Take Back Manufacturing

Shop Floor to Top Floor Automation
Improving Productivity

May 24, 2012
Connected Manufacturing Evolution

“Following the computer and the Internet, every machine tool will become a node on the network creating greater efficiency.”

The technology is here today, the tools are readily available and cost effective.
Business Challenges

• Rising Business Costs – Reducing Operating Costs
  – #1 strategic challenge
• Asset Utilization maximized
• Improving Processes
• Improving Labor Productivity
• Real-time status of production
• Data collection accuracy
• Flexibility of production is critical
• Key Performance Indicators – OEE
  – Overall Equipment Effectiveness, Benchmark
Value Proposition

OEE + DNC

- Integrated Machine Monitoring & Control
  - Operator’s can manage the machine bed more efficiently
- Real-time machine visibility with OEE metrics on any Machine
  - Dashboard for ease of viewing – reduce downtime
  - Minimize rejects – root cause analysis
- Connect production floor to any ERP system on actual schedule
  - Data Highway
- DNC software tools to manage program code, including dynamically
  - Minimize Changeover
- Increase Productivity
  - Embrace Lean Manufacturing
About the OEE Industry Standard

The OEE Industry Standard aims to give guidelines how to define OEE in order to find ALL potential losses in effectiveness.

Why?

An average machine in an average factory runs about 35 to 45% OEE. So it is losing 55 to 65% capacity(!) while;

› not running,
› running at a reduced speed,
› or producing products out of spec.

How come than, that the average management reports numbers way over 80%?

It is all a matter of **definition**. What you are not looking for, you will not find.
To really reveal the hidden machines in our factories, ALL losses need to be defined and visualized.
Imagine

Productivity Increases of 10-50% 

- Reduce Unplanned Downtime
- Reduce Setup and Changeover Times
- Better Management of Resource Allocation, Planning and Scheduling
- Operator Productivity Increases
- Efficiency with Automated Data Collection
- Better Root Cause Analysis
- Improve Quality, Minimize Rejects
- Identify Bottlenecks and Constraints
- Improve On-Time Delivery
- Manage Operations Pre-emptively & Proactively (instead of Reactively) by Real-time visibility
- Measurably Improve Profitability
Customer Successes

Productivity Increases:

- Auto industry focused, went to Alberta, better products now 90% oil
- Precision machining company realized a 25% savings on plant
- Aerospace company realized 11% efficiency improvements in first 3 mo.
- 5% increase in productivity on 20 machines is equal to an extra machine.
- 32% faster using Memex products
- We save 3 hours per week per machining center. With 13 machining centers we save 2,000 hrs per year, representing over $200,000 per year.
- OEE went from 30% to now on average in the 60% range
- Large equipment manufacturer went from 24% to 62% OEE on machines
- Specialty Machining group went from 25% to 60% OEE
- Enterprise aerospace company saw a 25% overall improvement
- By fine tuning setup process went from 410 parts/week to 690, a 68% gain
- Furniture manufacturer 25% improvement, no overtime more production
Value Proposition

• Production improvements in the 10% - 50% range*
  – Financial Profit - EBITDA;
    ➢ 10% Operational improvement
    ➢ 20-60% Profit improvement
    ➢ Sales @ current & full capacity
  – Breakeven ROI in < 3 months

• Real-time machine visibility + OEE numbers
  ➢ including alerts: 2 - 5%

• Operator Productivity increases: 1 - 10%
• Reduce Downtime: 3 - 8%
• Minimize Rejects: 2 - 4%
• Root Cause analysis: 2 - 4%
• Value stream data collection & analysis: 2 - 4%
• Labor productivity tracking: 3 - 6%
• Usage-based Preventive Maintenance: 1 - 2%
• Benchmark scheduling & value streaming: 2 - 6%

* Based on customer survey
Manufacturing Efficiency

Lean 6S, OEE, TEEP, TPM, Takt Time, TQM, Kaizen, Continuous Improvement

All methodologies require data to support decision making

Collect actual automated machine data to prove the case

- Real-time machine visibility with OEE metrics on any Machine
  - Dashboard for ease of viewing – reduce downtime

- Connect production floor to any ERP system
  - Shop Floor to Top Floor

- Increase Productivity
  - Embrace Manufacturing Efficiency
If you can **Measure** it – then you can **Manage** it

- **Identify Constraints**
  - Production Counts
  - Scrap & Reject Counts
  - Run/Cycle Times
  - By Shift, work order, product

- **Improve Throughput**
  - Hidden capacity
    - accurate start/end times
    - uptime analysis - cutting/idle
    - breakdown analysis
  - Quality improvements

- **Increase Profitability**
  - Focus on bottleneck throughput
  - Accurate data allows for improved employee decisions

TOC = Theory Of Constraints
Memex Supports Lean Principles

Challenge: D.L. and O.H. Absorption Costing
OEE Enabled: Accurate Value Stream cost rollups give more accurate picture of what things and activities actually cost

Challenge: Achieving OEE metrics on a consistent basis
OEE Enabled: Automated Data Collection with Universal Machine Interface

Challenge: Manual, expensive inventory Tracking / Shop Floor Control
OEE Enabled: Automated Data Collection enable much easier, meaningful material/shop floor tracking

Challenge: MRPII report / expedite driven—sound familiar?
OEE Enabled: Simple and Visual Signals for work, advance warning to problems, shortages

Challenge: Quality managed by external Inspection Points
OEE Enabled: Quality designed into consistent processes, checked by lean software

Challenge: Push MRP Planning Cycles, Queues
OEE Enabled: Daily demand planning (TAKT Times, Flexible, Throughput-based)
• Make visible specific machine status for everyone
• Slideshow feature allows for any information screen to be displayed automatically on shop floor displays
a Window on your Shop
Shop Floor to Top Floor Information … in Real-Time

Let’s Take a Look …

It’s here now!
Lean - Efficiencies - OEE

Visibility – Real-Time Status of Production – Dashboard

![Dashboard Image]

Machine ID | OEE | Availability | Quality | Performance | Group
--- | --- | --- | --- | --- | ---
110: Olympia Vert Mil | 73.11 | 73.11 | 100 | 110 | Mill
111: Auto Chop Saw | 74.67 | 74.67 | 100 | 110 | Saw
112: Gun Drill 2 | 77.92 | 77.92 | 100 | 110 | Drill
113: Gun Drill 3 | 64.99 | 64.99 | 100 | 84.33 | Drill
114: Tacchi Lathe 1 | 65.02 | 65.02 | 100 | 84.27 | Lathe
115: Tacchi Lathe 2 | 64.97 | 64.97 | 100 | 77.34 | Lathe
116: Tacchi Lathe 3 | 64.98 | 64.98 | 100 | 85.07 | Lathe
117: Mori Seiki 65V | 71.4 | 71.4 | 100 | 110 | Lathe
118: Press 1 | 65.37 | 65.37 | 100 | 76.51 | Punch Press
119: Press 2 | 64.74 | 64.74 | 100 | 99.6 | Punch Press
120: Press 3 | 65.41 | 65.41 | 100 | 76.74 | Punch Press
121: Press 4 | 65.01 | 65.01 | 100 | 76.61 | Injection MM
122: Husky IMM 1 | 65.01 | 65.01 | 100 | 85.01 | Injection MM
123: Husky IMM 2 | 65.37 | 65.37 | 100 | 85.01 | Injection MM
124: Husky IMM 3 | 73.67 | 73.67 | 100 | 78.29 | Injection MM
125: Doosan Mil 99 | 64.75 | 64.75 | 100 | 99.6 | Mill
126: Doosan Mil 100 | 65.01 | 65.01 | 100 | 83.82 | Mill
127: Cincinnati Gantry | 65.01 | 65.01 | 100 | 76.61 | Mill
128: Cincinnati Gantry | 65.01 | 65.01 | 100 | 85.01 | Mill
129: Vertical Mill | 80.22 | 80.22 | 100 | 90.62 | Mill
Automated Data Collection

“Traditional Approach”

Disadvantages:
1. Information not real time
2. Information subject to operator interpretation
3. Prone to Data entry errors
4. Prone to incomplete data input

ERP, MES, Dashboard
(Data consumer)

Reactive information generating lagging metrics

“Operator Centric”
Data collection depends on operator action.

Manufacturing Connectivity Solutions™
Automated Data Collection

“Automated Approach”

AxHistorian SQL Database

Open database

Real-Time Data

Proactive Alerts

Two-way, Bi-synchronous

“Machine Centric”
Donate directly to the machine,
Automated data collection in real-time

Universal Machine Interface Ax9150
(Data Producer)

“Traditional Approach”

ERP, MES, Dashboard
(Data consumer)

Reactive information generating lagging metrics

“Operator Centric”
Data collection depends on operator action.

Manufacturing Connectivity Solutions™
Advantages of the “Automated Approach”

- Automated data collection from machine
- Accurate and objective information
- Not reliant on operator
- Down Time Log - detailed to the second reporting all down time with reason codes
- Historical data for analysis
- Visibility of machine performance in real-time
- Proactive alerts rather than reactive
- Leading OEE Metrics, automatically
- Minimize “Cultural Impact” on operations
- 20% of cost of PLC based solutions
- No need for barcode scanning (optional)
- Connect to any machine
- Supports OPC standards
- Supports MTConnect standards
- Event monitoring
- Send job/shift completion results automatically back to ERP/MES
- Complement and add value to your application
Reporting

Comprehensive & Historical Analysis

Daily Operations OEE Report
Excluding NoShift WOs

<table>
<thead>
<tr>
<th>Machine</th>
<th>Date</th>
<th>Shift</th>
<th>Work Order</th>
<th>Sub WO</th>
<th>Overall Eff%</th>
<th>Total Hours</th>
<th>Run Hours</th>
<th>Down Hours</th>
<th>Util %</th>
<th>Mach Shift Parts</th>
<th>Shift Rejects</th>
<th>Yield %</th>
<th>Std Cycle Hour</th>
<th>Std Units Hour</th>
<th>Shift Hours</th>
<th>Rate Eff%</th>
</tr>
</thead>
<tbody>
<tr>
<td>89/5MAC10</td>
<td>6/10</td>
<td>1/1st</td>
<td>MemexDie1</td>
<td>10MIN - 75 Util - 75 Util - 75 Util - 75 Util - 75 Util</td>
<td>416.7</td>
<td>0.06</td>
<td>0.04</td>
<td>0.02</td>
<td>66.7</td>
<td>1</td>
<td></td>
<td>100.0</td>
<td>2.67</td>
<td>2.67</td>
<td>16.67</td>
<td>625.0</td>
</tr>
</tbody>
</table>

OEE Summary

Pareto Down time
• Taps into points on the machine not easily discerned to create a valid measurement.
• Electrical Signal Conditioning utility with both hardware and software parameters and timing.
• Unlimited Ladder logic for flexibility.

AxConfig

• Utility Tool
• Signals
• Logic Ladder

In Alarm mode, all green text is “active” or “true” in state.
All normal text is “inactive” or “false” in state.
Proposed Solution

Complete Productivity Solution
- Hardware - Ax9150
- Software - AxOEE

Visibility –> Real-Time Status of Production Enables Proactive Control

Universal Machine Interface
Shop Floor Router in each machine feeds the OEE Software Server
Ax9150 UMI Features:

- Local CNC Flash Memory
- Supports all makes + models of machines
- Powered by machine (12-24V)
- Magnetic mount for easy installation
- 8 - 24 Inputs + 4 Digital Outputs
- Integrated OEE + DNC for robust monitor & control
- Provides access to work orders loaded from any ERP
- Alerts to your email, PDA or Phone
- Onboard DNC option & extensive firmware
- Embedded OEE (Overall Equipment Effectiveness)
- Ethernet connectivity and wireless option
- OPC capable connections
- Machine Monitoring & Adaptive Control

Ax9150 UMI OEE+DNC Benefits

- Overall Equipment Effectiveness metrics (OEE)
- “File Messaging System” (FMS) enables flexibility
- Reliable — Up to 2 GB of Non-volatile flash storage
- Preserves all Machine Monitoring data on the Ax9150 UMI in the event of a network failure.
- Machine Monitoring — real time cycle status right out of the box
- Capability to capture data for shop floor measurement systems (MES, PDM, ERP, etc)
- Additional serial port for peripherals such as hand held terminal, gauges, RFID or a barcode reader (dependent on configuration).
- 100BaseT Ethernet port + Wireless option
- Adaptive Control capability (let the system work for you — help automate your automation)
- Bar Code support available
- Operates independent of the corporate network.
- Visibility to DNC process — see the file when dripfeeding
- Onboard DNC functionality (get, put and dripfeed locally)
- Modify Code on the fly with DNC software
- Bulletproof DNC - even if the network totally collapses.
Ax650 MCI & Ax750 I/O Link Boards

Ax750 I/O Link - Fanuc Interface Board
For any Fanuc CPU Controller with serial I/O Link
(16, 18; M or T or any I series; 16i, 18i, 21i, 31i, etc.)
• Designed to passively monitor any Fanuc Serial I/O bus
• A natural complement to Memex Ax9150 UMI for OEE+DNC
• Fits to any Fanuc controller with a serial I/O link

Ax650 Machine Control Interface Board
• I/O Link for any Controller for NC/CNC Machine Tools
• A quick and easy way to find and monitor signals of a machine
• Monitor any signal from the machine non-intrusively
• Designed to passively monitor any Controller’s I/O

Interface Boards
• Dramatically reduce installation time.
• Simplify connectivity of many controls
• Active, non-intrusive data collection
**Interface Boards**
- Dramatically reduce installation time.
- Simplify connectivity of many controls
- Active, non-intrusive data collection

**Ax750 I/O Link - Fanuc Interface Board**
For any Fanuc CPU Controller with serial I/O Link
- Designed to passively monitor any Fanuc Serial I/O bus
- A natural complement to Memex Ax9150 UMI for OEE+DNC
- Fits to any Fanuc controller with a serial I/O link

**Ax650 Machine Control Interface Board**
- I/O Link for any Controller for NC/CNC Machine Tools
- A quick and easy way to find and monitor signals of a machine
- Monitor any signal from the machine non-intrusively
- Designed to passively monitor any Controller’s I/O
Customer Installations

Machine Description

Makino Pro 5 PC Based Control (Fanuc 310i – AO5) with an Ax750 I/O Link & Ax9150 UMI
Customer Installations

Machine Description

Toshiba VBM - Tosnuc 888 Control with an Ax9150 UMI & Ax650
Machine Description

Homag Edge Bander Machine with an Ax9150 UMI & Mx2000 HMI
Machine Description

Fanuc 21i – tt (Mori-Seiki lathe)
With an Ax9150 UMI & Mx2000 HMI & 2 - Ax750 I/O Link boards
Customer Installations

Machine Description
Fanuc 18t Control on a O-M VBM
With an Ax750 I/O Link & Ax9150 UMI & Mx2000 HMI
Customer Installations

Machine Description

WNT 2000 Panel Saw with an Ax9150 UMI & Mx2000 HMI
Machine Description

Fanuc 18i – M with JD1A or JD1B with an Ax9150 UMI & Ax750 I/O Link
Machine Description

Matsurra 640M Milling Machine with an Ax9150 UMI & Mx2000 HMI
Customer Installations

Machine Description

Okuma LB25 with OSP-7000L Control
Ax9150 UMI & Mx2000 HMI, ~ 1 hour install
Customer Installations

Machine Description

Okuma LB400 with OSP-U100L Control
Ax9150 UMI & Mx2000 HMI, ~ 1 hour install
Customer Installations

Machine Description

Lewis 200T Rubber Injection Press
Ax9150 UMI, Mx2000 HMI & Bar Code Reader
Customer Installations

Operator Interface (HMI)
Customer Deployment

The Memex Productivity Solution an integral part of Vermeer’s aggressive productivity enhancements
Tablet Deployment

Tablets can be very useful in a mobile dynamic environment.
Shop Floor to Top Floor

- Mx2000 HMI
  - Hand held

- AxOEE Server

- Ax9150 Universal Machine Interface

- Any Machine Tool

- ERP, EAM, CMMS

- Barcode Printer

- Barcode Scanners

- Light Stack

- External Supported Peripherals

- Workstations running the OEE Dashboard client

The Ax9150 can control Scanners, Light Stacks, Robotic or Pallet Loader
New Shop Floor Designer

Real time shop floor visibility
Asset Tracking

Active Hand Held Reader

Passive RFID Portals

Active Locator

Listener- AP

Active RFID Asset Tags

Passive Hand Held Reader
Once a Lift truck is installed with an asset tag and locator, it will be visible at any time in the system.
Track materials

- With an Active RFID tag attached to each bin or pallet, they become visible to the system.
- Materials are associated with the tagged bin/pallet and therefore their location is tracked.
Operator Panel (HMI)
Productivity Increases

- Improve *manufacturing productivity* with real-time monitoring of production.
- Minimize *unproductive labor* with automated data collection and reporting.
- Improve *inventory accuracy*
- Give *accurate delivery dates* with visual production scheduling and job tracking.
- *Identify problems fast*, before production or quality suffers, with real-time displays.
- Link shop floor to any ERP - business system two-way link, to improve *accuracy* of information.
- Real-time Machine Detail lets you *zero in on problems*.

OEE = % Performance x % Availability x % Quality
Productivity Increases

- Real-time monitoring of every production machine *prevents problems* from occurring.
- *Eliminate manual* data entry.
- Schedule and *track job progress* at individual machine level...in real-time.
- OEE Software is scalable and *cost-effective* you install only the capability you need.
- OEE Software is *practical* because it was designed by and for manufacturing users.
- Connect to *any machine* on the shop floor.
- Real-time *display screens* Data Tables as you run your business – your own KPI or OEE.
OEE Benefits

Productivity Increases

- Determine real Job Standards to help *improve your Job costing*.
- *Analyze causes* for Downtime and Rejects then eliminate them.
- *Preventive Maintenance* scheduling based on real run time and cycle count data, rather than calendar.
- *Visual*, “drag and drop” production scheduling and Job tracking based on actual shop floor conditions.
- *Machine operating history* in detail with a “paperless” Strip Chart.
- Shift scheduling the way you run your plant.
- Monitor production schedule *remotely* or in multiple locations.
- Real-time Process Variable *monitoring* prevents problems and can control complex machines with programmed logic.
- Analyze operator and maintenance *staff performance*.
Articles written about Memex

"Aerospace Components Maker Rejects Low Productivity"
"Shop Floor to Top Floor Automation in Real-Time"
"Tracking Machine Utilization the Memex Way"
"Improving Overall Equipment Effectiveness With Lean and Value-Stream Mapping"
"Real-time Shop Floor Data Increasing Important as Manufacturing Returns to Growth"
"Automate Your Automation"
"Internetworking The Factory Floor"
"Measuring the Effectiveness Of Your Mold Machining Operations"
"The Advantages of Migrating from Serial to Ethernet Communications on the Shop Floor"
"MTConnect Forming Working Group on Best Practices"
"CTMA Tour Memex Customer with OEE + DNC"
"Real-Time Performance drives Food Manufacturing Efficiency"
"Memex Automation Typically Delivers Twenty Percent Increased Plant Floor Efficiency"
"Memex Universal File Server Improves CNC Machine Tool Productivity Intro"
"Overall Equipment Effectiveness in Food Production"
"Technology helps Canadian aerospace firm cruise to success"
"Automation Software In Real-Time Improves Manufacturing Productivity"
"Executives Sustain Manufacturing by Reducing Labor Costs"
"Memex Mission Is to Save Manufacturing by Increasing Efficiency Typically 5 to 20%"
Summary

✓ Real-time machine monitoring (OEE + DNC):
  ✓ Cost-effective, Fast ROI
  ✓ Practical (automated + standardized)
  ✓ Proven System means minimum risk
  ✓ Enterprise Scalable

✓ Enables Lean Manufacturing

✓ Leverages existing infrastructure

✓ Enhances Competitiveness

Next Step?

Proof of Concept
The First Step

60 days of improved Efficiency
Why you should ACT NOW

• More value than buying a new machine.
  – By measuring RPM – Real-time Performance Management
• Increase capacity 10+%, saves machines, space, labor & more.
  – Increase profitability 60+% 
• Competitive advantage, retain and capture more customers 
  – Validation, traceability, efficiency, accurate data, lower costs.
• Visibility for everyone means better performance 
  – Culture of efficiency means extend job security
• For every day you wait – it is money not recovered = lost.

RPM + Financial OEE = WIN – WIN – WIN
Win ➔ Lower customer prices
Win ➔ Increase company profits
Win ➔ Extend Job security
Thank You

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A Proven Solution

Customer Testimonials
# OEE Return On Investment

## OEE ROI Calculator

**GENERAL INFORMATION:**
- Days / Week plant is in operation: 7
- # of Shifts / Day worked: 3
- # of Hrs / Shift worked: 8
- # of Machines in enterprise connected to Memex: 40
- Estimated # of Operators on the Shop Floor for # of machines being Monitored: 40
- Estimated True Cost per Hr (Operator, Overhead, and Machine amortization, in Dollars): $145.00
- Estimated Hourly Labour cost per Operator (Burdened in): $40.00
- Estimated Gross Profit per Part Made (in Dollars): $5.00
- Estimated Annual Gross Revenue (in Dollars): $60,000,000.00
- Estimated Annual Expenses (in Dollars): $54,000,000.00

**AVAILABILITY or UTILIZATION:**
- Number of coffee Breaks / Shift - NOT INCLUDED IN OEE CALCULATIONS: 2
- Duration of coffee Breaks (Minutes) - NOT INCLUDED IN OEE CALCULATIONS: 15
- Duration of Lunch Breaks (Minutes / Shift) NOT INCLUDED IN OEE CALCULATIONS: 30
- Estimate of Unplanned Downtime per shift (Minutes / Shift, per Machine): 20
- Estimate of Avg Setup Time / Job (Included in OEE Calculation): 0
- Estimate of # of Jobs per shift, per machine: 1

**QUALITY:**
- Estimate # of Good parts made per Shift (Average Shift in any week): 200
- Estimate # of Total parts made per Shift (Average Shift in any week): 210
- PERFORMANCE or AVERAGE STANDARD RATE: 81.5%
- Estimate of Max. Output of parts / shift (@100%, No Downtime Accounted for) - Average: 240
- Estimate of Actual Output of Parts / Shift - Average: 210

**CALCULATED OEE % (Availability X Quality X Performance):** 79.6%

**Typical improvement Areas - across the enterprise (Based on Actual Memex Deployments and relevant customer feedback):**
- Shop Floor Visibility - Via email alerts and enterprise
- Operator Productivity Increases - Managed Time and Equipment
- Reduction of Downtime - Adoption of Lean
- Minimize Rejects - Root Cause Analysis - Thresholds
- Labor Productivity Tracking (By product / Operator / Shift, etc)
- Usage based Preventative Maintenance - Action(s)
- Reduction in Setup time - Can measure consumed vs. allotted, React quickly to offline conditions

**Estimated % increase Expected**

<table>
<thead>
<tr>
<th>SMALL</th>
<th>MEDIUM</th>
<th>LARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00%</td>
<td>1.00%</td>
<td>1.00%</td>
</tr>
<tr>
<td>0.50%</td>
<td>0.50%</td>
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<td>0.00%</td>
</tr>
<tr>
<td>2.00%</td>
<td>2.00%</td>
<td>0.50%</td>
</tr>
</tbody>
</table>

**Totals**

<table>
<thead>
<tr>
<th>Utilization</th>
<th>Performance</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>79.6%</td>
<td>83.5%</td>
<td>4.0%</td>
</tr>
</tbody>
</table>

**SMALL OEE INCREASE** $1,319,864

**Expected Efficiency Improvement**

## Assumptions

<table>
<thead>
<tr>
<th>Columns</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units ----&gt; New # of Parts / Shift</td>
<td>Increase in Parts Produced / Shift</td>
</tr>
<tr>
<td>Estimated # of Total parts made per Shift (Average Shift in any week)</td>
<td>201.1</td>
</tr>
<tr>
<td>Estimated # of Good parts made per Shift (Average Shift in any week)</td>
<td>201</td>
</tr>
<tr>
<td>Estimate of # of Jobs per shift, per machine</td>
<td>1</td>
</tr>
</tbody>
</table>

**ROI is Based on a Small Incremental change in Enterprise Wide OEE**

<table>
<thead>
<tr>
<th>Proposed New Calculated Values</th>
<th>Delta / Shift / Machine</th>
<th>Delta - Totals / Year / All Machines</th>
<th>Cost Savings on an Annual Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Current Values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Annual Gross Revenue (in Dollars)</td>
<td>$60,000,000.00</td>
<td>$54,000,000.00</td>
<td>$6,000,000</td>
</tr>
<tr>
<td>Estimated Annual Expenses (in Dollars)</td>
<td>$54,000,000.00</td>
<td>$48,000,000.00</td>
<td>$6,000,000</td>
</tr>
</tbody>
</table>

**Instructions:** To model and calculate your specific unique ROI value equation utilizing Memex's leading edge UMI based, OEE centered Technology, simply key in the areas colored in **Purple** (Column A) with the data requested. For a quick view of the associated benefits expected, either click on the "SMALL", "MEDIUM", or "LARGE" buttons located at top right (Cell A1), or located in cell A28 to preload the **Blue** Area (Column A) with (3) typical pre-defined incremental OEE Improvement datasets. If you wish to model your own dataset, simply key the data into the **Blue** area. The % resultant changes will be shown in **Green** and **Red**. In Column H, The Associated Cost reduction benefits in Dollars are shown in **Green** in Column J. Total Savings are shown in Cell B46, along with # of Weeks to full payback, in Cell B47. If Gross revenue and expense numbers were provided, true OEE adoption benefits can be seen in Cells B/C 41 to 43 in Dollars and Percentages.

**Total Savings Based on Small Increase** $1,319,864

**Profitability Increase**

<table>
<thead>
<tr>
<th>New Available Capacity, Equated to Dollars</th>
<th>Dollars / Percentage - (Based on Full Utilization of hidden Capacity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Annual Gross Revenue (in Dollars)</td>
<td>$60,000,000.00</td>
</tr>
<tr>
<td>Estimated Annual Expenses (in Dollars)</td>
<td>$54,000,000.00</td>
</tr>
<tr>
<td>Decrease in Total operating Expenses Due to savings attributed to OEE improvement</td>
<td>$42,224</td>
</tr>
<tr>
<td>Increase in Gross Revenue (Based on increased capacity attributed to OEE improvement)</td>
<td>$1,745,834</td>
</tr>
<tr>
<td>Increase in EBITDA Profit Due to Increased Revenue and Decreased Expenses</td>
<td>$1,788,058</td>
</tr>
<tr>
<td>Cost of a Memex System - Installed per Machine - Average</td>
<td>$5,995</td>
</tr>
<tr>
<td>Total cost of Deployment (Based on # of Machines)</td>
<td>$239,800</td>
</tr>
<tr>
<td>Savings attributed to OEE centered Continuous Improvement</td>
<td>$1,319,864</td>
</tr>
<tr>
<td># of Weeks till return of entire Investment in memex Te is achieved</td>
<td>9.4</td>
</tr>
</tbody>
</table>
Our Background...

- 1992 Co-Developed Bubble Memory Replacement for Fanuc 6/9/11/12
- 1993 Created Fanuc 0 & 10 CMOS Memory Upgrades
- 1994 Created the first High Speed Loader for Fanuc 6
- 1995 First Released the popular Mx1000 BTR
- 1996 Enabled a Network connection to Fanuc 6/11 – Invested in Spectrum
- 1997 Started Successful Caterpillar Flexible Manufacturing Retrofit
- 1998 Developed Fanuc 16/18 Memory Upgrades - Also Started retrofitting
- 1999 First CNC Web Connection – Joined OMAC
- 2000 Developed advanced DNC with R&D efforts
- 2001 Became one of the Largest DNC Vendors in North America
- 2002 Memex focuses on Research & Development
- 2003 Memex launches its Mx1100 Universal Machine Tool Interface
- 2006 Memex invents Dynamic Computer Aided Machining
- 2007 Memex invents Tool Tip Automation
- 2008 Astrix Group of companies formed - assets together, MTConnect TAG
- 2009 Launch of Integrated OEE+DNC machine monitoring and control
- 2010 MTConnect leads in connecting legacy machine tools
- 2011 Launched new AxOEE enterprise solution
- 2012 Memex enters its accelerated Commercialization Phase
Leaders in Connectivity

Memex has had a leading role over the years in the development of the Global HMI XML Schema ...
MTConnect® Institute Announces Legacy Machine Tool Connectivity Working Group

Chicago, Ill. … Today at the International Manufacturing Technology Show, the MTConnect® Institute proposed the establishment of the Legacy Machine Tool Connectivity Working Group (WG). This group will be essential in addressing the very important issue of providing best practices and overall guidance for the physical connectivity of the thousands of legacy machine tools in manufacturing shops around the globe. The group will be lead by David McPhail, President & CEO Memex Automation Inc., and John Turner, Director of Technology for FA Consulting and Technology, as the co-chairs and consist of manufacturing equipment providers, ISVs, consultants, and users.

Dave Edstrom, President and Chairman of the Board for the MTConnect Institute stated, “This proposed
Representative Customers

- The Gillette Company
- GWA Corporation
- Lear Corporation
- Metso Automation
- Eaton
- Siemens
- Rehrig Pacific Company
- Rexnord
- Pratt Industries
- Heroux Devtek
- ITW Construction Products
- Oral B
- Messier-Dowty
- SAFRAN Group
- ALCAN
- Goodrich
- GSW
- Kwikset
- Georgia-Pacific
- Electrolux
- Olin
- Kumpu
- Winn-Dixie
- P&G
- Electrolux
- PSMRIFT
- Sterilite
- Hunter Douglas
- Temple-Inland
- Snap-on
- JEFFERSON
- Paslode
- The power in power fastening
- International Paper
- Manufacturing Connectivity Solutions™
<table>
<thead>
<tr>
<th>Steelcase</th>
<th>A&amp;E Precision Machining Limited</th>
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</thead>
<tbody>
<tr>
<td>Samuel Steel</td>
<td>Arvin Special Machinery Ltd.</td>
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<td>Steel Centres Machinery</td>
<td>Bidwell Machining Inc.</td>
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<td>Steel Fabricating &amp; Welding Co. Inc.</td>
<td>Black Diamond Machining Inc.</td>
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<tr>
<td>Steelfabco</td>
<td>Champion Road Machinery Co. Ltd.</td>
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<tr>
<td>Bay City Steel Company Ltd.</td>
<td>Cool Cut Machining Enterprises</td>
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<tr>
<td>National Steel Car Ltd.</td>
<td>Eagle Tool &amp; Machine Company</td>
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<tr>
<td>Arcelor-Mittal</td>
<td>Harvard Machine Ltd.</td>
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<td>Metalumen Mfg. Inc.</td>
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<td>JRBS Machine Inc.</td>
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<td>Templeton &amp; Sons Metal Products</td>
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<td>Triple Metal Products Ltd.</td>
<td>Keldco Machine Works Ltd.</td>
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<tr>
<td>Aar-Kel Moulds Ltd.</td>
<td>National Feed Screw and Machinery</td>
</tr>
<tr>
<td>AG Anderson Ltd.</td>
<td>New West Machine Tool Corp.</td>
</tr>
<tr>
<td>Eastern Mould &amp; Die Co. Ltd.</td>
<td>Nirmal Machine &amp; Tool</td>
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<tr>
<td>Phillips Tool &amp; Mould</td>
<td>O'Hara Machine &amp; Tool</td>
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<tr>
<td>Cincinnati Mold Incorporated</td>
<td>Paragon Machine</td>
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<tr>
<td>Hi-Tech Mold &amp; Eng., Inc.</td>
<td>Perth Precision Machining &amp; Mfg.</td>
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<td>Metric Mold Inc.</td>
<td>Peyton Machine &amp; Tool Co.</td>
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<tr>
<td>Mold-Masters Ltd.</td>
<td>Royal City Machine Ltd.</td>
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<tr>
<td>Precision Mold &amp; Tool</td>
<td>Stahl Machine -Thermoform Concepts</td>
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<td>Romeo Mold Technologies</td>
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<td>Sagittarius Mold Inc</td>
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<tr>
<td>Snider Mold Co. Ltd.</td>
<td>Virginia Machine &amp; Supply Co., Inc.</td>
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<tr>
<td>Superior Mold &amp; Die</td>
<td>Williams Machineworks Inc.</td>
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<tr>
<td>Wentworth Mold Inc.</td>
<td>Yamazen Machine Tools</td>
</tr>
</tbody>
</table>
Aerospace

Major Aerospace Companies use our OEE + DNC Solution now ...

- Common interface – reduced maintenance (designed for the factory floor)
- Every machine a node on the corporate network
- Link to ERP and other MES systems
- Enable “broadband on the factory floor”

This Memex OEE + DNC solution addressed the root problem in our industry – closed hardware & software architectures.

The Universal Machine Interface addresses this fundamental problem in a cost effective way for all controls...

Manufacturing Connectivity Solutions™
“Productivity growth is the cornerstone of economic growth and wealth creation.”

– Fraser Institute

“Much lag in productivity can be traced to a lack of ICT (Information and Communications Technology) in companies, and can account for 60% of productivity gap.”

– U of T & London Business School

“Manufacturers often lack the metrics required to assess their organization’s productivity, and fail to make these measures visible even when they’re available.”

– Grant Thornton, Profitability via Productivity paper.

Productivity directly affects Profitability
The Drive Towards Connectivity

Drivers Include:

- Higher customer satisfaction
- Lower costs
- Competitive agility
- Greater Productivity
Definitions

Overall Equipment Effectiveness

OEE % = Availability x Performance x Quality
Shows group or plant output as a percentage of maximum capacity
World Class = 85% (= 95% x 95% x 95%)
   It is not uncommon to > 90%!

Availability %
Percentage of scheduled time that the operation is actually operating.
Availability % = Run Time / Scheduled Time

Performance %
Speed at which the Work Center runs as a percentage of its designed speed or ideal cycle time or most often considered the “Standard”.
Performance % = (Parts Made x Standard) / Run Time

Quality %
Good Units produced as a percentage of the Total Units Started.
Quality % = Good Units / Units Started