



# Sorter Maintenance Diagnostics (SMD) Platform

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# Sorter Maintenance Diagnostic (SMD) Platform



- : Sorter crashes, costly downtime, and mis-sorts are typical occurrences for all types of sorter transports
- : SMD Platform saves:
  - : Preventative Maintenance Hours
    - : Eliminates PM tasks
    - : Automated alignment checks and diagnostic routines will provide technicians with valuable information on critical areas where maintenance is needed to improve performance or prevent downtime
  - : Corrective Maintenance Hours
    - : Proactively monitoring and reporting on potential failure points and conditions can help reduce unplanned downtime
- : Creative use of sensors, low-cost machine vision and measurement algorithms can spot potential failures before they occur
- : Provides ability to incorporate measurement techniques and analysis into a centralized reporting system can finally give maintenance and operations personnel the information the need to better manage systems on a daily basis

# Objective

- : Produce a system that:
  - : Provides a maintenance aid to detect sorter maintenance needs (ie, alignment requirements, performance degradation, etc)
  - : Covers almost any electro-mechanical sorter (e.g. cross-belt, tilt tray, flats, letter, etc.)
  - : Provides a maintenance aid to detect potentially catastrophic issues with the sorter
  - : Use a combination of real time monitoring and initiated test routine modes to effectively monitor the sorter
  - : Produce a concise and easy-to-read report to the maintenance technician
  - : Readily applicable technology to address/flag root causes of destination sort failures and improve sort accuracy
  
- : Goal
  - : Improve sorter maintainability
  - : Improve sorter operational availability and uptime

# Primary Mission



- : Primary mission is to enable the user to shift their maintenance philosophy from:
  - Preventative Maintenance - doing a prescribed series of tasks every day whether needed or not
  - to --
  - Condition-Based Maintenance (CBM) - using a set of measured conditions to determine what maintenance is actually required

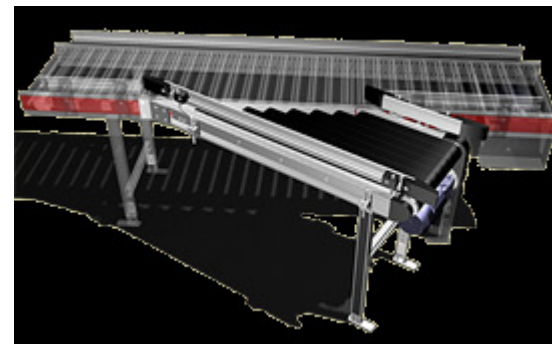
# Areas of Focus

- : Induction module
- : Sorter Cell
- : Carriers / carrier assembly
- : Cell output solenoid



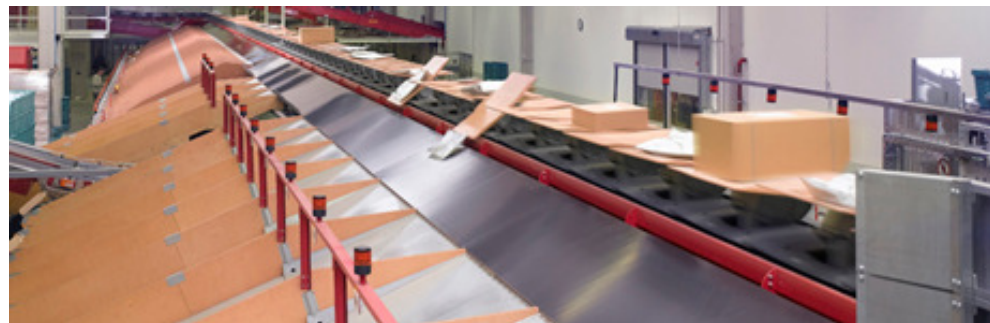
# Induction Module

- : Effect of improper alignment
  - Improperly tuned Induction Module will result in poor induction to sorter cell, resulting in mis-sorts from doubles, fly-over / fly-unders, etc.
  
- : Method
  - Detect acceleration speed to detect loose belts, worn or misadjusted drives
  - Detect package placement on sorter to detect timing issue
  
- : Technique
  - Run specified test piece through induction. System will measure modules performance
  - Initiated test routine during periodic maintenance



# Sorter Cell

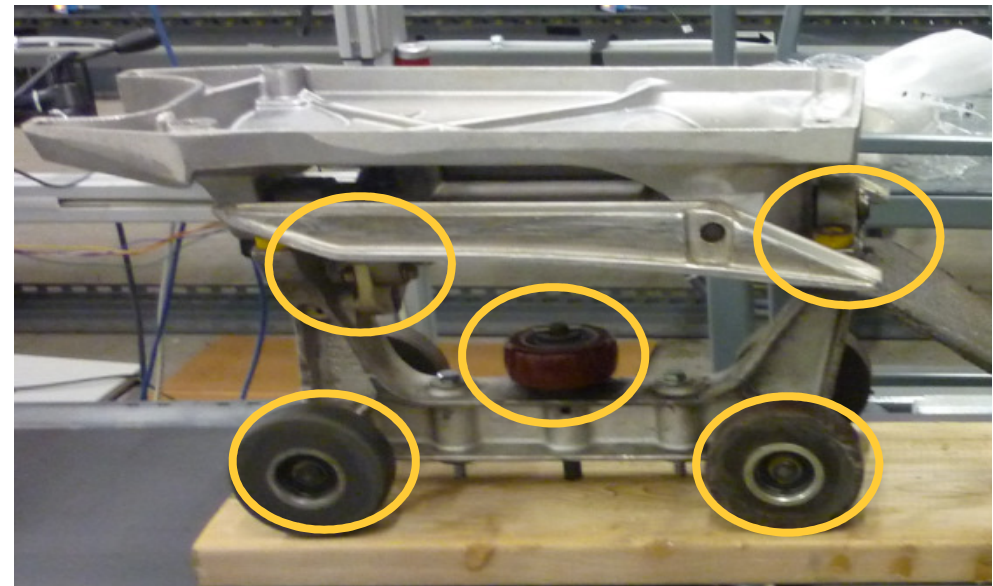
- : Effect of improper alignment
  - Improperly maintained cells (ie, cross belt or tilt tray) will result in mis-sorts fly-over / fly-unders, etc, sorter crashes, etc
  
- : Method
  - Detect cell condition
    - Cross-belt
      - detect worn belts
      - detect belt speed
    - Tilt-tray
      - detect angle of platter in level and tipped positions
  
- : Technique
  - Camera and vision software is used to detect conditions of belt as an initiated test routine



# Sorter Cell Carrier



- : Effect of improper alignment
  - Worn or missing components can lead to catastrophic crashes of the sorter and extended downtime
- : Method
  - Detect carrier components (wheels, couplings, etc)
- : Technique
  - Camera inspection system is used to inspect wheels, key components for physical compliance



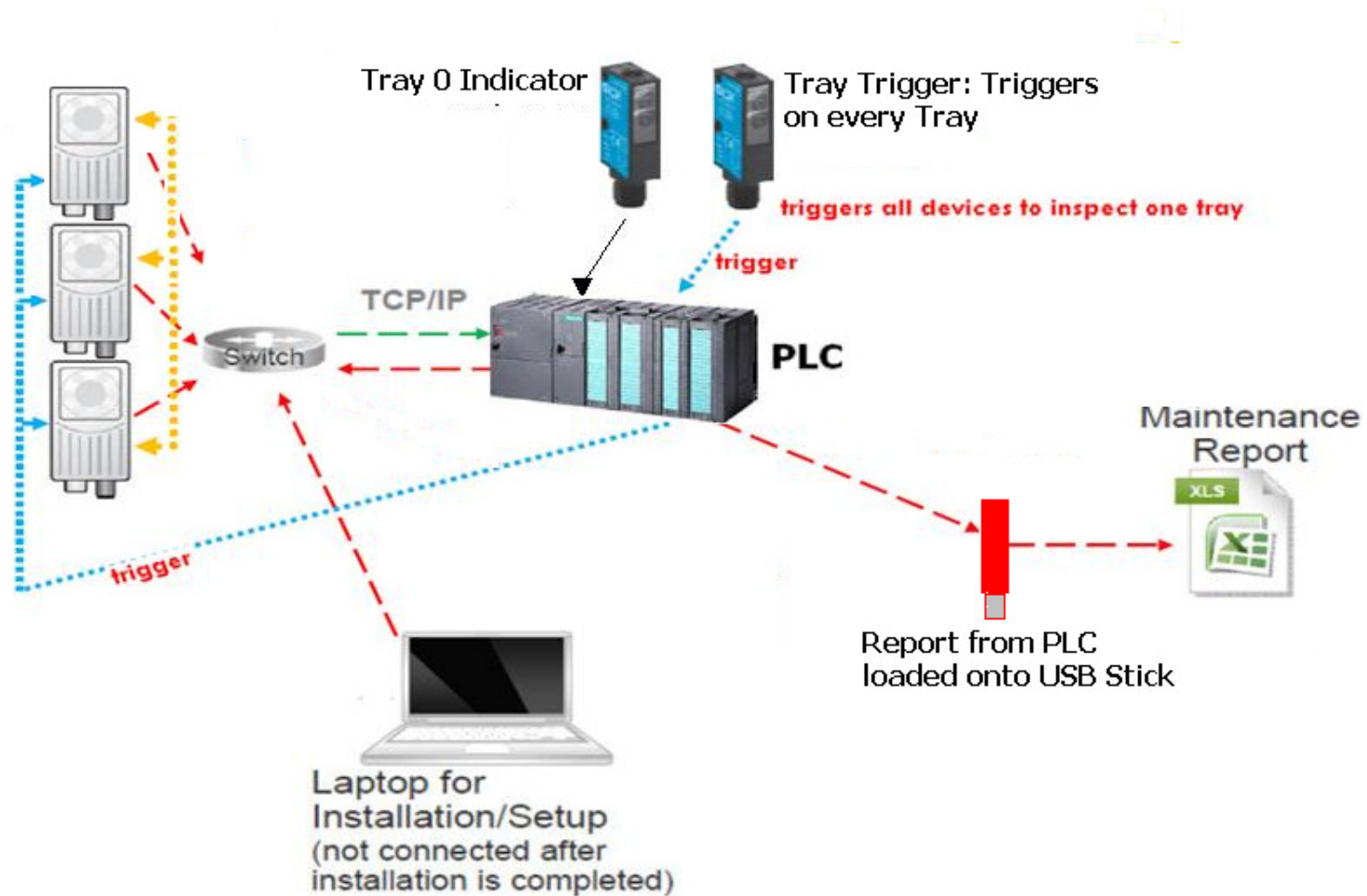


# Output Solenoid

- : Effect of worn or sticking solenoids
  - Excessively worn solenoids (ie, slow to actuate or sticking in out position) will result in product being diverted at the incorrect chutes and therefore mis-sorts fly-over / fly-unders, etc
  
- : Method
  - Use a fixture to test each of the sort locations for proper functioning solenoids
  
- : Technique
  - Using a test fixture, attached to the cell, run the sorter on an initiated test routine, and monitor each of the output chutes movement for acceptable timing

# Basic System Architecture

## Block Diagram



# SMD Solution

## : Main Controller

- Embedded controller based system
- Responsible for keeping track of tray number to associate inspection results
- Can stop sorter to prevent catastrophic failure
  - If selected criteria is met, Controller will activate E-Stop circuit and stop identified tray at specific maintenance location
  - Can stop sorter on consecutive alerts (ie, if there are 2 fails in a row of any particular inspection to avoid false results). Configurable by maintenance.
- Generates report

## : System Power, I/O, and Controller Cabinet

- Everything is terminated inside this enclosure
- Requires 115VAC
- Internal 24VDC 10 Amp supply will supply power to all components

# Sample Report

## SPBS Sorter Inspection Report

Office: Toronto Date: February 1, 2012  
 Machine Number: 1 Machine Serial #: 1234  
 Maintenance Operator: Ryan

### Program #1 - Induction

	Acceleration (Belt/Drive)	Timing (PE's)
Induction #1	●	●
Induction #2	●	●
Induction #3	●	●

### Program #2 - Carousel

	Belt Health	Belt Speed	Chute Sensor	Carrier	Chain	Stray Mail
Cell #2	●	●	●	●	●	●
Cell #19	●	●	●	●	●	●
Cell #105	●	●	●	●	●	●
Cell #168	●	●	●	●	●	●

Sorter Maintenance Diagnostics

Sorter Inspection Report#1

Inductions

Sorter Cells

# Inspection Report



- : Report will be generated on PLC
- : It can be downloadable initially onto a USB flash drive
- : Data will be imported into an excel spreadsheet
- : Will include the data from the last lap, or can include the last few revolutions
- : Can be connected to network so statistics can be downloaded on any PC on the network

# Program Benefits



- : Multiple systems in the same building can be linked together (via network and PLC).
- : Saves significant time over manual inspection.
- : Maintenance report can be produced directly on command, not only x times/year.
- : Detects problems of sorter faster/easier and preventive maintenance can take place before problems occur. Minimizes uncontrolled production stops and more expensive repairs of sorters.
- : Provides high level view of problem areas on each sorter at any time
- : Quick ROI based on greatly reduced inspection time, catching problems before they cause catastrophic results, and reduced downtime.
- : System can be non-intrusive to sorter, if desired by customer
  - Fielded/commissioned independently, no software interface required

# ROI Analysis



Productivity Savings						
			Lost	Cost/Hr	Total Op Impact \$	
Induction Diagnostics	Lost Operation Time Impact	Hours	48	\$ 200	\$ 9,600.00	
	Performance	% Throughput	1.00%	\$ 200	\$ 9,856.00	
Sorter	Lost Operation Time Impact (Crashes / Jams)	Hours	8	\$ 200	\$ 1,600	
	Lost Operation Time Impact (Crashes Due to Bucket Condition)	Hours	5	\$ 200	\$ 1,000	
					<b>\$ 22,056.00</b>	
Maintenance Hours Savings						
		Hours	Labor Rate	USPS Labor Cost	Est. Mat'l Cost	Total CM Cost Savings
Induction Diagnostics	Corrective Maintenance Hours	48	\$ 51.50	\$ 2,472	\$ 1,000	\$ 3,472
	Preventative Maintenance Hours	10.5	\$ 51.50	\$ 541	\$ -	\$ 6,489
Sorter	Corrective Maintenance Hours	8	\$ 51.50	\$ 412	\$ 200	\$ 612
	PM Hours (Monthly)	0.75	\$ 51.50	\$ 463.50	\$ -	\$ 464
	PM Hours (Yearly)	25	\$ 51.50	\$ 1,287.50	\$ -	\$ 1,287.50
					<b>\$ 12,324.58</b>	

# ROI Analysis

Est. Cost Of SMD Per Sorter ---->>	\$ 15,000		
		Payback Period	
Savings - Operational Availability	\$ 22,056	8	✓
Savings - Maintenance Hours / Repair Materials	\$ 12,325	15	✓
Projected Annual Savings Per AFSM	\$ 34,381	5	✓

## Soft Savings

- : Cost of re-directing mail
- : Service impact
- : Destination sort failures





**Thank you for your attention**

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