An Economic Overview of Automated Pallet Handling Systems (Part 1)

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Product Line Manager
An economic overview of automated pallet handling systems (Part 1)

In addition to the “technical” challenge of making the part…
Today’s manufacturing engineer must also reduce costs to compete globally…….
An economic overview of automated pallet handling systems (Part 1)

It is not just about manufacturing parts anymore - it is about how you run your business?
View manufacturing as a process - with its many elements:

- Time (and the value of money?)

Diagram:
- Part Drawing
- Part Specifications
- Customer Order
- Order Due Date
- Quality Requirement
- Direct & Indirect Labor
- Raw Material
- Inventory
- Tool & Fixture Development
- Investment
- Equipment
- Set-up Labor
- Fixtures
- Final Part
View manufacturing as a process - with its many elements:

Now the "real" question?

"did I make any money in this transaction?"
An economic overview of automated pallet handling systems (Part 1)

- Are there economic advantages associated with an automated pallet handling system?
- What are they & how do I quantify them?
  - Spindle Utilization – leading to Equipment Utilization and ultimately Capital Utilization
  - Lead-Time reduction (productivity)
  - Labor Content
    - Direct, Indirect & Burden
  - Flexibility
    - Product Life Cycle
    - Re-deployment
“Others”
- Impact of reduced capital & less machines
- Better quality
- Extended operation
- Control

Summary – An economic overview of automated pallet handling systems (Part 1)

Q&A at the end
- Type your questions into the box on the left and click “submit”
Historically, spindle utilization is on the rise:

- Manual machine = 10% to 15% utilization
- Manual tool change with CNC = 20% to 40% utilization
- ATC machines = 30% to 50% utilization
- ATC and APC = 40% to 80% utilization
  - Given the “right” application (i.e. dedicated product/high volume)
- Automated pallet handling = 95% and beyond!
An economic overview of automated pallet handling systems (Part 1)

Equipment utilization

- 40% Spindle in-cut Time
- 20% In-cycle, Non-cut Time
- 40% Machine Setup Non-cut Time

Based upon Industry Averages
An economic overview of automated pallet handling systems (Part 1)

Does an HMC offer some benefits?

HMCs not only address the “in-cycle” non-cut times – but, are better positioned to address the machine set-up non-cut time.

“attacking” the in-cycle, non-cut time

Reference: “Lower your costs by going horizontal” Webinar – June 11, 2009
An economic overview of automated pallet handling systems (Part 1)

Does an HMC offer some benefits?

Traditional Equipment Utilization:
- 40% Spindle In-Cut Time
- 40% Machine Setup Non-Cut Time
- 20% In-Cycle Non-Cut Time

Based upon industry averages
- ALL industries
- ALL types of equipment

What is all of that set-up, change-over and spindle non-cut time worth?
$217,800 \times 40\% = $87,120

Baseline Data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th>$217,800</th>
</tr>
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<tbody>
<tr>
<td>Hours/day</td>
<td>20.5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Days/Year</td>
<td>250</td>
<td></td>
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<tr>
<td>Efficiency</td>
<td>85%</td>
<td></td>
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</table>

Based upon $50 per hour

Reference: “Lower your costs by going horizontal” Webinar – June 11, 2009
• **Spindle utilization can be increased by:**
  – “Targeting” the In-cycle, Non-cut Time:
    • only 20% of total
    • can never be totally eliminated
    • already significantly reduced on Makino machines:
      – 1-Series (a51, a61, a71, etc.)
      – faster tool changes, spindle spool-up/down, rapids, acc/dec, etc.
  – “Targeting” the Machine Setup Non-cut Time:
    • 40% of total
    • can be totally eliminated!
    • greatest potential
An economic overview of automated pallet handling systems (Part 1)

- **What is “in” that 40% non-cutting time?:**
  - Part load / unload & repetitive handling
  - Part changer – over (i.e. fixtures, tooling, etc.)
  - Work flow (i.e. moving work, balance, etc.)
  - Shortages (i.e. labor, material, etc.)
  - Running economic order quantities (EOQ)
  - “First part” checks
  - Part mix
  - Uncertainty
  - Etc.
The Pitfalls of Sequential Part Processing

Dedicated Production - in the best case!

Perfectly balanced production

Input

Op #10 95% Uptime

Op #20 95% Uptime

Op #30 95% Uptime

Op #40 95% Uptime

Output

Overall Process Productivity = 81% (95% x 95% x 95% x 95%)
The Pitfalls of Sequential Part Processing

Dedicated Production - in the best case!

Perfectly balanced production

Input → Op #10 → Op #20 → Op #30 → Op #40 → Output

95% Uptime

Overall Process Productivity = 81% (95% × 95% × 95% × 95%)

Investment | Productivity
------------|-------------
$400,000    | $324,000    
$100,000 per machine
An economic overview of automated pallet handling systems (Part 1)

“Real World” Equipment & Process Production Capability

Input: Op #10 - 100% Asset Utilization

Op #10 -> Op #20 - 50% Asset Utilization

Op #20 -> Op #30 - 75% Asset Utilization

Op #30 -> Op #40 - 33% Asset Utilization

Output:

60 parts/hr 120 parts/hr 90 parts/hr 180 parts/hr

Average Machine Utilization = 65% \(\frac{100\% + 50\% + 75\% + 33\%}{4} = 64.5\%\)

Operating Efficiencies = 85% (what would your number be?)

Uptime of Overall Process = 81% \(\frac{95\% \times 95\% \times 95\% \times 95\%}{4} = 81\%\)

Capital Utilization = 65% \times 85\% \times 81\% = 44\%
An economic overview of automated pallet handling systems (Part 1)

“Real World” Equipment & Process Production Capability

<table>
<thead>
<tr>
<th>Input</th>
<th>Op #10</th>
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<th>Op #30</th>
<th>Op #40</th>
<th>Output</th>
</tr>
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<tbody>
<tr>
<td>60 parts/hr</td>
<td>120 parts/hr</td>
<td>90 parts/hr</td>
<td>180 parts/hr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100% Asset Utilization</td>
<td>50% Asset Utilization</td>
<td>75% Asset Utilization</td>
<td>33% Asset Utilization</td>
<td></td>
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</tr>
</tbody>
</table>

Average Machine Utilization = 65% \(\frac{(100\% + 50\% + 75\% + 33\%)}{4} = 64.5\%\)
Operating Efficiencies = 85% (what would your number be?)
Uptime of Overall Process = 81% \(\frac{(95\% \times 95\% \times 95\% \times 95\%)}{4} = 81\%\)
Capital Utilization = 65% \times 85\% \times 81\% = 44\%

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<th>Investment</th>
<th>Productivity</th>
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<tbody>
<tr>
<td>$400,000</td>
<td>$176,000</td>
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</table>

$100,000 per machine
An economic overview of automated pallet handling systems (Part 1)

Ultimate Manufacturing Problem

Equipment & Process Production Capability

60 parts/hr  120 parts/hr  90 parts/hr  180 parts/hr

Input → Op #10 → Op #20 → Op #30 → Op #40 → Output

100% Asset Utilization  50% Asset Utilization  Machine Down  33% Asset Utilization

100% Reduction in productive capacity - NO part output

Capital Utilization = 0%
An economic overview of automated pallet handling systems (Part 1)

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<th>Productivity</th>
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<tbody>
<tr>
<td>$400,000</td>
<td>$0</td>
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</tbody>
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$100,000 per machine

100% Reduction in productive capacity - NO part output
Capital Utilization = 0%
An economic overview of automated pallet handling systems (Part 1)
An economic overview of automated pallet handling systems (Part 1)

No Impact - one asset to another!

Op #10, #20, #30, & #40

Mach #1

Mach #2

Mach #3

Mach #4

MMC

Input
(Raw Material)

Output
(Finished Parts)
Average Machine Utilization = 100%  \((100\% + 100\% + 100\% + 100\%)/4 = 100\%\)

Operating Efficiencies = 85% (what would your number be?)

Uptime of Overall Process = 100%  \((100\% + 100\% + 100\% + 100\%)/4 = 100\%\)

Capital Utilization = 100\% \times 85\% \times 100\% = 85\%
An economic overview of automated pallet handling systems (Part 1)

No Impact - one asset to another!

<table>
<thead>
<tr>
<th>Mach #1</th>
<th>Mach #2</th>
<th>Mach #3</th>
<th>Mach #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Op #10, #20, #30, &amp; #40</td>
<td>Op #10, #20, #30, &amp; #40</td>
<td>Machine Down</td>
<td>Op #10, #20, #30, &amp; #40</td>
</tr>
</tbody>
</table>

Input (Raw Material)

Output (Finished Parts)
An economic overview of automated pallet handling systems (Part 1)

Average Machine Utilization = 75% \((100\% + 100\% + 0\% + 100\%)/4 = 75\%\)

Operating Efficiencies = 85\% (what would your number be?)

Uptime of Overall Process = 75\% \((100\% + 100\% + 0\% + 100\%)/4 = 75\%\)

Capital Utilization = 75\% \times 85\% \times 75\% = 48\%
Does this make sense (cents)?

• Conventional “wisdom”:
  – 4 machines
  – 44% Capital Utilization
  – 1.76 “effective machines”

• MMC your business:
  – 4 machines
  – 85% Capital Utilization
  – 3.4 “effective machines”
Lead-Time Is Money?!

Conventional “wisdom”:
Average Machine Utilization = 66% \( (100% + 50% + 75% + 33%)/4 = 64\%
Operating Efficiencies = 85\% \text{ (what would your number be?)}
Uptime of Overall Process = 81\% \( (95\% x 95\% x 95\% x 95\%)/4 = 81\%
Capital Utilization = 64\% x 85\% x 81\% = 44\%

The “wise way“ (MMC) to run your business:
Average Machine Utilization = 100\% \( (100% + 100% + 100% + 100%)/4 = 95\%
Operating Efficiencies = 85\% \text{ (what would your number be?)}
Uptime of Overall Process = 100\% \( (100% + 100% + 100% + 100%)/4 = 100\%
Capital Utilization = 100\% x 85\% x 100\% = 85\%
## Dare to Compare

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Makino MMC</th>
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<tbody>
<tr>
<td><strong>Machines Required</strong></td>
<td>4</td>
<td>4</td>
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<tr>
<td><strong>System Utilization</strong></td>
<td>44.0%</td>
<td>85.0%</td>
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<tr>
<td><strong>Hours per year</strong></td>
<td></td>
<td></td>
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<tr>
<td>1 shift</td>
<td>3,520</td>
<td>6,800</td>
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<tr>
<td>2 shift</td>
<td>7,040</td>
<td>13,600</td>
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<td>3 shift</td>
<td>10,560</td>
<td>20,400</td>
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<td><strong>Billings per year</strong></td>
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<tr>
<td>1 shift</td>
<td>$176,000</td>
<td>$340,000</td>
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<td>2 shift</td>
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<td>3 shift</td>
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<td><strong>$ 50 per hour</strong></td>
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<tr>
<td><strong>Capital:</strong></td>
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<tr>
<td>Invested</td>
<td>$400,000</td>
<td>$400,000</td>
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<tr>
<td>Recognized</td>
<td>$176,000</td>
<td>$324,000</td>
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<tr>
<td>DELTA $</td>
<td>$224,000</td>
<td>$76,000</td>
</tr>
<tr>
<td>DELTA %</td>
<td>56.0%</td>
<td>19.0%</td>
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</table>
Does it “pay”

• For a “given” production order:
  – MMC approach would:
    • deliver in half the time (52%)
    • and at a much lower cost per part!
      – Less inventories, WIP, labor content, high equipment utilization, etc.
  – delivery not a problem? (oh - really!):
    • MMC could deliver in the same time
    • with half of the investment in capital!
      – What impact would that have on price per part?
        » and your competitive position?
        » How about your competition?
Even in the worst case scenario

- Maintains production
  - Assures some level of part flow to your customer

- Increases capital utilization
  - Even with one (1) machine of four (4) stopped - the Makino MMC, parallel processing, flexible approach:
    - Maintains 75% of full production part flow….
    - Uptime of Overall Process is still 72%...
    - Capital Utilization is still 48%...
      - better than achieved with the four machine dedicated approach (44%) with all four machine making parts?

- Can you afford to “shut-down” one of your key customers?
Equipment Utilization – other factors:

- This means LESS machines,
- LESS capital investment,
- and also less:
  - Floor space & building
  - Power, energy requirements and associated costs
  - Maintenance of machines and related equipment
  - Reduced investment in tools, fixtures & up-keep
  - Lower overhead, direct labor content, office space, etc.
  - Shrink lead-time, “carrying” costs, expenses, etc.
Direct & Indirect Labor Content:

- Burden or Indirect Labor: 40%
- Raw Material Costs: 50%
- Direct Labor: 10%

Traditional Product Cost
Direct & Indirect Labor Content:

• 50% of traditional product cost is in material.
  – Speaks to “up-front” design for “manufacturability”
• Direct Labor @ 10% of traditional product cost:
  – limited impact on total product cost even if eliminated
    • reduce or eliminate “repetitive” direct content:
      – fixture and tooling setup
      – searching for programs, information, etc.
• Focus on reducing and/or eliminating Burden or Indirect Labor (40%)
Direct & Indirect Labor Content:

- Focus on reducing and/or eliminating Burden or Indirect Labor:
  - raw material inventory
  - work in process (WIP)
  - part handling, staging, movement, counting, tracking, expediting, storage, “sorting”, etc.
  - running “economic order quantities” (EOQ)
  - tooling and fixture set-up, “first-part” production, etc.
  - redundant inspection processes
  - finished goods inventories
  - supervision, etc.
Direct & Indirect Labor Content:

Cost Added 95% of Time

Value Added 5% of Time

Typical Part Flow Time

Non-value time (in your plant) adds cost (and delays) to the product!?
An economic overview of automated pallet handling systems (Part 1)

Does an HMC offer some benefits?

HMC provides more access to the part
- Index Table provides access to the face and both sides of the part:
  - Single set-up
  - Less handling
  - Tighter tolerance capability
  - Better quality

Does an HMC offer some benefits?

Reduced non-cutting time = reduced cost

Reference: “Lower your costs by going horizontal” Webinar – June 11, 2009
Start – a – part - finish a part processing
Done – in – one part processing

Reference: “Lower your costs by going horizontal” Webinar – June 11, 2009
An economic overview of automated pallet handling systems (Part 1)

• Focus on “done–in–one–processing”:
  – Flexibility in mix and volume
    • EOQ of “one”
    • Manufacture in “ship – sets”
  – Eliminate repetitive steps:
    • Tooling, fixture set-ups & change-over
    • “First run” checks
    • Minimize part handling – consolidate operations
  – Reduce, eliminate material inventories and queue
    • Raw material, WIP & finished goods
  – Results
    • Cut lead-time, reduce costs, increase quality, maximize equipment utilization, enhance productivity, minimize investment, etc.
How would your competition view you - if you had…

- Cut your lead-time in half…
- Significantly reduced inventories…
  - doubled (or tripled) turns
- Reduced capital investment…
  - and associated “carrying” costs
- Increased equipment utilization...
- Slashed manufacturing costs…
- Minimized direct & indirect labor…
- Eliminated part setup time…
- Ultimate flexibility…
  - EOQ of one part
- Improved quality…
- “Done-in-one” part processing…
But - there are more benefits…

- Flexibility for Product Life Cycle:
  - Product Development:
    - R & D, prototype production
    - reduced “risks” & cost of pre-production runs
    - design change, management, and implementation
  - Product Introduction, Growth, Maturity, and Decline
    - Unpredictable market demand
      - introduction & early growth
      - market acceptance & steady growth
      - product maturity, design proliferation, and steady volume
      - product decline
      - service & maintenance requirements
It grows - when you need it....

MMC provides a flexible approach - for agile parts production
Add capacity (and investment) in increments as the market requirement grow
Risk is reduced

What is this flexibility (and risk avoidance) worth?
As one product(s) matures and volumes decline, new product(s) can be developed, prototyped, and introduced - while service & maintenance requirements of the original product(s) are also produced - on the same equipment (investment).
And because you can - it changes the economics.

- **“Traditional”:**
  - typically “short term”
    - funding based upon a per project basis
    - finite capacity for economic return
    - defined years for return
    - virtually no redeployment
    - very limited salvage value

- **MMC Approach:**
  - typically “long term”
    - funded based upon a commitment to production
    - capacity for economic return is the life of the equipment
    - undefined years for return
    - virtually always redeployed for further part production
    - market salvage value
Not to mention the ‘other” impacts on your business…

• **Less machines:**
  – Less investment
  – Reduced floor space and associated costs
    • insurance, upkeep, maintenance, “carrying costs”, etc.
  – Less electrical power, lighting, air, etc.
  – Less equipment maintenance, upkeep, etc.
    • Less money in fixtures, tooling, etc.
  – Less direct & indirect labor and associated expenses
  – Reduced overhead…
Not to mention the “other” impacts on your business…

- **Better quality:**
  - “done-in-one”
    - Consolidation of operation
    - Shorter “process train”
    - Completed on a single fixture & machine
  - eliminate setup
    - Associated tooling & fixture errors
  - predictable, traceable
  - reliable
  - proven
Consider extending the hours of operation and the impact of unattended operations:

\[
\begin{align*}
\text{Investment} & = \$ X \text{ per hour} \\
\text{2,000 hours/year} \\
50\% \text{ (Investment) } & = \$ X \text{ per hour} \\
\text{4,000 hours/year} \\
\text{33}\% \text{ (Investment) } & = \$ X \text{ per hour} \\
\text{6,000 hours/year}
\end{align*}
\]

Many manufacturers do not utilize multiple shift operation….
And more control and timely management information

- Machine, tool, and fixture management
- Program - and change management
- Manage production scheduling requirements
- Single Point, efficient operation:
  - multiple machines, multiple production orders, multiple product(s), tool management, preventative maintenance requirements, etc.
- System monitoring
- Tracking and historical reporting
  - trending and analysis
It really is about how you run your business!

- Consider these business elements:
  - Investment
  - Equipment Utilization
  - Direct & Indirect Labor
  - Lead-time
  - Inventory
  - Flexibility
  - Floor space
  - Quality
  - Ease of operation
  - Management information

Making it ALL work together…
Not convinced? - Consider the balance sheet (relative to inventory and capital equipment)
Inventory versus Capital Equipment (both are assets on the balance sheet)

**Inventory:**
- absorbs (ties-up) capital
  - interest expense and opportunity costs
- subject to tax:
  - as much as 30%
- must be “warehoused”
- becomes obsolete
- potential for loss:
  - fire
  - theft
- very low ROI (if any)

**Capital Equipment:**
- justified based upon ROI
  - 3 year ROI = 33% annual
- generates revenue
- may be subject to investment tax incentives
- increases competitive position:
  - reduced lead-times
    - shrink inventories
  - minimize labor
  - improve quality
  - reduce floor space
  - maximize productivity
Inventory versus Capital Equipment  
(both are assets on the balance sheet)

• Inventory is an asset that increases expenses:
  – “carrying” costs
    • cost of money
    • cost to “count” & manage
    • cost of space
  – Insurance
    • fire, theft, loss, etc.
  – obsolescence
    • loss of value (capital)
  – taxes
  – opportunity cost

• Capital Equipment is an asset that decreases expenses and generates revenue:
  – virtually all capital equipment is “paid” for through return on investment:
    • 3 year ROI would generate 33% of the investment per year - thus eliminating the debt in three years.
Strike the “right” balance (Inventory versus Capital Equipment)

- For every $ shifted from inventory to capital equipment - avoid 30% in expenses:
  - taxes, interest, warehousing, insurance, obsolescence, etc.

- For every $ invested in capital equipment - return 33% (ROI) - and:
  - reduce expenses
  - increase productivity
  - improve competitiveness
Reallocation of your assets - could be the key to putting your business over the top!

Changing the balance of inventory to capital equipment

- Inventory Expense avoidance = 30%
- ROI on Investment = 33%

--------
63%

The bulk of the investment dollars required to revolutionize your manufacturing operations may already be in your financial plan!
How would these kind of results impact your business (and your competition)?

- “Moved to “just-in-time” delivery”
  - Eliminated 6 months to a year of inventory
  - Significantly slashed inventory costs
- Reduced Lead-time
  - “Raw material to finished product in half the time”
- “Routinely run 21 to 24 hours per day”
- “Doubled production output”
  - With less labor input
- “Have virtually eliminated setups”
  - “We can provide “value pricing” to our customer
  - eliminated changeover and setup
  - “First part = good part”
How would these kind of results impact your business (and your competition)?

- “Realized a 30% reduction in cycle time”
- “Scrap rates are down 19%”
- “Manufacturing lead-time has been cut in half”
- “Greater responsiveness to the market”
- “Flexibility”
  - quickly respond to part changes
  - rapid introduction to market
  - minimal impact due to repair part, product mix, & volume issues
  - minimize costs
- “Production lead-time went from weeks to just hours”
In Summary:

- Are there economic advantages associated with an automated pallet handling system?
- What are they & how do I quantify them?
  - Spindle Utilization – leading to Equipment Utilization and ultimately Capital Utilization
  - Lead-Time reduction (productivity)
  - Labor Content
    - Direct, Indirect & Burden
  - Flexibility
    - Product Life Cycle
    - Re-deployment
In Summary:

– “Others”
  • Impact of reduced capital & less machines
  • Better quality
  • Extended operation
  • Control

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Questions & Answers