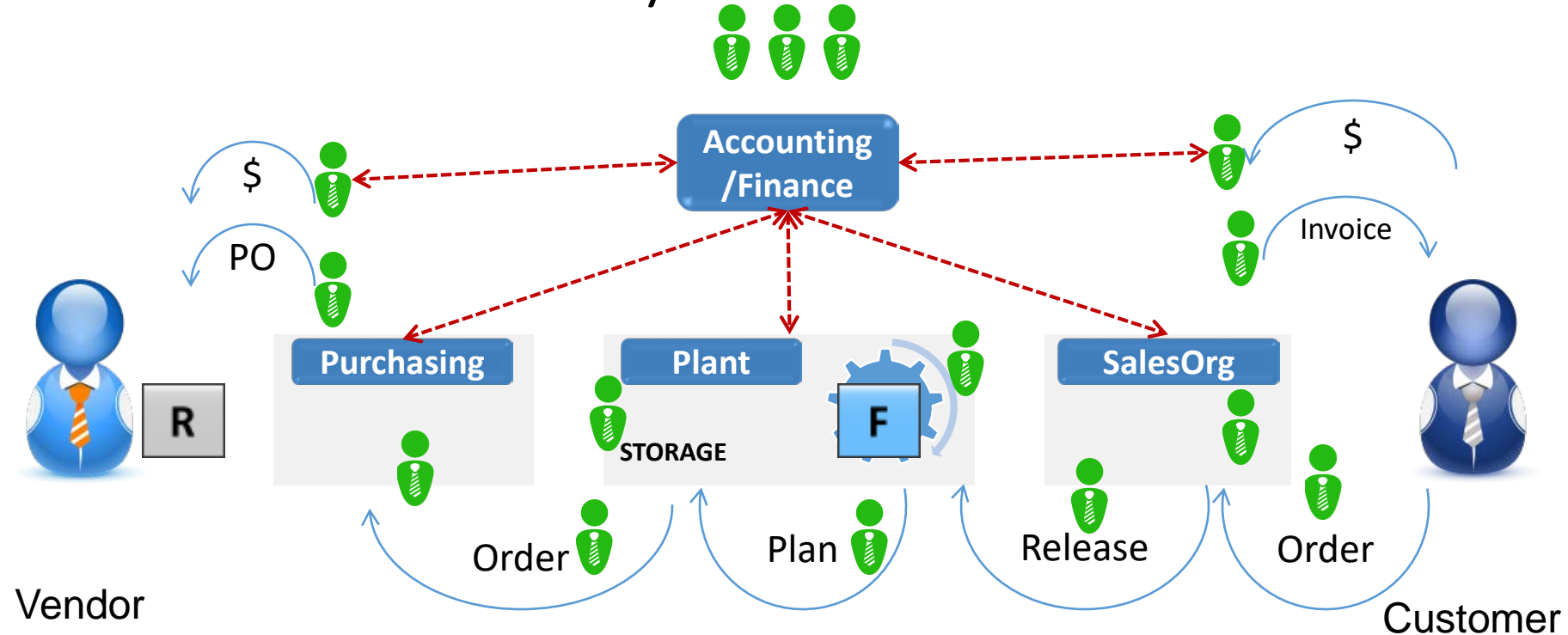
- Engineering, MBA & PhD in Management (of technology) from RPI
- 20+ years Assoc. Prof. (Operations) at Auburn University
- 35+ years working and studying and managing business systems
- 18+ years CEO of video training services company
- 20+ years innovating, selling and innovating with industrial video

# Data in Production

# Materials Drive the Business



# If process were driven by human decisions



- Each human decision is a possible point of failure
- Each human decision is an added cost
- Each human decision can delay material movement

# Transaction vs Master Data

- Separate the required information and decision criteria into two categories:

Type of Data	Description	Examples
<b>Transaction Data</b>	Information that is specific to each individual order.	order number, shipment date, quantity, etc.
<b>Master Data</b>	Information that says how all items <i>of that material type</i> should be handled and accounted.	material description, planned storage location, preferred vendor, published price, etc.

- Put master data in a database (**once**) and refer to it at every decision point in the system.
- The database is the **Material Master**.

# Master and transaction data are interwoven

**Purchase Order**

THIS PURCHASE ORDER IS ISSUED FOR PRODUCTS, MATERIALS AND/OR SERVICES INTENDED FOR USE OR RESALE BY SIEMENS INDUSTRY INC. FIELD ORGANIZATION. THE TERMS AND CONDITIONS APPLICABLE MAY BE OBTAINED FROM SIEMENS INDUSTRY INC. HEADQUARTERS AT THE FOLLOWING ADDRESS: <http://www.siemens.com/industrial>. THE TERMS AND CONDITIONS LISTED ON THE WEBSITE ARE INCORPORATED HEREIN AND MADE A PART HEREOF BY THIS REFERENCE.

In order to comply with legal export regulations the AL number (Germany) resp. EOCN (US) subject to German or US-Export Regulations has to be stated due to each product number.

**INTERACTIVE POINT OF VIEW**  
 IPOV  
 319 HICKORYWOODS DR  
 AUBURN AL 36830

PHONE: 3348215412-SII  
 FAX: 3348215416

Please deliver to  
 Siemens Industry Inc.  
 3333 Old Milton Parkway  
 Alpharetta GA 30005

Order No. <b>4501938464</b>	Date Dec 21 2009	Your Vendor No. with us 30058793	Your reference
Our reference	SLIT Procurement	Code of Disposition	Receipt
Invoice Address Siemens Industry Inc - MC IMAD68 Please submit your invoices electronically on our IOL website at <a href="http://www.iolportal.com/siemens/">http://www.iolportal.com/siemens/</a> (Click on help "?" for phone #s, eMail, and training info)	Partial delivery allowed Sep 30 2010	Identifier Siemens 2000	YCL
	Payment Terms	20 15 Days Net 60	

Item	Description of Goods / Service	Quantity / Unit	Currency / Price/unit Currency USD	Total Price Currency USD
00010	Module Overview	5 Piece	1,000.00	5,000
00020	Alpha version classes	50 Piece	800.00	40,000
00030	Alpha to production version classes	50 Piece	800.00	40,000
00040	Non Production Serv Hrs	150,000 Hours	65.00	9,750
00050				

**Remarks**

Address of Buyer:  
 Siemens Industry Inc.  
 3500 Quasimere Boulevard  
 Orlando, FL 32817  
 USA

Page 1 / 3

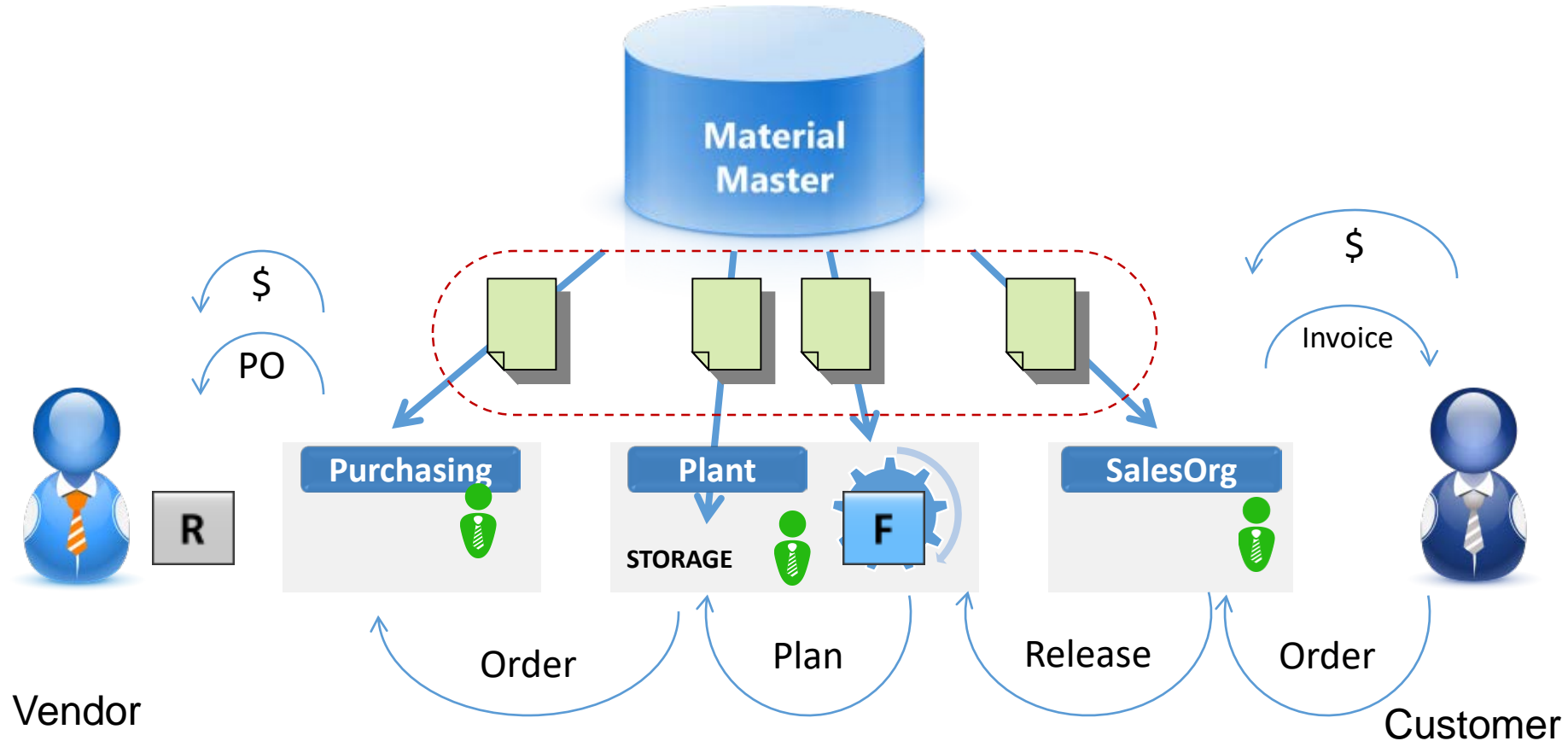
## Master Data, e.g.

- vendor name
- material description
- delivery address
- unit prices
- etc.

## Transaction Data, e.g.

- order number
- quantities
- order date
- etc.

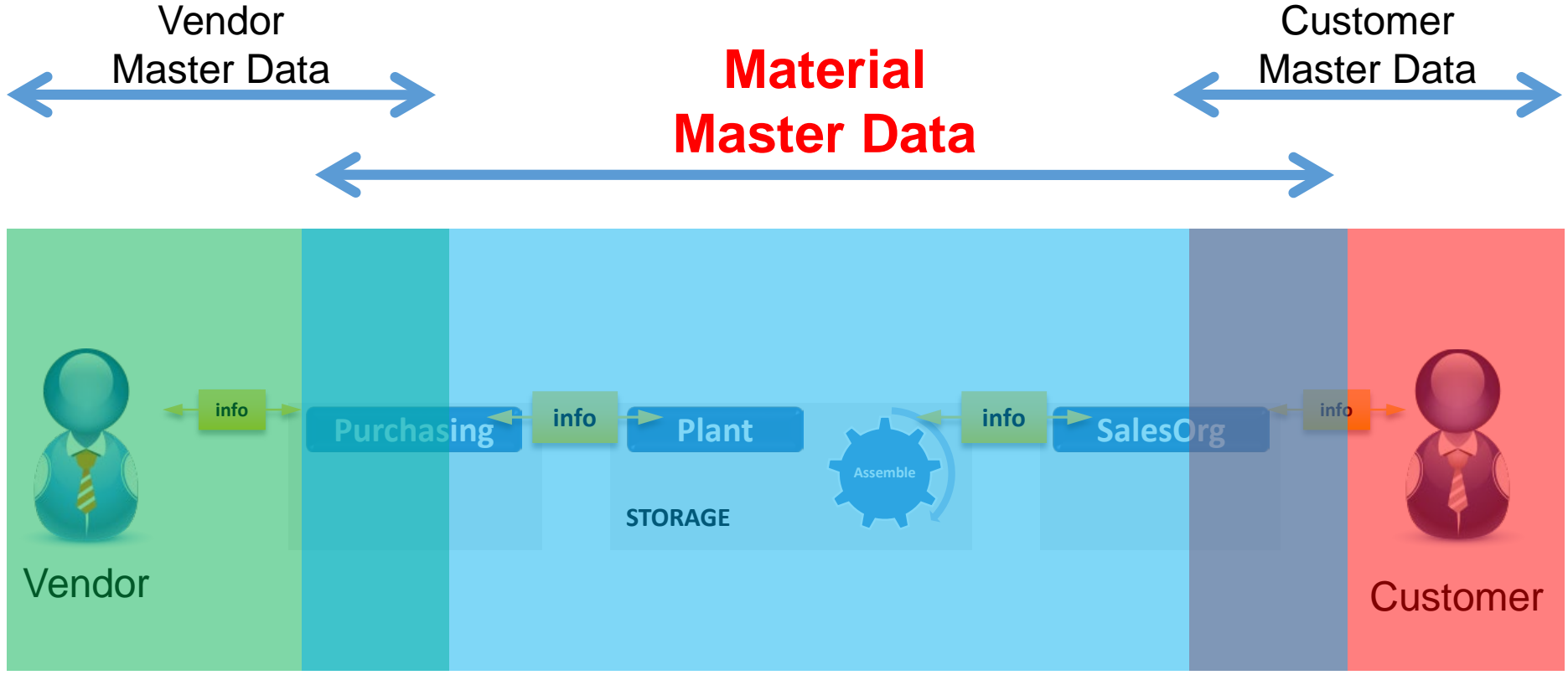
# Self-Navigating Materials & Information



- Decisions are consistent over time
- Less opportunity for human error in transactions
- Decisions get made more quickly and at lower cost



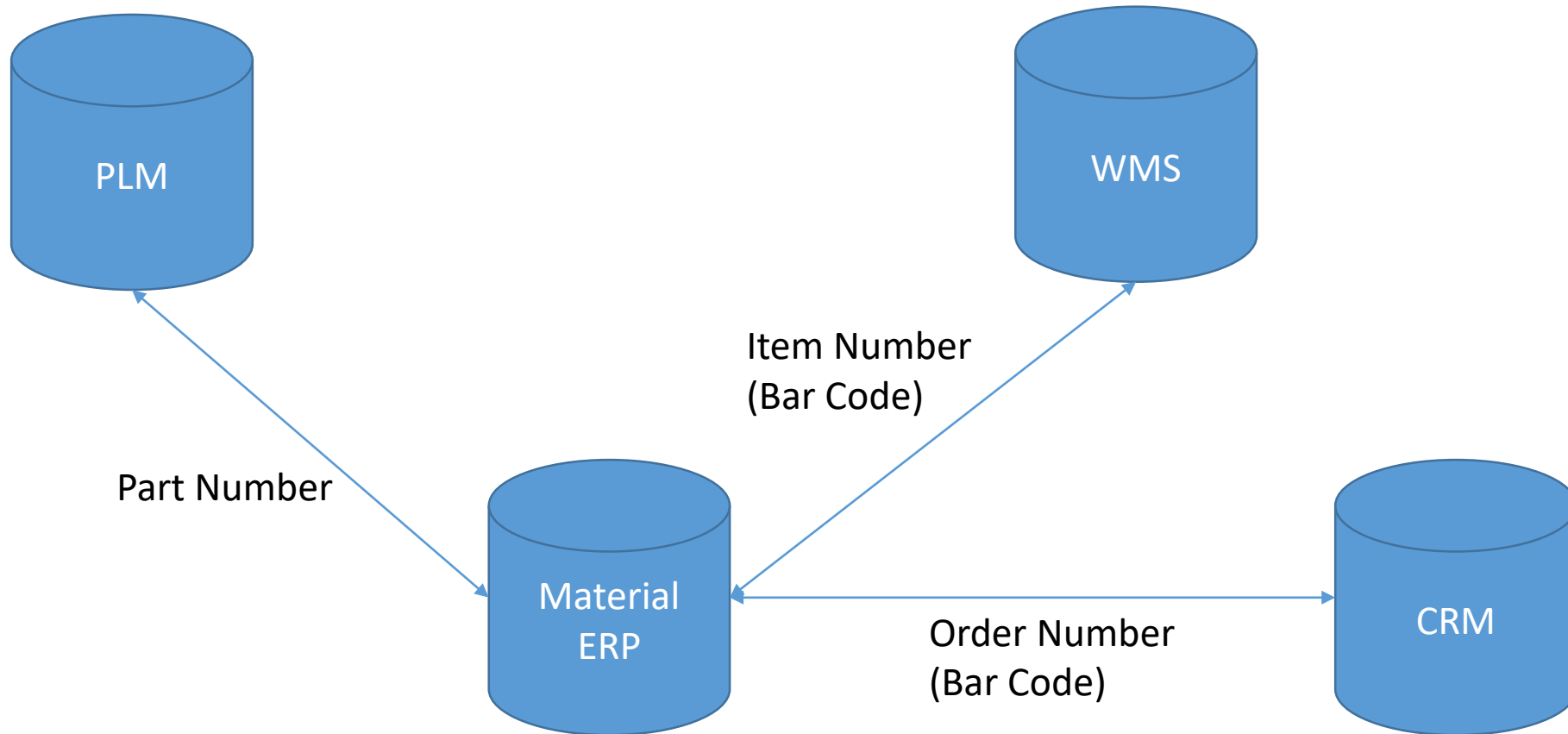
# Three Types of Master Data



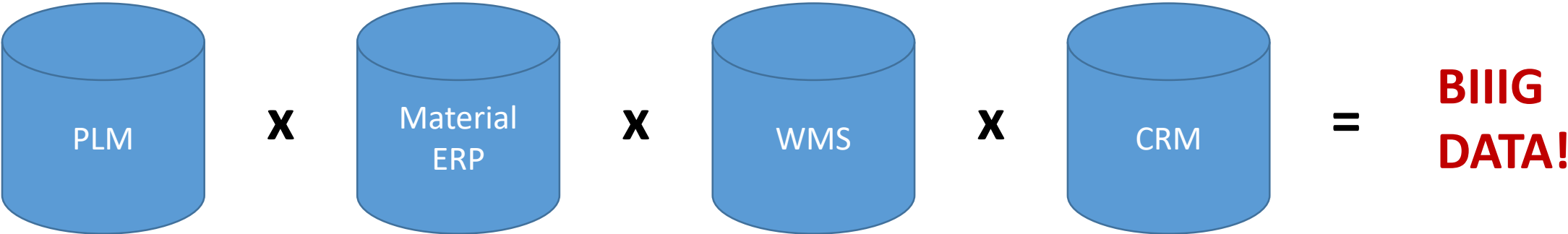
# Similar Systems

- Customer Relationship Management (CRM) Systems
  - Stores master data about customers
  - Tracks vendor interactions to sell, deliver, support and sustain customers
- Warehouse Management Systems (WMS)
  - Stores master data about products, warehouse layout and best practices
  - Tracks movement of items into, through and out of the warehouse
- Product Lifecycle Management (PLM) Systems
  - Stores master data about designs, parts and assemblies
  - Tracks part designs through concept, engineering, testing, manufacture, assembly, delivery and after-sales service

# Data Systems are Linked by A Few Numbers



# The Possible Combinations Add Up





# Everything Happens in Context

**You Need to “See” the Whole Process**

# Trend: Fewer People per Process



- More of the operation is (intentionally) hidden from view:
  - Automated & unattended
  - Inside equipment
  - Only “seen” through data
- But what remains is (unintentionally) less visible
  - Fewer staff see things happen

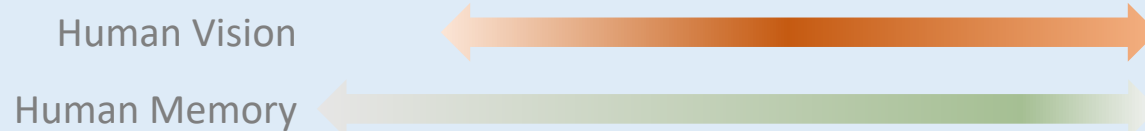
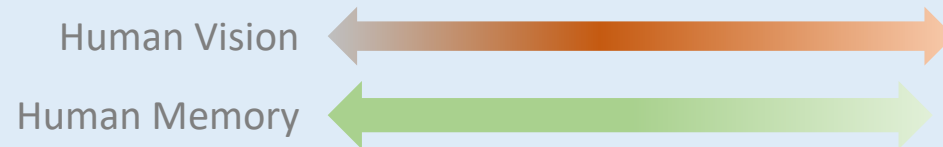
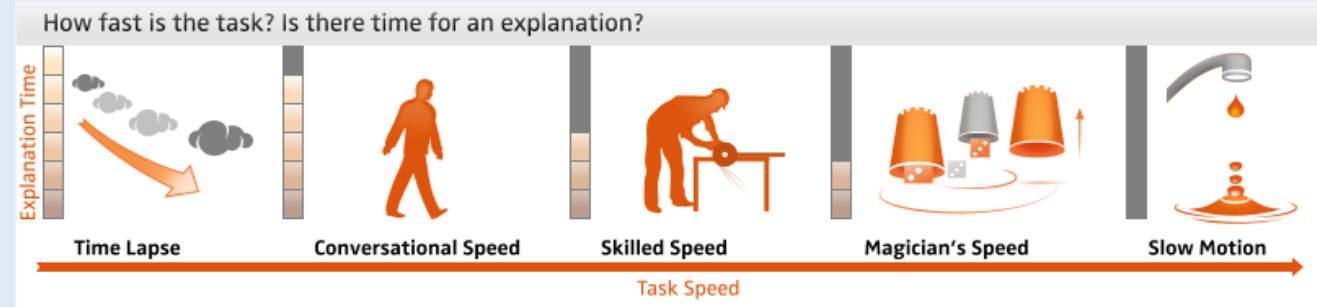
# We Only REALLY See Part of the Scene



- Eye sees 5 to 10 degree arc in clear focus - “foveal” vision
- The rest is “peripheral” vision
- Even if you watch actively, it’s easy to miss important action

# And ... Human Sight and Memory are Limited

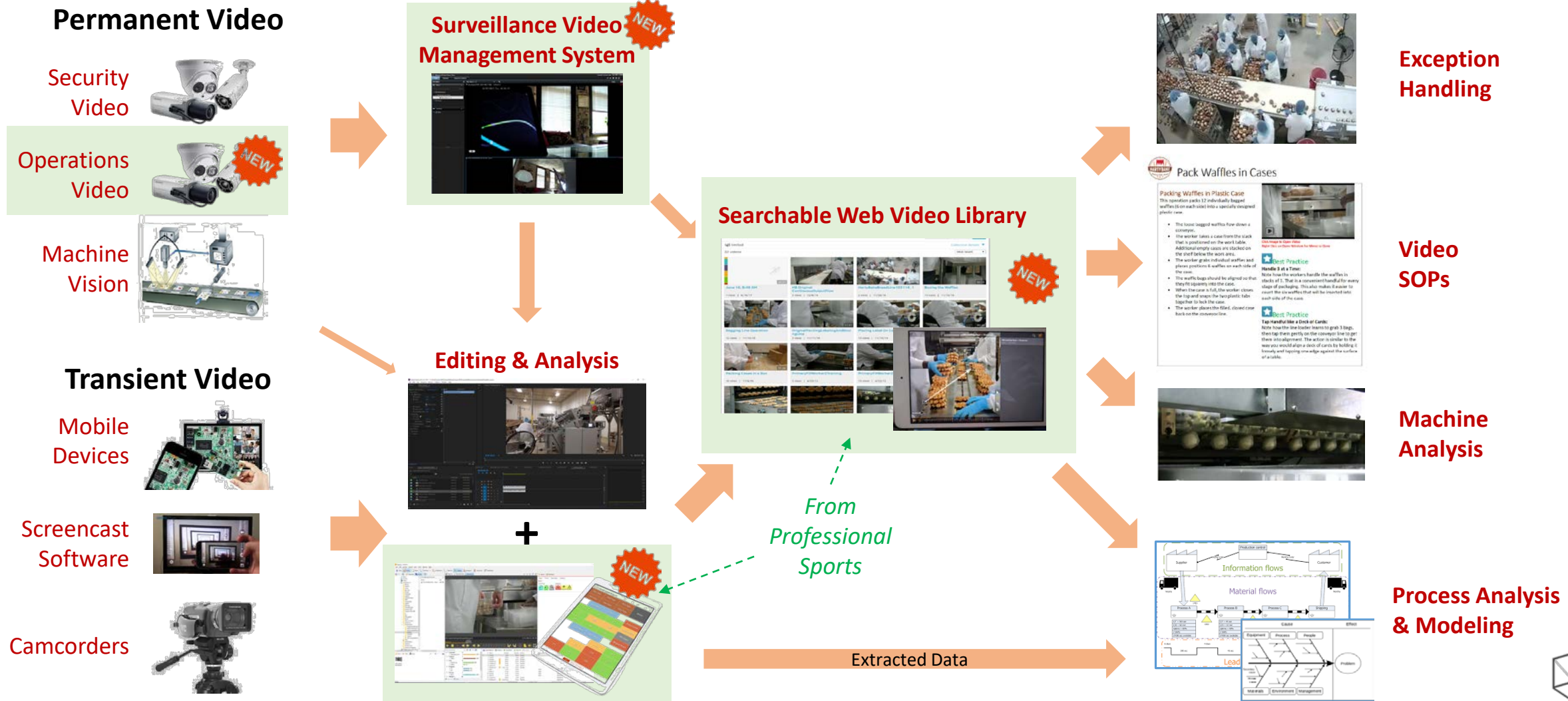
Things happen too fast or too slowly



Things are too big, too small, too distant, too scattered, or out of sight



# Technologies Converge → *Video-For-Operations*



# Power of Digital Zoom (after the fact)



7K - \$6000 to \$10000



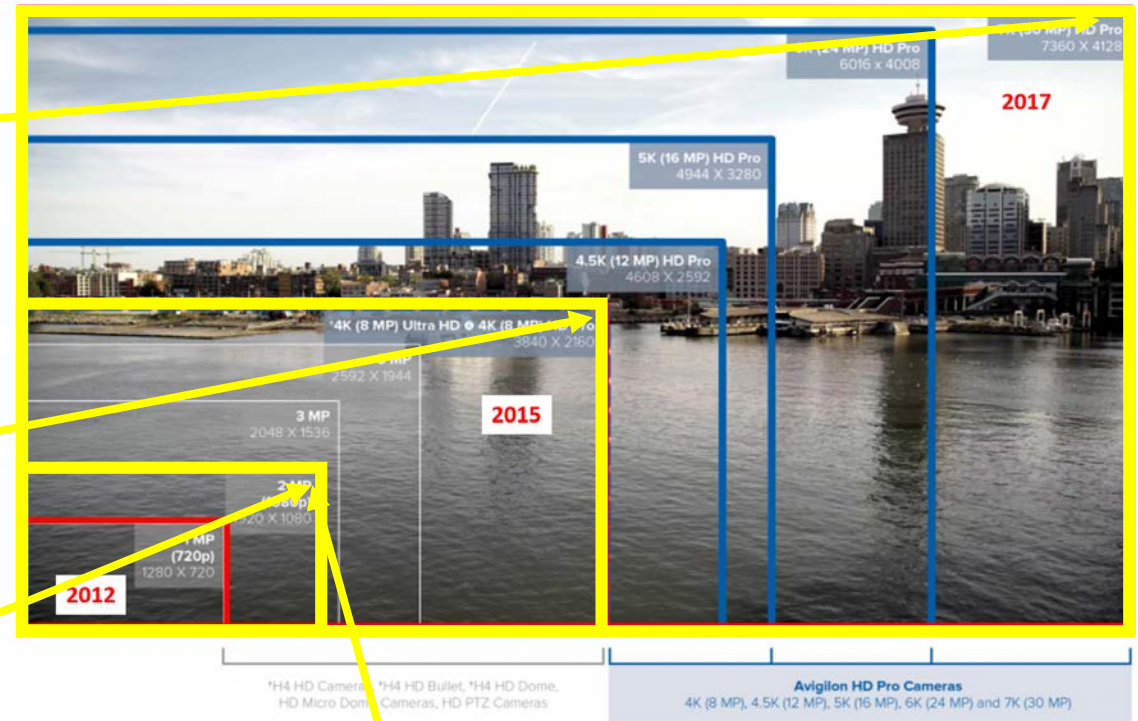
4K - \$350 to \$1000



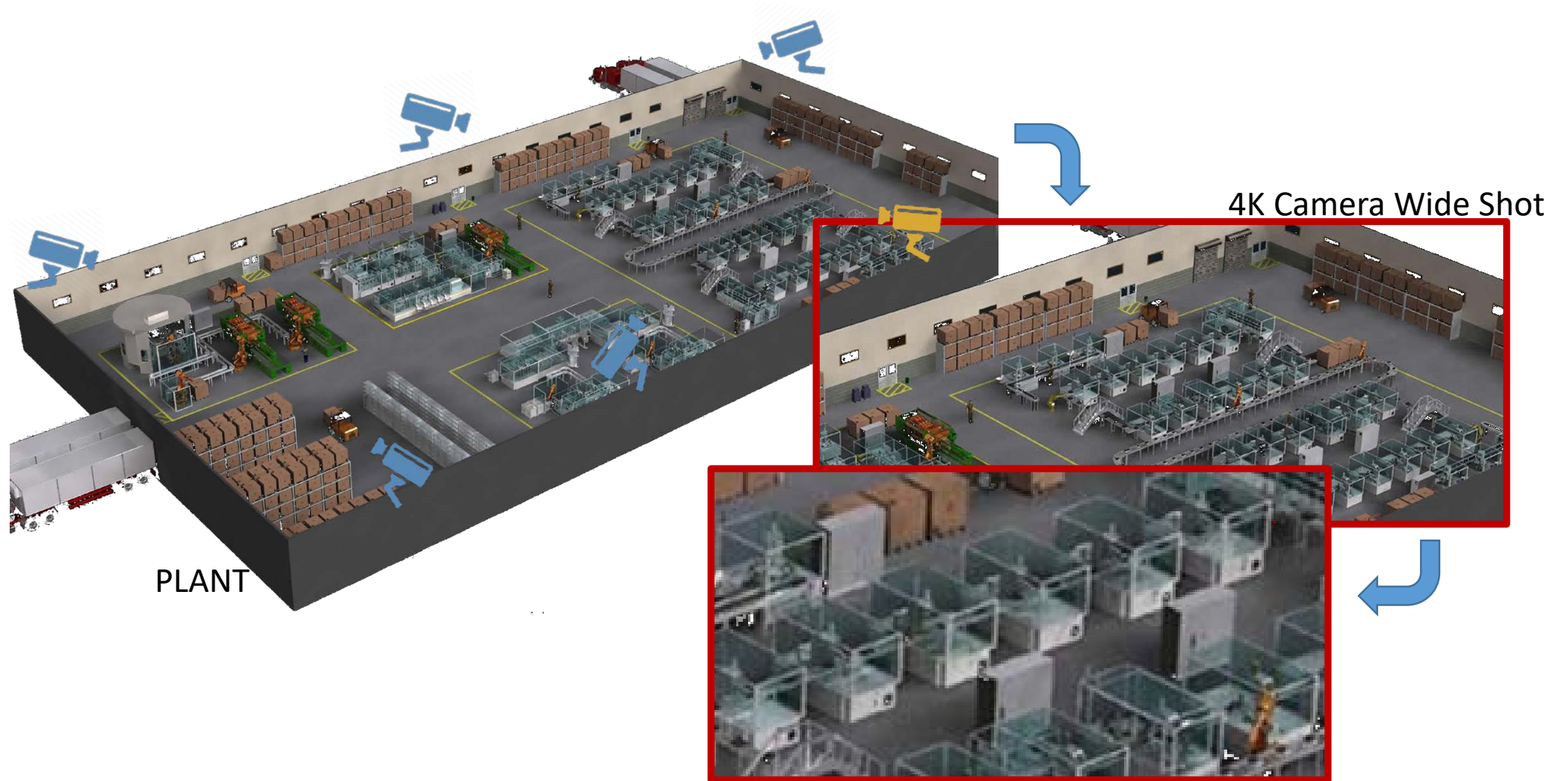
HD - \$250 to \$400



HD/WiFi - \$180 to \$300



# Permanent Installation

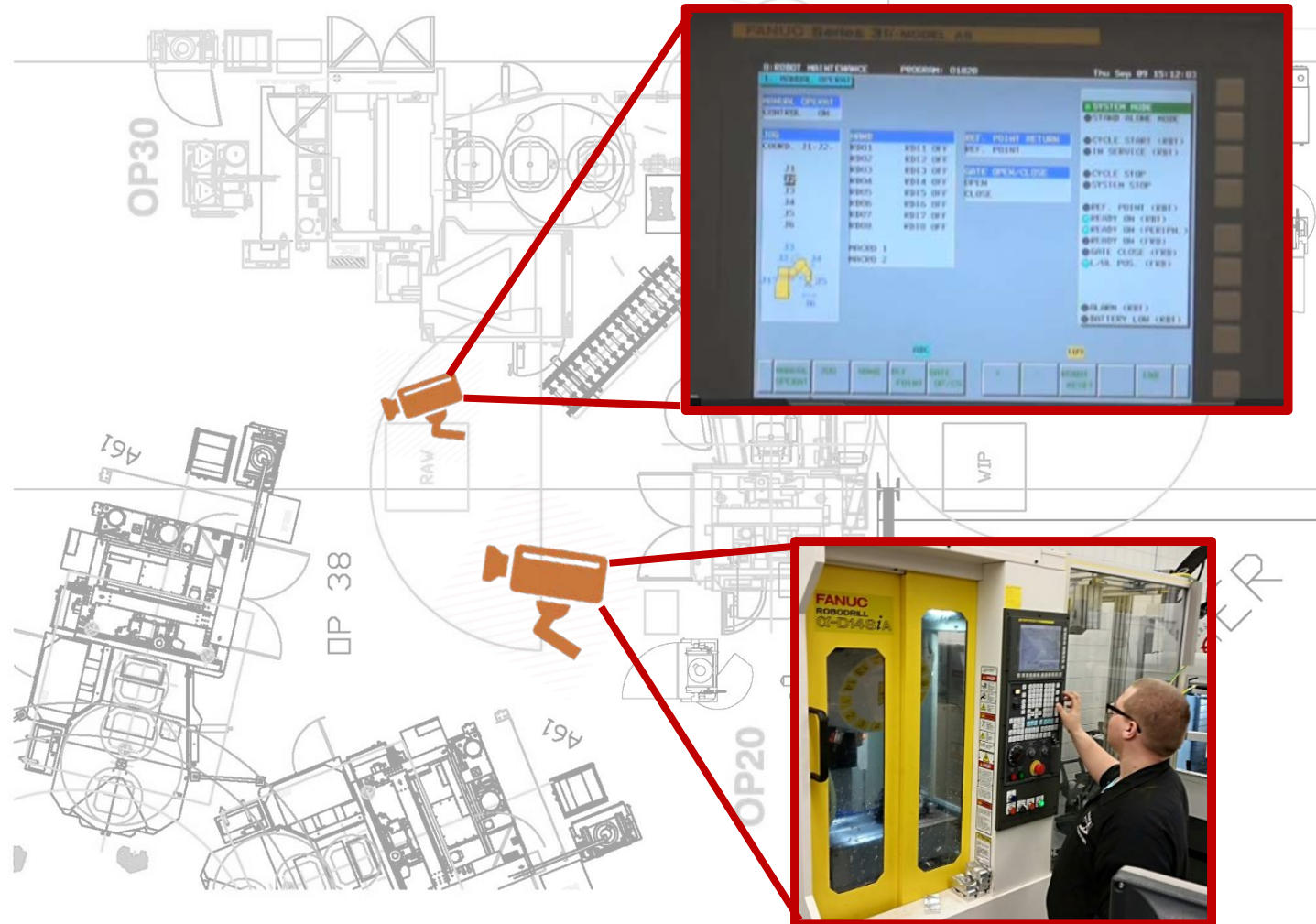


PLANT

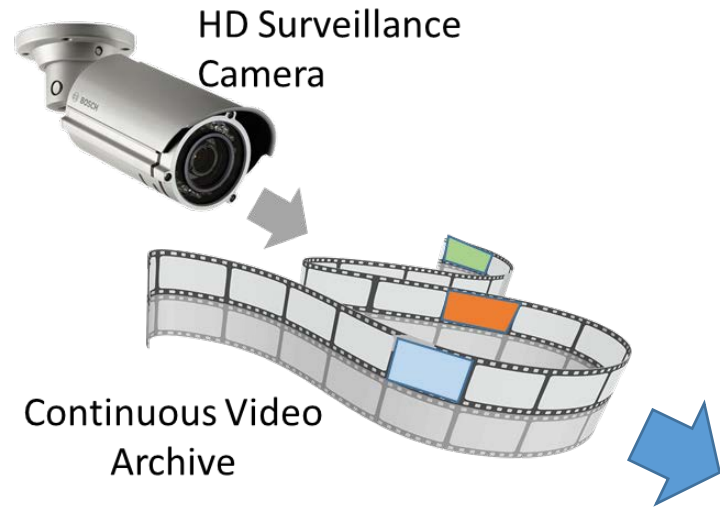
4K Camera Wide Shot

HD Resolution Zoom

# Operational Focus



# Everything on One Time Line = TIME MACHINE

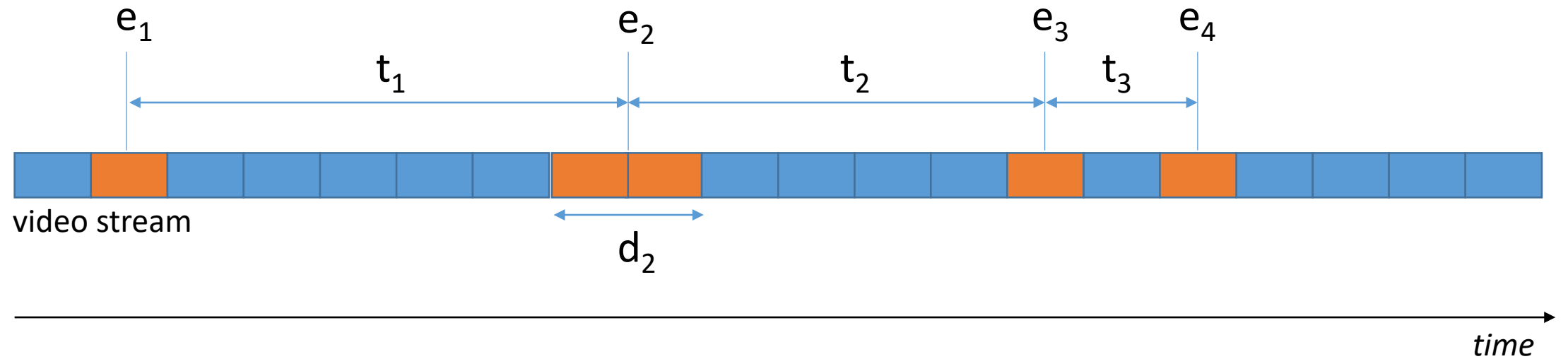


Dozens or Hundreds of Video Feeds



Recording Timeline (days, weeks, months ... more?)

# Key measurements and metrics

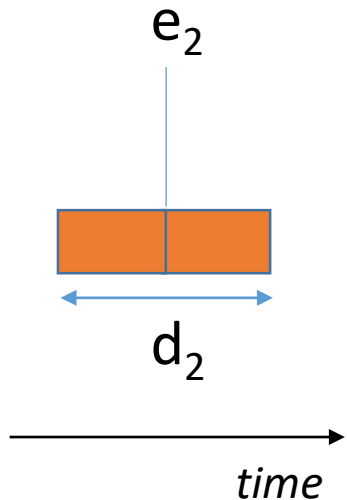


$e$  = events (descriptions and metrics)

$t$  = time between subsequent events

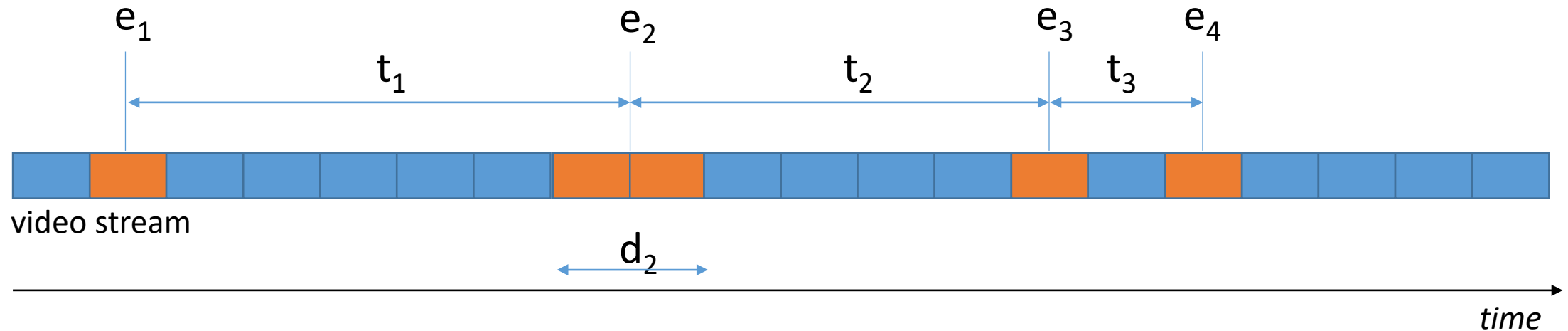
$d$  = duration of event

# Event Descriptions and Metrics



Metrics	Tools
<ul style="list-style-type: none"><li>• Characteristics<ul style="list-style-type: none"><li>• What, Why, How? (we know when and where)</li></ul></li><li>• Context<ul style="list-style-type: none"><li>• Who, What was happening around it?</li></ul></li><li>• Metrics<ul style="list-style-type: none"><li>• Characteristics</li><li>• Behaviors</li><li>• Outcomes</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Qualitative description</li><li>• Classify/categorize</li><li>• Measure from video<ul style="list-style-type: none"><li>• Duration (<math>d</math>)</li><li>• Ranking</li><li>• Ratio scale<ul style="list-style-type: none"><li>• Direct measure (distance, angle, frequency, etc.)</li><li>• Visual reference scale</li></ul></li></ul></li></ul>

# Derived calculations



## Point Events

- Density
  - = #events over time
  - =  $1/\text{avg. time between events}$
- Change in density over time
- Variation in density over time

## Duration Events

- Mean duration
- Change in mean duration over time
- Variation of duration
- Change in duration variation over time

## Event Metrics

- Sum/Avg of event metrics over time
- Variation of event metrics over time



# Industrial Engineering Applications



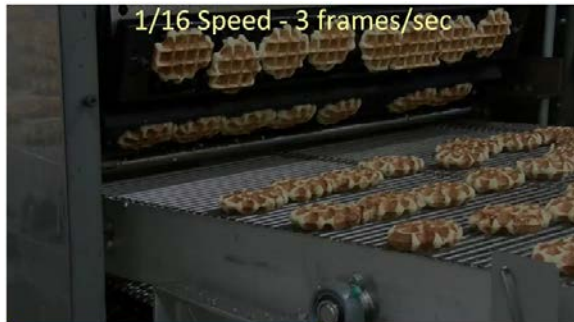
Machinery Operation



Measuring from Video



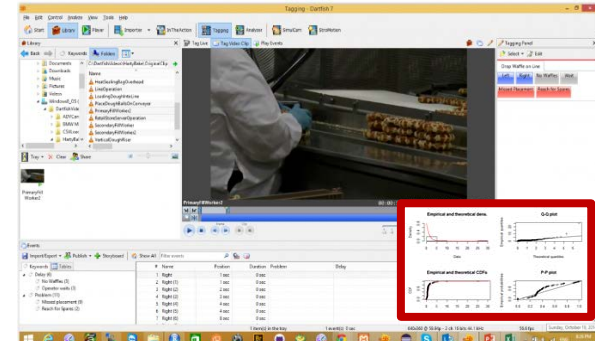
Visualizing Variability



Seeing in Slow Motion

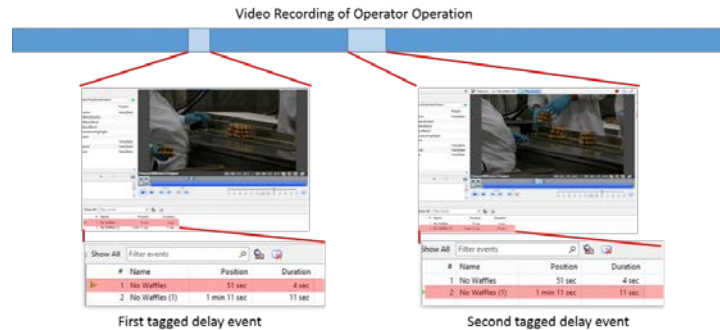


Studying Team Activity

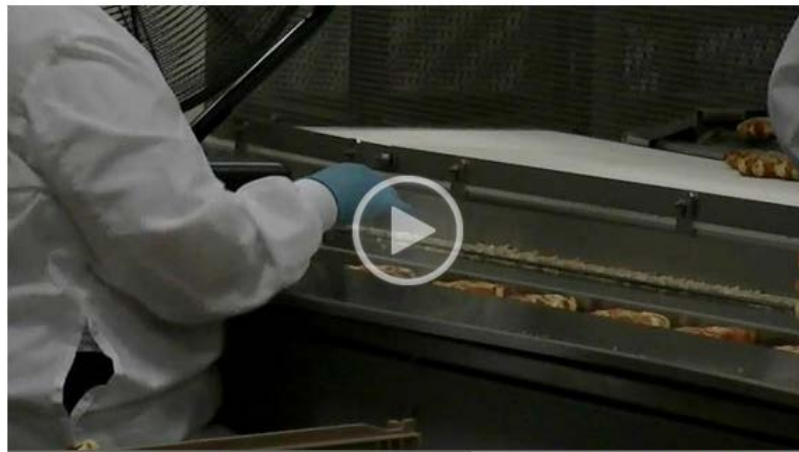


Measuring Process Variables

# Isolating Intermittent Events



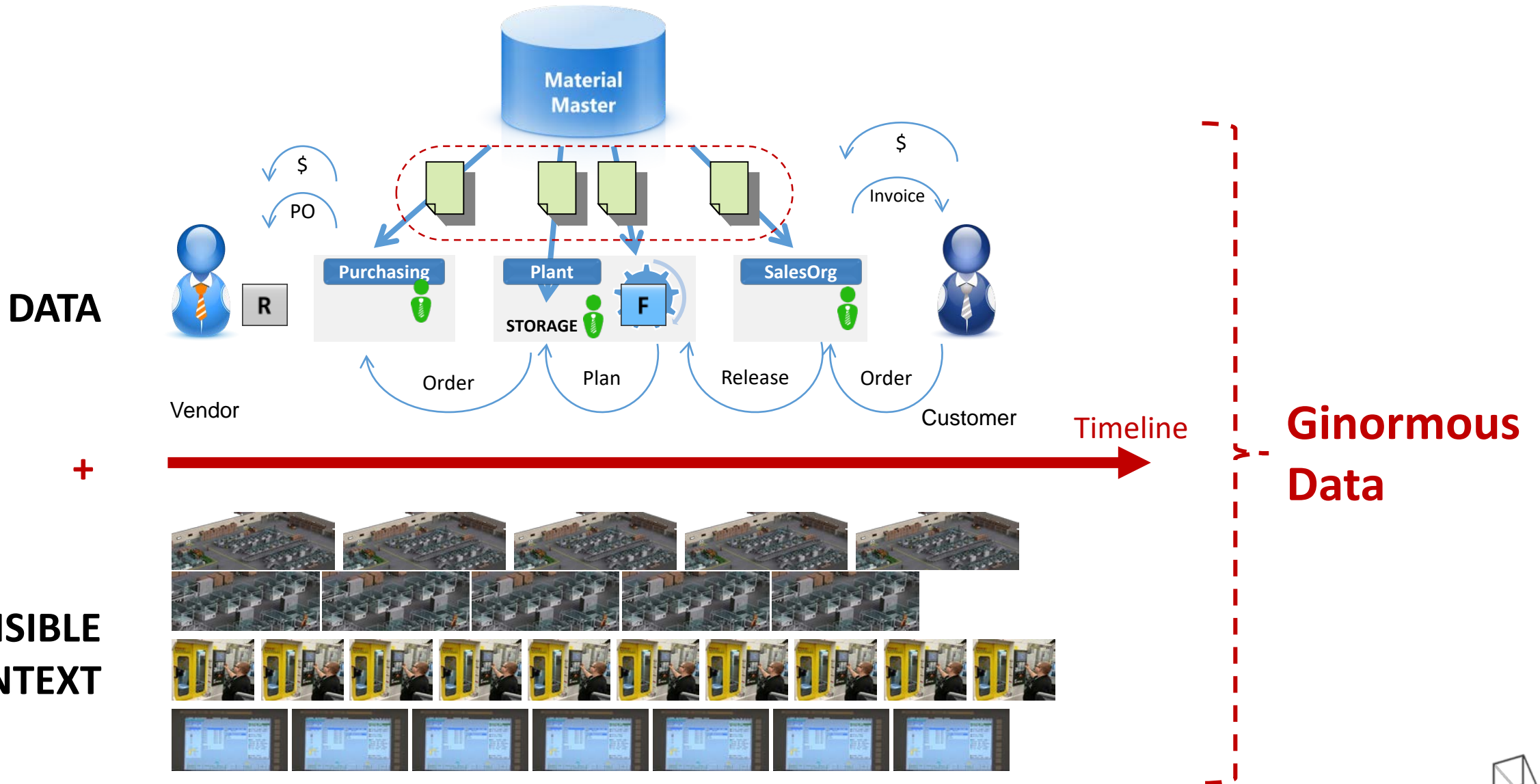
- Review video footage and tag intermittent events of special interest
- Extract the segments as clips
- Assemble clips into a sequence that isolates and highlights the events.
- Apply analysis to the specialized collection



[Click picture to open example](#)

Powered by **DARTFISH TV**

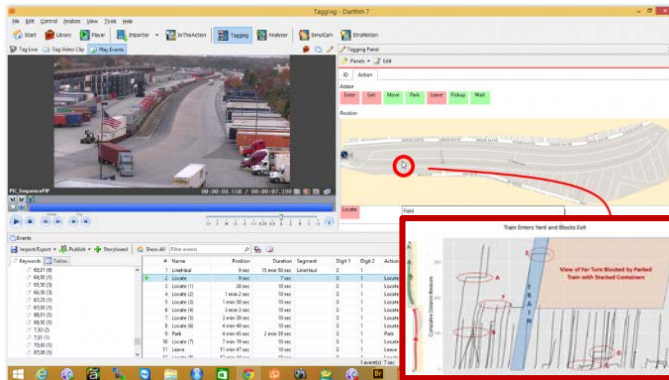
# Assembling the All of the Pieces



# Training Applications

Topic	View #1	View #2	View #3	Synthesis
How much day-to-day responsibility do you give your outsourced subcontractors (OCs)?				As much as possible - except where it might pose a material risk to us.
How often do you check up on the business practices of your OCs?				We assess the risks - then check often enough to prevent their practices from raising serious risks.
What are the warning flags that make you more vigilant in monitoring your OCs?				Evasiveness Unexplained delays Complaints
What information could your OCs supply on a regular basis to assure you of their performance?				Performance statistics Meetings with staff
What consequences of OC inactions or misbehaviors do you fear the most?				Loss of key personnel Fraud
What are the most frequent OC-related problems (of a material significance)?				Delays Loss of quality Lack of focus on us

Policy Variations



Tracking Movements



Teachable Moments



Depicting Physical Action

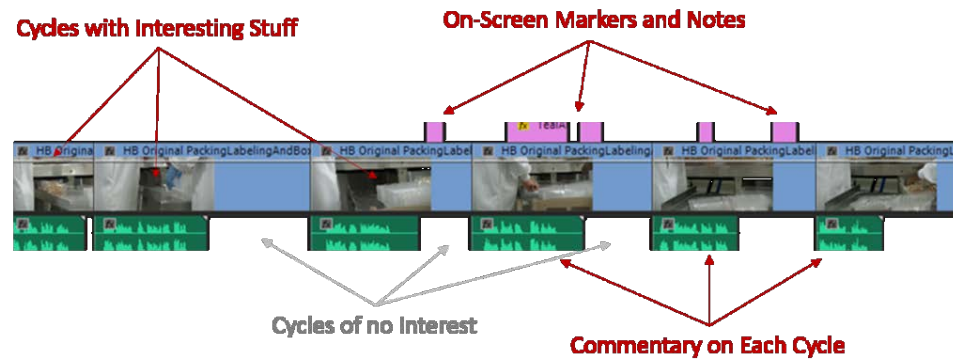


Showing Dangerous Action



Showing

# (nearly) Instant Video SOPs



- Record multiple cycles of action
- Add an informal commentary
- Transcribe and edit comments
- Rephrase comments as instructions
- Format into SOP and embed video



**Put Labels on Cases**

This operation peels labels from a roll and applies them to the packed plastic cases of waffles.

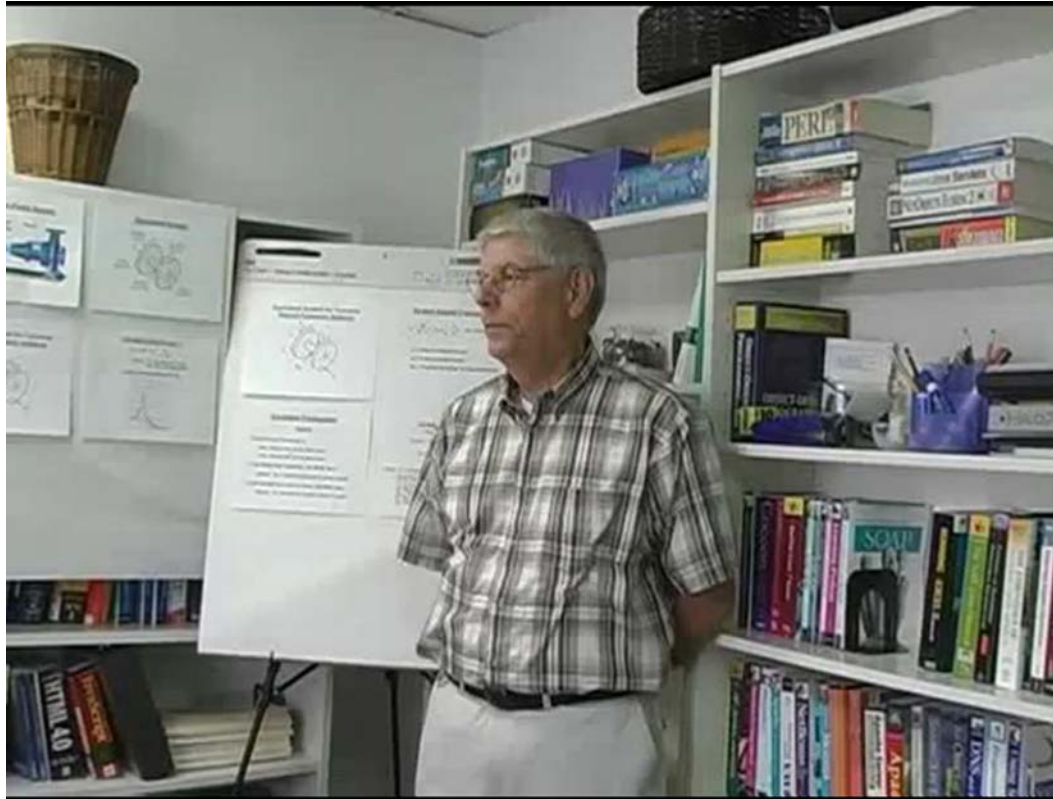
- Pull a label off the roll.
- Peel it from the backing.
- Grab an unlabeled case from the conveyor.
- Orient the case so the label is first applied to the top of the case with the top edge matching the line on the far side of the case. *(watch the first video)*
- Wrap the label around the case and press the end to the middle of the bottom of the case.
- Press the label down over its entire length.
- Place the labeled case back on the conveyor.

**Warning**  
Make sure that the label is aligned with the embossed line on the case.

**Best Practice**  
**Align the Case with the Edge of the Conveyor**  
It is important to put the label on straight. One way to do that is to align the case with the edge of the conveyor so you always pick it up in the same position.

**Suggestion**  
**Keep the Case in A Comfortable Location**  
Note how the worker pushes the case up the conveyor to make sure it is in a comfortable location where she can apply the label easily and smoothly. If it takes a bit longer to peel the label, she just pushes it back up until she is ready.

# Expert Interview



[Click picture to open example](#)

- Give expert their favorite instruction aids and ask them to explain their topic
- A designated questioner probes until each point is clear
- Video record entire session
- Transcribe and time-stamp session dialog
- Install dialog in DF TV as events and comments