Is Automation Right for Your Company?

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Applied Manufacturing Technologies
Is Automation Right for Your Company?

Advanced Manufacturing Engineering “V”:

- **Voice Of Customer (VOC)**
  - Want to automate packaging processes
  - Eliminate manual labor
  - Increase throughput
  - Improve ergonomics
  - Safety
  - ROI: important! Safety: top priority

- **Functional Requirements**
  - Min. Output @ 750/777 cycles/hr
  - 25,900/60,000/60,000 Capital Budget
  - 1,900 lbs. per package
  - 1,000 lbs. per pallet
  - ISO 14,969 Clean Room

- **Concept Development**
  - Fully Automated with Robots
  - Fully Automated with Hard Automation
  - Fully Automated with manual packaging
  - Automatic vs. manual stacking

- **Concept Selection**
  - Cost vs. Requirements
  - Benefits vs. Issues
  - Comprehensiveness vs. Approach
  - Maximum Desirability

- **Pre-Engineering**
  - Specific Equipment Selection: “R2000iB-210F”
  - Process Validation: simulations, model times, throughputs
  - Risk Assessment: FMEA, Proof of Concept
  - (Rerun until acceptable risk)

- **Technical Specifications**
  - Describes behavior of systems
  - Zoning, Zone
  - Outlines major system components
  - Supporting Drawings, Layouts, etc.

- **Design & Build**
  - Detailed Engineering
  - Systems integration
  - Installation
  - Production Support

- **Bid Package**
  - Functional & Technical Specifications
  - Statements of Work
  - Request for Quotes
  - Schedule, Payment Terms

- **AME: Phase 1**

- **AME: Phase 2**

- **AME: Phase 3**

Project Execution
As technologies advance and production costs climb, automation continues to permeate new industries at a growing pace. While the net effect is positive, it seems that for every success story there is a project that failed.

$75,000.00 Coat Hanger!!
What we’ll Cover:

1. Should You Automate?
2. Identifying the Business Requirements of a Project
3. Understanding Your Process
4. Determining the Appropriate Level of Automation
   - Self Integrate vs. Outside Integrator
   - Steps to Qualifying an Integrator
5. Having an Empirical Approach to Automation
Is Automation Right for Your Company?

Economic Drivers for Automation

- Technology Improvements
- New Market Segments with Proven Applications
- Re-shoring Growth
- Energy Efficient Materials
- Higher Quality and Increased Utilization
- Consumer Markets
- Product Life Cycles
- Quality of Work or Unsafe Tasks
1. Should you Automate?

- Should You Automate?
- Identify Business Requirements
- Understand Your Process
- Level of Automation
- Approach to Automation
Top Reason to Consider Automation

- Increase Throughput
- Reduce Labor Cost
- Improve Quality
- Improve Safety
- Reduced Footprint

Top Business Requirement to Consider Before Automation

- Schedule (Key Dates)
- Lead Time
- Capital Budget Limits
- Cost Payback Period (ROI)
Additional System Attributes to Consider

- Scalability
- Flexibility
- Facility Changes
- Manufacturing Risk (POP)
- Technology Risk (POP)
- Compatibility – Accommodate Current Product
- Packing Materials Design Change
- Material Flow
- Re - Occurring Schedule
- Re - Occurring Cost
- Product Re-Qualification
- Waste - Materials, Changeover
### Should You Automate?

<table>
<thead>
<tr>
<th>System Attributes</th>
<th>Metric</th>
<th>Target Value</th>
<th>Target Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROI</td>
<td>Years</td>
<td>2 / 5 / Min</td>
<td>7</td>
</tr>
<tr>
<td>Throughput Capacity</td>
<td>Parts / Year</td>
<td>&gt;= 10,000,000</td>
<td>3</td>
</tr>
<tr>
<td>Manufacturing Risk (how complicated is the process?)</td>
<td>RPN # Based on AIAG FMEA Standards</td>
<td>Minimize</td>
<td>1</td>
</tr>
<tr>
<td>How many tasks per machine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology Risk (brand new, unproven tech)</td>
<td>RPN # Based on AIAG FMEA Standards</td>
<td>Minimize</td>
<td>1</td>
</tr>
<tr>
<td>Timeline Project Schedule</td>
<td>Months</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Timeline (Installation Duration)</td>
<td>Days</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Scalability</td>
<td>1 - 10</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>1 = Highly Scalable</td>
<td>10 = Not Scalable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>1 - 10</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>1 = Highly Flexible</td>
<td>10 = Not Flexible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facility Changes (new compressor, take down wall, pour new floor)</td>
<td>1 - 10</td>
<td>Minimize</td>
<td>3</td>
</tr>
<tr>
<td>1 = No Changes</td>
<td>10 = Gut Everything</td>
<td>(Known Changes)</td>
<td></td>
</tr>
<tr>
<td>UnSkilled Labor Requirements</td>
<td># Operators / Process</td>
<td>Minimize</td>
<td>3</td>
</tr>
<tr>
<td>Skilled Labor Requirements</td>
<td># Technicians / Process</td>
<td>Minimize</td>
<td>3</td>
</tr>
<tr>
<td>Packing Materials Design Change</td>
<td>1 - 10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1 = No Changes</td>
<td>10 = All New</td>
<td></td>
<td></td>
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<tr>
<td>Material Flow Traffic Congestion</td>
<td>% Time Blocked / Starved (Based on simulation estimates)</td>
<td>Minimize</td>
<td>3</td>
</tr>
<tr>
<td>Recurring Schedule</td>
<td>% Reduction In Time</td>
<td>Maximize</td>
<td>3</td>
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<tr>
<td>Recurring Cost Maintenance, Spare Parts, etc..</td>
<td>1-10</td>
<td>Minimize</td>
<td>7</td>
</tr>
<tr>
<td>1= Min Cost</td>
<td>10 = Max Cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modularity (Phased Approach)</td>
<td>1-10</td>
<td>Minimize</td>
<td>7</td>
</tr>
<tr>
<td>1= Min Impact</td>
<td>10 = Max Impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>1-10</td>
<td>Maximize</td>
<td>3</td>
</tr>
<tr>
<td>1= Just Meets Standards</td>
<td>10 = Significantly above and beyond standards</td>
<td>Subjective - AMT Expertise</td>
<td></td>
</tr>
</tbody>
</table>
Should You Automate?

Top Reasons to Automate:
- Footprint Reduction
- Improve Quality
- Improve Throughput
- Improve Safety
- Reduce Labor Costs

Should You Automate?
Should You Automate?

Top Reasons to Automate

1. Improve Throughput
Should You Automate?

Top Reasons to Automate

1. Improve Throughput
2. Reduce Manpower (Direct Labor Costs)
Should You Automate?

Top Reasons to Automate

1. Improve Throughput
2. Reduce Manpower (Direct Labor Costs)
3. Improve Quality
Should You Automate?

Top Reasons to Automate

1. Improve Throughput
2. Reduce Manpower (Direct Labor Costs)
3. Improve Quality
4. Improve Safety
Should You Automate?

Top Reasons to Automate

- **Improve Safety** – ANSI/RIA R15.06:2012 – 3 Top Highlights
  1. **Functional Safety** – A change in requirements to define and quantify safety control Circuitry
  2. **Safety Rated Soft Limits (SRSL)** – A Change in the approved control of robot motion to include newly developed safety-rated soft axis and space limiting
  3. **Mandatory Risk Assessment** – A Risk Assessment SHALL be performed and is no longer optional
Should You Automate?

Top Reasons to Automate

1. Improve Throughput
2. Reduce Manpower (Direct Labor Costs)
3. Improve Quality
4. Improve Safety
5. Reduce Footprint
Should You Automate?

Bad Reasons to Automate

1. Tradeshow - Robots are Cool!
2. The Competition is Automating
3. Capital Budget Availability
Should You Automate?

Why do Automation projects Fail?

Installation & Commissioning

Automation Systems Are Very Complex!!

Controls Design & Layout

Equipment Design & Layout

Process Requirements

Budget / Resource / Schedule
Should You Automate?

Results of Failed Automation

- Safety Violations
- Final System Layout
- Process/Application Tracking
- Hardware Damage
- High Resource Utilization Costs
- Recreation of Logic on Manufacturing Floor
2. Identifying the Business Requirements of Your Automation Project?

- Should You Automate?
- Identify Business Requirements
- Understand Your Process
- Level of Automation
- Approach to Automation
Project Business Requirements

Schedule Requirements

• Fast/Good/Cheap – Pick 2
Project Business Requirements

Lead Times

- Best/Worst Case

Reference – datascales.com
Capital Budget Limits

- Strong Business Case
  Vs.
- Available Dollars
ROI Requirements

- Clearly Define the Payback Period
- Consider all Costs
- Establish your Baseline

<table>
<thead>
<tr>
<th># Operators / Shift</th>
<th># Shifts</th>
<th># Operators</th>
<th>Cost / Operator</th>
<th>Cost / Year</th>
<th>Cost / Year: 1.25$/€</th>
<th>Cost / 2 Years</th>
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<td>12</td>
<td>5</td>
<td>60</td>
<td>30,000.00 €/y</td>
<td>1,800,000.00 €/y</td>
<td>2,340,000.00 $/2 Years</td>
<td>4,680,000.00</td>
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<table>
<thead>
<tr>
<th># Operators / Shift</th>
<th>2 Year ROI Budget For Automation</th>
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<tr>
<td>0</td>
<td>$ 4,680,000.00</td>
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<tr>
<td>1</td>
<td>$ 4,290,000.00</td>
</tr>
<tr>
<td>2</td>
<td>$ 3,900,000.00</td>
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<tr>
<td>3</td>
<td>$ 3,510,000.00</td>
</tr>
<tr>
<td>4</td>
<td>$ 3,120,000.00</td>
</tr>
<tr>
<td>5</td>
<td>$ 2,730,000.00</td>
</tr>
<tr>
<td>6</td>
<td>$ 2,340,000.00</td>
</tr>
<tr>
<td>7</td>
<td>$ 1,950,000.00</td>
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<tr>
<td>8</td>
<td>$ 1,560,000.00</td>
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<tr>
<td>9</td>
<td>$ 1,170,000.00</td>
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<tr>
<td>10</td>
<td>$ 780,000.00</td>
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<tr>
<td>11</td>
<td>$ 390,000.00</td>
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<tr>
<td>12</td>
<td>$ -</td>
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</table>
Current Process

3. Understanding Your Current Process

- Should You Automate?
- Identify Business Requirements
- Understand Your Process
- Level of Automation
- Approach to Automation
Current Process

Value Stream Map

Spaghetti Chart

Process Flowchart
Current Process

- Product Mix - How Many Final Assemblies?
- Number of Sub- Components per Final Assembly
- Number of Processes per Final Assembly
Current Process

- Product Mix - How Many Final Assemblies?
- Number of Sub-Components per Final Assembly
- Number of Processes per Final Assembly
- Number of Operators

<table>
<thead>
<tr>
<th>Task</th>
<th>#People</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Add Label 1 to Sleeves</td>
<td>N/A</td>
<td>Note required task</td>
</tr>
<tr>
<td>QA Extraction/Reinsertion</td>
<td>N/A</td>
<td>QA manpower not counted in packaging process</td>
</tr>
<tr>
<td>Move Sleeves from Press to Package Area</td>
<td>0</td>
<td>Sleeve Conveyor</td>
</tr>
<tr>
<td>Group Sleeves into Bows</td>
<td>0</td>
<td>Sleeve Conveyor</td>
</tr>
<tr>
<td>Erect Case, Fold and Tape Bottom Flaps Closed</td>
<td>1</td>
<td>Case Erector requires one person to load flat boxes, maintain</td>
</tr>
<tr>
<td>Insert Liner Bag 1 into Box</td>
<td>0</td>
<td>Bag inserter machine</td>
</tr>
<tr>
<td>Insert Liner Bag 2 into Box</td>
<td>0</td>
<td>Bag inserter machine</td>
</tr>
<tr>
<td>Move Box to Packaging Area</td>
<td>0</td>
<td>Box Conveyor</td>
</tr>
<tr>
<td>Pack Sleeves into Boxes</td>
<td>0</td>
<td>Robotic</td>
</tr>
<tr>
<td>Move Box to Clipping Area</td>
<td>0</td>
<td>Box Conveyor</td>
</tr>
<tr>
<td>Tie / Fold / Seal Liner Bag 2</td>
<td>1</td>
<td>Bag sealer handles bag 2 that are sealed. Person required for tying or folding Bag 2.</td>
</tr>
<tr>
<td>Apply Label 1 to Box</td>
<td>0</td>
<td>Label B Printer/Applier</td>
</tr>
<tr>
<td>Fold Liner Bag 2</td>
<td>0</td>
<td>Bag folder handles Bag 2.</td>
</tr>
<tr>
<td>Close and Tape the Box</td>
<td>0</td>
<td>Bag Closer</td>
</tr>
<tr>
<td>Apply Label At Box</td>
<td>0</td>
<td>Label A Printer/Applier</td>
</tr>
<tr>
<td>Apply Labels CBD to Box</td>
<td>0</td>
<td>Label C Printer/Applier and Label D Printer/Applier</td>
</tr>
<tr>
<td>Move Box to Palletizing Area</td>
<td>0</td>
<td>Box Conveyor</td>
</tr>
<tr>
<td>Move Box to EBSA Area</td>
<td>0</td>
<td>Box Conveyor</td>
</tr>
<tr>
<td>Palletize the Box</td>
<td>0</td>
<td>Palletizing Robot System</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
Current Process

• Product Mix - How Many Final Assemblies?
• Number of Sub- Components per Final Assembly
• Number of Processes per Final Assembly
• Number of Operators
• Type of Equipment
Current Process

- Product Mix - How Many Final Assemblies?
- Number of Sub-Components per Final Assembly
- Number of Processes per Final Assembly
- Number of Operators
- Type of Equipment
- Cycle Time
Current Process

- Product Mix - How Many Final Assemblies?
- Number of Sub-Components per Final Assembly
- Number of Processes per Final Assembly
- Number of Operators
- Type of Equipment
- Cycle Time
- Current System or Line Throughput = Baseline
Current Process

- Product Mix - How Many Final Assemblies?
- Number of Sub- Components per Final Assembly
- Number of Processes per Final Assembly
- Number of Operators
- Type of Equipment
- Cycle Time
- Current System or Line Throughput = Baseline
- Current Quality Numbers (Cpk, Ppk, Scrap, Rework)
Current Process

• Product Mix - How Many Final Assemblies?
• Number of Sub- Components per Final Assembly
• Number of Processes per Final Assembly
• Number of Operators
• Type of Equipment
• Cycle Time
• Current System or Line Throughput = Baseline
• Current Quality Numbers (Cpk, Ppk, Scrap, Rework)
• Footprint
4. Determining the Appropriate Level of Automation

- Should You Automate?
- Identify Business Requirements
- Understand Your Process
- Level of Automation
- Approach to Automation
Level of Automation

Investigate Robots vs. Dedicated Machines
Investigate Conveyors vs. AGV’s
Level of Automation

Fully Automated vs. Manual Inspections
Level of Automation

Fully Automated Factory Vs. Single Station Automation

VS.
Level of Automation

Self Integrate vs. Outside Integrator

1. What are your in house capabilities?
2. Do you have the time and resources?
3. Do you have application experience?
4. Are you up to date on the latest safety standards?
Qualifying an Integrator

1. Trust
2. Business Stability
3. Proposal
4. Application Experience
5. Engineering Capabilities
6. Program Management
7. Service and Technical Support
8. Spare Parts
9. Safety
10. Training
5. Having an Empirical Approach to Automation

- Should You Automate?
- Identify Business Requirements
- Understand Your Process
- Level of Automation
- Approach to Automation
Your Approach to Automation

Advanced Manufacturing Engineering “V”:

**AME: Phase 1**
- **Voice Of Customer (VOC)**
  - Want to automate packaging process
  - Eliminate Manpower (save $20)
  - Meet current/future throughputs
  - Improve ergonomics/safety
  - ROI: important!!! Safety (top priority)

**AME: Phase 2**
- **Functional Requirements**
  - 10 Presses @ 5.27 Sec/cycle
  - $2,000,000.00 Capital Budget Limit
  - 10 Unique Box SKU’s packaged
  - 18 Unique packaging patterns
  - ISO 7 Clean Room

- **Concept Development**
  - Fully Automated with Robots
  - Fully Automated with Hard Automation
  - Automate conveyance, manual packing
  - Automate packing/manual stacking

- **Concept Selection**
  - Ideas vs. Requirements
  - Ideas vs. Ideas
  - Comprehensive approach
  - Maximize Doability

- **Pre-Engineering**
  - Specific Equipment Selection: “Robot” -> Fanuc R2000iB 210F
  - Process Validation (simulations, cycle times, throughputs)
  - Risk Assessment – FMEA, Proof of Concept
  - (Iterate until acceptable risk)
  - Preliminary Bill of Materials
  - Detailed Cost Analysis

**AME: Phase 3**
- **Design & Build**
  - Detailed Engineering
  - System Integration
  - Installation
  - Production Support

- **Bid Package**
  - Functional & Technical Specs
  - Statement of Work
  - Request for Quote
  - Schedule, Payment Terms

- **Technical Specifications**
  - Test Methods, Acceptance Criteria
  - Hardware and Software Requirements
  - Certification requirements
  - Safety, Environmental, etc.

- **Functional Specification**
  - Describes behavior of system
  - Zone by Zone
  - Outlines Major System Components
  - Supporting Drawings, Layouts, etc.

**Project Execution**
Your Approach to Automation

The Advanced Manufacturing Engineering Process (AME)

Phase 1 - Analyze
- Preliminary Analysis
  - Capture Existing System
  - Data Gathering
  - Idea Generation
  - Investigations

Phase 2 - Concept
- Concept Development
  - Simulate Mfg. Concept
  - Analyze relevant Mfg. scenarios
  - Develop functional description
  - Obtain approval of layout

Phase 3 - Define
- Functional Spec. & Cost Analysis
  - Develop Functional Specification
  - Develop System Layout Dwgs
  - Provide +/-10% Cost Estimates
Phase 1 - Preliminary Analysis – “The Sniff Test”

Capture the existing system and Current Process

- Walk the plant floor
- Map the Process
- Field Check Equipment
- Areas of Focus:
  - Material Flow
  - Information Flow
  - Equipment
  - Floor space
  - Manpower
  - Level of Automation
  - Production Metrics
  - Quality Metrics
  - Safety
  - Skill Level
  - Standards

Phase 1 - Analyze
Phase 1 - Data Gathering

1. Pre-engineering List – What’s Important?
2. Document all Captured Parameters
3. Clearly State Assumptions for Unavailable Parameters
4. Reach an Accordance with your Automation Team and Stakeholders
Phase 1 - Target Setting

1. Establish Important System Attributes
2. Establish Quantifiable Metrics
3. Document the State of the Existing System
4. Define Targets for the New System
Phase 1 – Initial Concepts & Investigation

• Idea Generation
  • Assemble an Automation Team
  • Internal Brainstorming – White board process
    • Material Flow Concepts
    • Product Handling Concepts
    • Review Available off the Shelf Technology
  • Capture Every Idea
    • Description, What it does? Why it helps?
    • What investigation is required?

• Investigations
  • First Order Analyses
  • Preliminary Simulation Investigations
  • Supplier Research and Meetings
  • Order of Magnitude Costing
Phase 1 - Initial Concepts & Investigation

- Idea Generation
  - Assemble an Automation Team
  - Internal Brainstorming – White board process
    - Material Flow Concepts
    - Product Handling Concepts
    - Review Available off the Shelf Technology
  - Capture Every Idea
    - Description, What it does? Why it helps?
    - What investigation is required?

- Investigations
  - First Order Analyses
  - Preliminary Simulation Investigations
  - Supplier Research and Meetings
  - Rough Order of Magnitude Costing
Phase 2 - Concept Development

- Simulate Manufacturing Concepts
- Analyze Relevant Manufacturing Scenarios
- Develop Functional Description
- Obtain Approval of Layout
Phase 3 - Functional Spec. & Cost Analysis

- Develop Functional Specification
- Develop System Layout Drawings
- Provide +/-10% Cost Estimates
Questions?

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