“Robotic Packaging Opportunities”

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Vice President – Robotics Technology
SWF Companies – GSMA

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PAK/PAL Conference
Sheraton St. Louis City Center
St. Louis, Missouri
Presentation Objectives

- Understanding the “Robotics Opportunity”
  - Robotic Features & Benefits
  - How robotics compares to traditional packaging automation.
  - Examples of robotics from “in-feed” to “end-of-line”.
Speaker’s Background

- **Experience**
  - Vice President Robotics Technology – GSMA, Division of SWF Companies
  - Former CEO/President – GSMA Systems, Inc.
    - Design, manufacturer and support robotics/automation systems
  - Former Vice President/Director – Advanced Magnet Lab
    - Design, manufacturing of normal and superconducting magnetic systems.
  - Former, Manufacturing Engineer – Cray Research, Inc.
    - Design and manufacturing of Supercomputers
  - Over 16 years of product development, automated manufacturing & systems engineering

- **Industry Recognition**
  - Advisor, Robotics International SME
  - Outstanding Young Manufacturing Engineer Award, International Award, Society of Manufacturing Engineers, 1992
  - President’s Award & Service Pin, Society of Manufacturing Engineers, April 1993
  - Cray Research Leadership and Innovation Award, 1990
  - 1st Recipient, Distinguished Alumnus Award 97–98, Wisconsin State Technical College Boards Association, Jan. 1998
  - Certified Manufacturing Technologist, 1987–present
  - 1st Recipient, National Outstanding Technical Student of the Year, American Technical Education Association, 1989
  - Distinguished Student Scholar, Phi Theta Kappa National Honor Fraternity, 1988

- **Publications/Speaker: Robotics & Automation Expositions/Conferences**
  - Robotic Line Realities, PackOps 2006, PMMI, November 2005
  - Robotic Packaging Automation Opportunities, PackExpo 2005, Sept 2005
  - Robotic Packaging Automation/Automation & Assembly Summit, April 2005
  - Leveraging Robotics to Improve Packaging Line Performance, Flexibility and Cost, PackExpo, Nov. 2004
  - Vision Integrated Robotics, American Imaging Association, October 2004
  - Robotic Packaging & Palletizing, PackExpo, October 2003
  - Robotics Small Parts Assembly, Assembly Technology Expo, September 2003
  - Robotics in Assembly, Assembly East, June 2003
  - Successful Implementation of Robotics for Small Parts Assembly, Test & Packaging, WESTEC, March 2003
  - Robot vs. Pneumatics Analysis, IMTS Manufacturing Conference, September 2002
  - Robotic Citrus Harvesting Technology Forum, April 2002
  - Fully-Integrating a Robotic System for Small Parts Assembly, Assembly Tech Expo, October 2001
  - The Challenge of CIM: Prototype to Production, AUTOFACT ’92 Conference, Nov. 1992
  - Cray Research Technical Symposium: Manufacturing the GRAVITY- NP C90 Wire Chassis, June 1991
Today’s “Commodity” Robots
Reliability

Robots are proven to provide:

50,000 to 75,000 hours MTBF [Mean Time Between Failure] of operation without failure.

Equivalent to 25–37 “man–years”
Robotics Are in All Industries

- Aerospace
- Agriculture
- Appliances and Consumer Goods
- Automotive
- Building Products & Materials
- Education
- Electronics
- Furniture
- Space & Defense
- Distribution
- Food & Beverage Healthcare
- Pharmaceutical
- Plastics & Metals
- Printing & Publishing
- Semiconductor
- Marine
- Medical
- Mining and Foundry
- High Energy Physics
- Research & Development
- Textile
Reliability: Failure Opportunity Analysis

3-Axis Pneumatic
Pick & Place

6-Axis Robot
Assemble, Unload & Sort
Reliability: Robotic vs. Pneumatic

- Robotic Components Required
  1. Robot (4-6 axes)
  2. Gripper
  3. Break-away device (collision sensor)
  4. Software Replaces Sensor

- Pneumatic Components Required (per one axis only)
  1. Axis slide
  2. Axis sensors/brackets/cables/connectors (2 each)
  3. Hard Stop (2)
  4. Shocks (2)
  5. Mounting interface plates and hardware
  6. Flow controls (2)
  7. Valve/cable/connector
  8. Pressure Regulator
  9. Tubing and Connectors
  10. Gripper
Reliability: Failure Opportunity Analysis

- 2-Axis Pneumatic Manipulator with one Rotary Axis

<table>
<thead>
<tr>
<th>Component</th>
<th>Sensor</th>
<th>Cable</th>
<th>Valves</th>
<th>Flow Control</th>
<th>Tubing</th>
<th>Shock</th>
<th>Slides</th>
<th>Bearing</th>
<th>Seal</th>
<th>Bracket</th>
<th>Air Quality</th>
<th>Fasteners</th>
<th>Tech. Adj</th>
<th>Total</th>
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- 6-Axis Robot

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<th>Component</th>
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<th>Cable</th>
<th>Valves</th>
<th>Flow Control</th>
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<th>Shock</th>
<th>Bolts</th>
<th>Bearing</th>
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<th>Air Quality</th>
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</table>

*Robots range from 50,000 – 75,000 hours MTBF*
Three-Axis Pneumatic Manipulators is *6-times More* likely to have a *Failure* than a 6-axis Robots

*Robots range from 50,000 – 75,000 hours MTBF*
Reliability: Robotic vs. Traditional

Vs.
Reliability: Robotic vs. Traditional

Failure Opportunity Analysis

- Bottle Gripper
- Servo Drive
- Pneumatic Cylinder
- Conveyor
- Diverter
- Sensor
- Flexing Cables
- Valves
- Flow Control
- Shocks
- Bearings
- Chains/Pulleys
- Bracket Adjustments

# of Failures

- Traditional
- SWF Robotic
Reliability: Robotic vs. Traditional

Total Failure Opportunity Comparison

# of Failures

Traditional

SWF Robotic

0
50
100
150
200
250
## Reliability: Robotic vs. Traditional

<table>
<thead>
<tr>
<th>#</th>
<th>Specifications &amp; Features</th>
<th>SWF Robotic</th>
<th>Traditional</th>
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<tbody>
<tr>
<td>1</td>
<td>Cases Per Minute</td>
<td>65 Max.</td>
<td>30 Max.</td>
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<td>Axes of Packing Motion</td>
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<td>3</td>
<td>Changeover Time</td>
<td>5 minutes</td>
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<td>4</td>
<td>Reliability of Motion Components</td>
<td>64,500 MTBF</td>
<td>100's MTBF</td>
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<td>5</td>
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<td>6</td>
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<td>7</td>
<td>Remote Support</td>
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<td>8</td>
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<td>9</td>
<td>Continuous to Continuous Motion Packing</td>
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<td>Continuous [Rounded] Corner Motion</td>
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<td>15</td>
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<td>16</td>
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</table>
Reliability Conclusion

Robots are proven to provide:

*50,000 to 75,000* hours MTBF [Mean Time Between Failure] of operation without failure.

*Equivalent to 25–37 “man–years”*

*A six-axis servo robot is more reliable than one pneumatic actuator!*
System Reliability

• Key to system reliability is providing integration of both robot and system

• System Reliability is Directly Related To:
  – The Total Number of Electrical & Mechanical Components

• Robots Increase Overall “System” Reliability
  – Eliminate Peripheral Equipment or Devices
    • i.e. Use of a pallet rack eliminated pallet dispenser, transfer conveyor and 90-degree transfers
  – Simplify Material Handling System
    • i.e. Random orientation eliminates complicated conveying systems required to orient, collate and accumulate
  – Simplify Tooling
  – Minimizes Mechanical Adjustments
    • Reduces problems from technician adjustments
System Reliability

- Old Way vs. New Way
System Reliability

• Eliminate collation and accumulation
System Reliability

• Eliminate collation and accumulation
Versatility & Flexibility

• Flexible Product In-Feed Presentation
  – Pick from *Random* or *Collated* presentations
  – Pick & Place from *Multiple Locations*
  – Pick & Place from *Multiple Heights*
  – Pick & Place *Mixture of Product Type* on a *Single In-Feed*

• Flexible to Handle More Than Just Product
  – Empty cases & full cases
  – Separators, inserts & partitions
  – Separator Sheets
  – Pallets, pucks, bins & totes
  – Tier sheets & pallet sheets
  – Unit load caps
Performance

• Optimum Product Handling
  – *Intermittent to Intermittent* Motion
  – *Continuous to Continuous* Motion
  – *Intermittent to Continuous* Motion
  – *Continuous to Continuous* Motion
  – *Highest Speeds* with *Gentle Handling*
    • Controlled acceleration & deceleration
  – Ability to use *Six Degrees-of-Freedom* for optimum loading, packing or palletizing
Changeover

- Changeovers
  - Very quick
  - Capable of automatic changeover
  - Programmable
Accurate Application Analysis

Depalletizing & Palletizing

Material Handling

Case Packing

De-Casing
Additional Benefits

• Maintenance
  – Minimizes the number of electrical and mechanical components in the system
• Facilities
  – Minimum footprint
  – Ease for custom configuration
  – Ease for mono-block solution
• Safety of Tooling & Product
  – Collision Guard Software *Protects Tooling*
  – Soft Float Software allows *X-Y “Float”* during product placement
Additional Benefits

• **Common Manufacturing Technology**
  - Same robot or robot family can be used for different applications such as packing/depalletizing/palletizing on the same line or within the same facility

• **Remote Support & Communication**
  - Direct connection and control to system
Environment

• Unlimited Opportunity
  – Clean Room
  – Cold
  – Dusty
  – Explosive
  – Heavy
  – Hot
  – Noisy
  – Radiation
  – Sanitary
  – Wet
Competitive

• Competitive Pricing for Robotic Solutions
  – Higher material costs are offset by reducing or eliminating:
    • Engineering
    • Fabrication
    • Assembly
    • Documentation
    • Debug & Installation
    • Risk, Rework… Redesign
Robotic vs. Traditional

- Traditional Shelf Horizontal Loader & Palletizer
  - More Cost
  - More Footprint
  - \( \approx 90\% \) More Maintenance
  - \( \approx 10x \) More Failure Opportunities

- Robotic Loading & Robotic Palletizing
  - Less Cost
  - Less Footprint
  - \( \approx 90\% \) Less Maintenance
  - \( \approx 10x \) Less Failure Opportunities

$850K $700K
Opportunities: In-Feed to End-Of-Line

• Robotics from Up-Line to End-of-Line Packaging
  – Depalletizing
  – De-Casing
  – In-feed Handling
  – Raw food Handling
  – Primary Packaging
  – Secondary Packaging
  – Mixing [Combo/Rainbow packs]
  – Palletizing
  – General Material Handling
  – Full-line & Integrated Solutions
Opportunities: In-Feed to End-Of-Line

- Common control, interface and operation from in-feed to end-of-line.
Depalletizing

- Removal of loaded and empty containers for up line filling/process applications
De-Casing

• Removal of product such as empty bottles for filling or product for mixing.
  – Common Technology for Mixing or Case Loading down stream.
  – Continuous motion tracking to prevent product tipping, eliminate accumulation and control of gapping.
In-Feed Product Handling

• Random Orientation Inspection & Processing
  – Vision inspection & part locate
  – Random oriented product locate and transfer into flow wrappers, cartoners, cases, trays, pouches, blisters
  – Continuous motion *pick*, continuous or intermittent motion *place*
Primary Packaging

• **Cartoning**
  – Robotics reduces complexity of in-feed and provides continuous or intermittent motion loading.
Primary Packaging

- **Cartoning**
  - Robotics minimizes mechanical systems used to accumulate and load cartons.
Primary Packaging

- Converting Horizontal Applications to Vertical Cartoning Solutions
Primary Packaging

- Horizontal Cartoning & Material Handling
  - Wrapped product unload, transfer & cartoner load
  - Five (5) Identical Robots, Two (2) Dial Tables, Fixtures, Puck Handling System
  - 6-month Payback
Primary Packaging

• Material Handling & Horizontal Cartoning
Primary Packaging

• Blister Loading – Random Orientation
  – Unstable product
  – High-speed
  – Continuous motion in-feed & loading
Primary Packaging

- **Blister Loading**
  - Blister load from racks
    - Small & Delicate Medical Devices
    - Seven (7) Products
    - Automatic Change Over
Primary Packaging

• Raw Food Handling
  – Random orientation with Vision Locate
Secondary Packaging

• Collated Product
  – 6-axis robot fully optimizes the packing process while eliminating flap control.
Secondary Packaging

- Servo Metered Product
  - Pick on-the-fly and eliminate collating, accumulation, product re-orientation and changeover
Secondary Packaging

- **Servo Screw In-Feed**
  - Pick on-the-fly or intermittent
  - 6-axis robot eliminates flap control and changeover
Secondary Packaging

• Food Canisters
  – Robotic case loading in trays with HSC lids
  – Six-axis motion enables packing of tapered product
Secondary Packaging

• **Food Product**
  – Stand-up bags
  – Pick on-the-fly without collating/accumulating
  – Continuous motion case/tray conveying
Secondary Packaging

• Food Products
  – Stand-up bags with Servo Collating In-Feed
  – 6-axis manipulation of product
Product Mixing

• **Rainbow & Combo Packs**
  – Market driven to mix flavors, colors and sizes
  – Mixing is labor intensive requiring depalletizing, mixing, repackaging & palletizing
Product Mixing

• Rainbow & Combo Packs
  – Continuous Motion
  – 3 & 4 Flavor
  – 6 Robots vs. 4 Robots
Palletizing

• High Flexibility
  – Robot handles multiple lines, multiple products, multiple pallet types and Slip Sheets
  – No changeover
Palletizing

- Dual Palletizing Cell - 90-degree Case Transfer, Pallet Dispenser, Transfer Carts, Unit Load Labeling, Stretch Wrapping with/without Pallets, Database Driven Robotics, Automatic Grade Change [on the fly]
Palletizing
Palletizing

- **High Flexibility**
  - Robot handles heavy Pails & Bliss Cases
Palletizing

- High Flexibility
  - Robot handles bags or bundles
Palletizing

- **High Flexibility**
  - Robot handles cases & pails; various pallet types
  - Automatic changeover utilizing a robotic tool changer
Integrated Packaging Solutions

• Healthcare Products
  – Robotic cartoning & case loading
  – Bottle mixing, vision verify, case erecting and sealing
Integrated Packaging Solutions

- Tape Product
  - RSC Case Erecting, Tray Forming, Case Packing, and Palletizing
  - Over 350 SKUs
Integrated Packaging Solutions

• Paper Product
  – RSC Case Erecting, Layer Forming, Case Packing, Case Sealing, Palletizing & Stretch Wrapping
  – Palletize directly on Stretch Wrapper without pallets
Integrated Packaging Solutions
Integrated Packaging Solutions

• Case Erecting, Layer Forming, Case Packing, Case Sealing, Palletizing & Stretch Wrapping
General Material Handling

- Tray/Pan/Bin Handling
  - Increase over manual production by over 30%
  - Eliminate ergonomic problems
Robotic Opportunity

- Performance, Reliability, Flexibility & Quick Changeover
Robotic Flexibility

- Transfer, Erecting, Packing, Sealing, Labeling & Lidding
Achieving State-Of-The-Art Performance

• **Optimization Through Robotics**
  – Minimize Product Handling
  – Minimize Damage To Product
  – Minimize Failure Opportunities
  – Minimize Operator Intervention
    • Change Over
    • Recovery
  – Minimal Grade Change/Product Change Over
  – Minimize Maintenance
  – Intelligent Software
    • Automatic Diagnostics & Error Recovery
Robotics for Packaging: When & Why

- Difficult Product to Collate or Accumulate
- Variety of Product
- Variety of Presentations
- Multiple Lines
- Mixing/Combo/Random
- High Frequency of Changeover
- Minimal Space
- “Drop In” for Existing Line
Where Robotics May Not Make Sense

• Difficult to “Pick” Product
• Ease of Product Handling
• Dedicated Product
• Single Line with High Speeds
• Simple Drop Packer Application
• 1st Project with High Risk
Robotic Compatibility

• Matching robotic functionality to product needs and operator capabilities.
  – Critical to perform detailed and accurate applications analysis.
  – Analysis should include:
    • Detailed specification showing ALL products and ALL presentations/configurations.
    • Simulation Analysis
    • Site Visit
      – Fully appreciate requirements
      – Understanding of facility and existing culture
  – Solid Understanding of Customers Expectations
    • Be realistic!
    • Focus on 1st time success!
      – Don’t invest in the highest ROI, if the project has the highest Risk!
      – Chose a “lower” risk project and then build on its success.
Questions & Comments

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321.480.8470

Depalletizing

Raw Food & In-Feed Handling

Primary Packaging

Secondary Packaging

Palletizing

Mixing/Combo Packs

Material Transfer & Handling