HOW TO AFFORD AND FUND AUTOMATED TRANSPORT SYSTEMS IN TODAY’S ECONOMY

September 21st, 2011
1:30pm- 3:00pm
Room Seven
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Learning Objectives

• Robotics & Artificial Intelligence for Healthcare
  • What is it…. Robotics & Artificial Intelligence?
  • Automated Guided Vehicle (AGV) system cost benefit analysis
  • Pneumatic Waste Removal (PWR) system cost benefit analysis

• Case Study Review
  • The Ohio State University Medical Center
  • Finances… From Acquisition to Payback

• LEAN Implementation for Healthcare Operations
THE PERFECT STORM IS COMING

AN AGING POPULATION NEEDING SUPPORT

DECLINING WORKER SUPPORT

SOCIAL SECURITY BENEFIT INCREASES HAVE SURPASSED THE RATE OF INFLATION

SKYROCKETING COST OF HEALTHCARE
OSUMC- Site
OSUMC- Site
AGV - Healthcare

- Atlis Hospital Vehicle
- Automatic Batch Retort
- Self Guided Cart
- Trailer Loading Vehicle
- Roll Clamp
- Press Delivery & Loading
- Flat Box Clamp
AGV- Healthcare

Service Carts
Transport Vehicles
Battery Chargers
Laser Bumpers
Cart Washers
Control System
PC Terminals
Pocket PC
Pagers
RFID
Elevators
Automatic Doors
Type: Lift Deck Cart Carrier
Dimensions: 65 in L x 24 in W x 81 in H
Weight: 990 lb (incl. Battery)
Max Payload: 1,000 lb
Lift Stroke: 3 in.
Max. Speed (forward/reverse): 238 FPM
Guidance Method: Laser Navigation

Features:
- rugged design
- 3-wheel design with
  * 1 drive/steer unit
  * 2 fixed follower casters
- bi-directional
- WLAN communication
- load verification: barcode

Safety System:
- Laser Bumpers front + rear
- bumper strips on both sides
- audio-visual signals
AGV- Frog/DS Automation

Type: Lift Deck Cart Carrier
Dimensions: 78 ¼” L x 23 ¾” W x 15” H
Weight: 900 lb (incl. Battery)
Max Payload: 900 lb
Lift Stroke: 2 3/8 in.
Max. Speed (forward/reverse): 250 FPM

Features:
- rugged design
- 4-wheel design with
  * 2 integrated drive units (diagonal mounting)
  * 2 casters (opposite diagonals)
- fully bi-directional
- grid navigation

Safety System:
- Laser Bumpers front + rear
- bumper strips on both sides
- audio-visual signals
- software watchdogs
### AGV - Swisslog

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type:</strong></td>
<td>Lift Deck Cart Carrier</td>
</tr>
<tr>
<td><strong>Dimensions:</strong></td>
<td>66.14” L x 24.25” W x 13.4” H</td>
</tr>
<tr>
<td><strong>Weight:</strong></td>
<td>550 lb (incl. Battery)</td>
</tr>
<tr>
<td><strong>Max Payload:</strong></td>
<td>1,000 lb</td>
</tr>
<tr>
<td><strong>Lift Stroke:</strong></td>
<td>2.35 in.</td>
</tr>
<tr>
<td><strong>Max. Speed (forward/reverse):</strong></td>
<td>390 FPM</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>- rugged design</td>
</tr>
<tr>
<td></td>
<td>- 4-wheel design with</td>
</tr>
<tr>
<td></td>
<td>* 1 drive/steer unit (front)</td>
</tr>
<tr>
<td></td>
<td>* 1 non-drive steer wheel (rear)</td>
</tr>
<tr>
<td></td>
<td>* 2 fixed side wheels (center)</td>
</tr>
<tr>
<td></td>
<td>- fully bi-directional</td>
</tr>
<tr>
<td></td>
<td>- contour following navigation</td>
</tr>
<tr>
<td><strong>Safety System:</strong></td>
<td>- laser bumpers front + rear</td>
</tr>
<tr>
<td></td>
<td>- bumper strips on both sides</td>
</tr>
<tr>
<td></td>
<td>- audio-visual signals</td>
</tr>
</tbody>
</table>

*Image of AGV - Swisslog lift deck cart carrier.*
AGV- Healthcare Benefits

- Reduce Operating Costs
- Separate Patient and Material Pathways
- Reduce Cart Clutter
- Improve Cleanliness
- Integrate Operations
- Load Tracking & Accountability
- Improve Support Department Operations
- Reduce Worker’s Compensation Claims
- Reduce Building Damage by Carts
- Eliminate Elevator Damage by Carts
- Reduce Staff/Patient Elevator Wait Time
- Rapid Material Delivery/Removal
- Increase Patient Satisfaction
The transporter recalculates its exact position several times per second based on the laser signal returned from wall mounted reflectors. This is how it stays on the Guidepath.

The Guidepath is a path where the vehicle has been programmed to travel.
AGV- How It Works (Magnet Guided)

The transporter recalculates its exact position several times per second based on magnets in the floor. This is how it stays on the Guidepath.

The Guidepath is a path where the vehicle has been programmed to travel.
AGV- How It Works

AGV Vehicle Exiting Position
AGV Vehicle Circulation Zone
AGV Vehicle Pick-Drop Position
Staff Delivery Route
Off Carts Staging Position

AGV Vehicle Entrance Position
The Ohio State University Medical Center

Manual Labor

Rail System and Manual Labor

AGV System

AGV System & Floor Supply Coordinator

AGV System & PWR System
Overhead Rail System

- Existing 25-year old system
- System occupied tremendous floor space
- Low reliability
- System was costing more to operate than it provided in labor savings
Overhead Rail System
Cost Justification

- Intense Competition for Funding
- Four Alternate Solutions Considered
  1) Abandon the overhead rail and deliver carts manually
  2) Replace current overhead rail with a new overhead rail
  3) Replace the vertical portion of the overhead rail and manually push carts horizontally on patient floors
  4) Install new ATS system
LIFE CYCLE COSTING - Accumulated Costs
OSU Hospitals - Rhodes/Doan/James

YEAR

Cumulative $ Millions
$0 $25 $50 $75 $100 $125 $150 $175 $200 $225

- MANUAL
- AGVS
- RAIL
- Man Horiz/Auto Vert
The Ohio State University Medical Medical Center

- LINEN VENDOR: $2.9M
- EVS SUPPLIES: $1.6M
- MEDICAL SUPPLIES: $46.8M
- FOOD SUPPLIES: $7.4M
- MEDICAL EQUIPMENT: $35.9M
- IT EQUIPMENT: $29.5M
- 3rd PARTY VENDORS
- USPS / FEDEX
- FURNITURE / OFFICE EQUIPMENT: $5.4M

Annual Spending (approx) = $130M
Annual Spending (approx) = $5M

The Ohio State University Medical Center
The Ohio State University Medical Center

LINEN VENDOR

MEDICAL EQUIPMENT

IT EQUIPMENT

CLEAN SUPPLIES

3rd PARTY VENDORs

MEDICAL SUPPLIES

USPS / FEDEX

FOOD SUPPLIES

FURNITURE / OFFICE EQUIPMENT

MEDICAL EQUIPMENT

3rd PARTY VENDORs

IT EQUIPMENT

LINEN VENDOR

CLEAN SUPPLIES

MEDICAL SUPPLIES

FOOD SUPPLIES

MEDICAL EQUIPMENT

3rd PARTY VENDORs

USPS / FEDEX

FURNITURE / OFFICE EQUIPMENT

HARD TRASH

RECYCLABLES

BLACK WASTE

CLEAR WASTE

YELLOW WASTE

RED WASTE

Annual Total Spending (approx) = $135M
Cost Justification

ATS Delivered…

- A four minute reduction in elevator wait time
- 95 employees returned back to patient care
- A savings of $65 million over 25 years
The Ohio State University Medical Center

Operational and Cultural Changes

- Pharmacy
- Central Sterile Supply
- Nutrition Services
- Distribution Services
- Lab
- Environmental Services
- Materials Management
- Linen Services

Support Services w/AGV
Staff Training – 1,500 staff
• Open House Introduction
• Basic Introduction 1-hour Class
• Detailed Classroom and Hands-On Training
LEAN Process… Continuous Improvements

- Learning to see the AGV as a partner in operations
  - Distribution - new pallet architecture from distributor
  - Environmental - timing of trash removal
  - Biohazard - see process from key source points
  - Linen - reduce storage on floor
  - Hot Food - setting priorities
  - Case carts - carts called for individual cases
## Comparison of 4 Major ATS Healthcare Operations

<table>
<thead>
<tr>
<th></th>
<th>OSUMC System 1</th>
<th>Hospital A</th>
<th>Hospital B</th>
<th>Hospital C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beds/Discharge</td>
<td>900/56,800</td>
<td>900/40,400</td>
<td>1,100/51,000</td>
<td>900/55,500</td>
</tr>
<tr>
<td>Warehouse</td>
<td>Vendor JIT</td>
<td>Off-site DC</td>
<td>On-site DC</td>
<td>Off-site DC</td>
</tr>
<tr>
<td>User Depts.</td>
<td>All</td>
<td>All, except Dist. &amp; Pharm.</td>
<td>All, except Case Carts</td>
<td>All, except Linen &amp; Frozen Food</td>
</tr>
<tr>
<td>Surgical Case Cart Dispatch</td>
<td>Automatically Called by ORIS</td>
<td>Push from CSS to OR storage</td>
<td>N/A</td>
<td>Push from CSS by surgery type</td>
</tr>
<tr>
<td>Off-line Cart Staging</td>
<td>In Patient Floor AGV Room</td>
<td>Patient Floor Rooms by Dept.</td>
<td>None Chute/Attended</td>
<td>In Patient Floor AGV Room</td>
</tr>
<tr>
<td>Dedicated Cart Delivery Staff</td>
<td>None</td>
<td>14</td>
<td>30</td>
<td>NA</td>
</tr>
<tr>
<td>Dedicated AGV Mgt Staff</td>
<td>Mgr., Engr., &amp; Techs (6)</td>
<td>Mgr, Dispatch (3), Techs (3)</td>
<td>Mgr.</td>
<td>NA</td>
</tr>
<tr>
<td>AGV Maintenance</td>
<td>Vendor (2)</td>
<td>Hospital (4 - not dedicated)</td>
<td>Vendor (2)</td>
<td>Vendor (1)</td>
</tr>
<tr>
<td></td>
<td>OSUMC System 1</td>
<td>Hospital A</td>
<td>Hospital B</td>
<td>Hospital C</td>
</tr>
<tr>
<td>------------------------------</td>
<td>----------------</td>
<td>------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>Cart Moves/Day</td>
<td>2400</td>
<td>3400</td>
<td>4800</td>
<td>1400</td>
</tr>
<tr>
<td>Vehicle Qty.</td>
<td>46</td>
<td>46</td>
<td>81</td>
<td>26</td>
</tr>
<tr>
<td>Charger Qty.</td>
<td>11</td>
<td>17</td>
<td>60</td>
<td>12</td>
</tr>
<tr>
<td>Elevator Qty. Single/Double</td>
<td>8/1</td>
<td>10/1</td>
<td>0/0</td>
<td>10/1</td>
</tr>
<tr>
<td>Cartwasher Qty.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Cart Types/Total</td>
<td>9/900</td>
<td>8/500</td>
<td>13/1050</td>
<td>8/600</td>
</tr>
<tr>
<td>Dispatch locations/positions</td>
<td>58/252</td>
<td>54/299</td>
<td>20/216</td>
<td>55/463</td>
</tr>
<tr>
<td>Avg. Delivery</td>
<td>9 minutes</td>
<td>12 minutes</td>
<td>14 minutes</td>
<td>17 minutes</td>
</tr>
<tr>
<td>Delivery Notification</td>
<td>Pager/escalates Arrival Light</td>
<td>Pager, Pocket PC Arrival Light</td>
<td>Pocket PC</td>
<td>Arrival Light</td>
</tr>
</tbody>
</table>
PNEUMATIC WASTE REMOVAL

What’s Next? Healthcare PWR 101
PWR for Waste, Soiled Linens, and Recyclables

- Lowers the costs substantially
- Operates in a fully sealed manner
- Eliminates bottlenecks and improves throughput
How It Works

Air Intake

Central Collection Plant

Air Exhaust

Trash in

Central Processing and Monitoring

Trash out

Fan Room

Velocity monitoring
PWR- Components

TYPICAL FULL VACUUM ELEVATION VIEW

GROUNDBED LOADING STATION

LOADING STATION (TYP.)

RECTANGULAR TRASH COLLECTOR

9000 TO 13000 CFM AIR SOURCE TYP.

9000 TO 13000 CFM AIR RESOURCE TYP.

DISCHARGE AIR

WET AIR CRUISHER

SYSTEM FAN

SHOWN WITH CYCLONE TRASH COLLECTOR

Fan Units

TransVac Air Scrubber

TransVac Gravity Loading

TransVac Full Vacuum Loading Station

TransVac Cyclone Collector

TransVac Rectangular Collector
System FAST FAQs

- Trash Moves @ 60 MPH
- Less staff handling waste
- Enclosed System = Odor Control

Typical System: 1 sick day per year per staff member due to cross contamination (work acquired infection)
PWR- Reasons to Use Automated Collection

- **Significant cost savings** – Minimal staff required to operate and maintain the automated system; reduced labor delivers significant cost savings.

- **Minimized exposure to infected materials** - Facilities are cleaner and potentially hazardous working conditions are minimized as waste and soiled linen handling and public exposure is limited.

- **Increases hospital space** – Space currently absorbed by waste & linen carts can be allocated for more productive uses.

- **Simplifies logistics** – Significantly fewer people involved in the process of handling materials.
### PWR Labor Comparison

#### Traditional Removal vs. PWR Automated System

<table>
<thead>
<tr>
<th>Activity</th>
<th>Manual + Elevators</th>
<th>Manual + Gravity Chutes</th>
<th>PWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Collection on Patient Floors</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Storage of Material on Patient Floors</td>
<td>$</td>
<td>$</td>
<td>✓</td>
</tr>
<tr>
<td>Vertical Transport</td>
<td>$</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Elevator Wait &amp; Travel Time (Down)</td>
<td>$</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Collection/Handling at Base of Chutes</td>
<td>✓</td>
<td>$</td>
<td>✓</td>
</tr>
<tr>
<td>Horizontal Transport</td>
<td>$</td>
<td>$</td>
<td>✓</td>
</tr>
<tr>
<td>Unloading at Dock</td>
<td>$</td>
<td>$</td>
<td>✓</td>
</tr>
<tr>
<td>Returning Carts</td>
<td>$</td>
<td>$</td>
<td>✓</td>
</tr>
<tr>
<td>Elevator Wait &amp; Travel Time (Up)</td>
<td>$</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

A typical hospital will reduce FTE requirements by 75% using PWR.
Exposure Comparison
Limited Exposure → Less Infection

Manual Collection
1344 minutes TOTAL EXPOSURE TIME
(based on 2 tons/day)

Automated Collection
132.00 minutes TOTAL EXPOSURE TIME
(based on 2 tons/day)
### PWR Resulting ROI - Cost Benefits Analysis

<table>
<thead>
<tr>
<th>Operation Function</th>
<th>Manual Transport</th>
<th>PWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTE required to transport soiled linens, trash and recycling through out hospital</td>
<td>$30,347</td>
<td>$0</td>
</tr>
<tr>
<td>to final collection point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTE Benefits at 50%</td>
<td>$15,173</td>
<td>$0</td>
</tr>
<tr>
<td>Cart replacements (fleet of 60 replaced 1 time/3 years)</td>
<td>$1,833</td>
<td>$0</td>
</tr>
<tr>
<td>Cart repairs (replacement parts and labor)</td>
<td>$500</td>
<td>$0</td>
</tr>
<tr>
<td>Repairs from required wear &amp; tear on interior spaces (walls, doors, elevators)</td>
<td>$3,000</td>
<td>$0</td>
</tr>
<tr>
<td>Infection Control</td>
<td>$4,500</td>
<td>$0</td>
</tr>
<tr>
<td>Life safety issues (workers comp, lost days)</td>
<td>$3,000</td>
<td>$0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$59,241</strong></td>
<td><strong>$0</strong></td>
</tr>
</tbody>
</table>
# PWR Resulting ROI - Cost Benefits Analysis

<table>
<thead>
<tr>
<th>Operation Function</th>
<th>Manual Transport</th>
<th>PWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upfront Capital Costs</td>
<td>$500,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>Net Upfront Capital Costs</td>
<td></td>
<td>$1,500,000</td>
</tr>
<tr>
<td>TransVac Maintenance - Annual</td>
<td></td>
<td>$15,000</td>
</tr>
<tr>
<td>Annual Manual Operating Expense</td>
<td>$59,241</td>
<td></td>
</tr>
<tr>
<td>5 Year Operating Expense</td>
<td>$3,540,000</td>
<td></td>
</tr>
<tr>
<td>10 Year Operating Expense</td>
<td>$7,080,000</td>
<td></td>
</tr>
</tbody>
</table>

Payback in Years for TransVac

2.1 Years

PWR systems turns the removal of waste, linen and recycling into a new source of cost savings, value, & bottom-line improvement.

2.1 Years
PWR- Cost Benefit Analysis
Savings Over 25 Years

$25+ Million in Savings

Graph showing cost savings over 25 years for different methods:
- TransVac 1 Riser
- Manual + Gravity Chutes
- Manual + Elevators
Design Flexibility and Delivery

Providing Solutions Through Constant Consultation

- **Client**: Jointly analyze operations & alternatives. Define capital & operational targets.
- **Project Manager / Consultant**: Project management updates and coordination. Make adjustments as necessary.
- **Contractor Operational Partner**: Provide contractors with necessary drawings. Timely delivery within GC or Owner's schedule.

Client Consultation:
- **Concept**
- **Proposal**
- **Installation**
- **Project Mgmt**
- **Design Engineering**
- **Training**
- **Comissioning**
- **Operation**
- **Maintenance**
LEAN

Process Applied…. Healthcare Operations
LEAN- Methodology / Process Applied

- Leadership
- Eliminate Waste
- Act Now
- Never-Ending
LEAN- Methodology / Process Applied

1. Key Process Identification
2. Key Process Champion(s) Selection
3. A3 Thinking
4. Kaizen Event
4a. Observation
   - Current vs. Future Process
4b. Value Stream Mapping
   - Flow Analysis / Spaghetti Diagram
5. Plan-Do-Study-Act. 5S Implementation
LEAN- Methodology / Process Applied

(external customer)

Primary Process

+ internal customer

Internal Process

Process
LEAN - Methodology / Process Applied

- Valuable
- Capable
- Available
- Adequate
- Flexible

Process

Linked to Flow
LEAN - Methodology / Process Applied

- Overproduction
- Waiting
- Transport
- Processing
- Inventory
- Motion
- Correction

Process Improvement
LEAN - Methodology / Process Applied

- Patient
- Vision
- Mission
- Values
- Strategies
- People, Quality, Service, Innovation
- Lines of Service, Prioritized
- Institution
- Healthcare System
The Ohio State University Medical Center

Manual Labor

Rail System and Manual Labor

AGV System

AGV System & Floor Supply Coordinator

AGV System & PWR System
Manual Delivery System

1. DISTRIBUTION CENTER (Emergency Supplies)
   - Break Down
   - Stock Warehouse
   - Prepare Carts
   - Cart Pickup/Dropoff

2. ALL DELIVERIES (In Pallets)
   - Break Down
   - Stock Warehouse
   - Prepare Carts
   - Cart Pickup/Dropoff

Supply staff delivers carts to floor using service elevators.

Nurse has to place orders manually using Fax.

SUPPLY FLOW MAP

VALUE ADDED MAP
AGV/Floor Supply Coordinator System

**Hospital**

**Patient Unit Purchasing**

- **Distributing Center (Emergency Supplies)**
  - **Break Down**
  - **Stock Warehouse**
  - **Prepare Cart for AGV**
  - **AGV Pickup/Dropoff**

- **Indirect Delivery (Prepackaged - In Pallets)**
  - **Break Down**
  - **Prepare Cart for AGV**
  - **AGV Pickup/Dropoff**

- **Direct Delivery (Prepackaged for Unit)**
  - **AGV Pickup/Dropoff**

**Hospital**

**Dock**

- **Stock Supply Rooms**

**Value Added Map**

**Supply Flow Map**

- **Use of Bar “Code” and Electronic Inventory**
- **Visual Check-up/Count Supplies**
- **Floor Supply Coordinator Checks/Orders/Tracks/Stocks**
- **Floor Supply Coordinator**
- **nurse tech**
- **nurse**
- **Patient Rm**

**Vendors**

- **SUPPLY**
  - **Visual Check-up/Count Supplies**
  - **Floor Supply Coordinator Checks/Orders/Tracks/Stocks**
- **PROCESS**
  - **Receive & Process Orders**
- **PURCHASING**
  - **Get Approval & Place Order to Vendor**
- **Floor Supply Coordinator**

**SUPPLY FLOW MAP**

**DELEVER**

- **Carts unloaded from AGV into store room**
- **Dedicated AGV Elevators**

**STOCK**

- **Stock Supply Rooms**
- **Floor Supply Coordinator**

**The Ohio State University Medical Center**
The Ohio State University Medical Center
OSUMC - Existing Service Compliment

- OR's / Procedural Services: 60 Total Invasive RM
- Diagnostic Services: 60 Total Diagnostic Gantries
- Inpatient: 919 Total IP Beds
- Outpatient: 347 Total Exam Rooms
- Emergency Services: 50 Patient Beds
OSUMC - Existing Loading Dock

- 85,000 – 110,000 pounds of incoming materials per day
- 6,000 – 8,000 pounds of materials movement per hour
- One 53 footer at a time
- Street back-up and waiting
- No 30 footer and vans accommodation
- Dock positions converted to storage

- 5 docks
- 1 Compactor
- Soiled 2 docks
- Receiving 5 docks
### March 8, 2010. Summary of vehicles - dock per day:

<table>
<thead>
<tr>
<th>#</th>
<th>Vehicle #</th>
<th>Vehicle Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dock 1</td>
<td>4</td>
<td>Panel Truck (20'-35'); Van</td>
</tr>
<tr>
<td>Dock 2</td>
<td>5</td>
<td>Panel Truck (20'-35'); Van</td>
</tr>
<tr>
<td>Dock 3</td>
<td>8</td>
<td>Semi (53'); Panel (20-35'); Van</td>
</tr>
<tr>
<td>Dock 4</td>
<td>12</td>
<td>Semi (53'); Panel (20-35'); Van; Car</td>
</tr>
<tr>
<td>Dock 5</td>
<td>11</td>
<td>Panel Truck (20'-35'); Van</td>
</tr>
<tr>
<td>Dock 6</td>
<td>17</td>
<td>Panel; Van; Car</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td><strong>57</strong></td>
</tr>
</tbody>
</table>
OSUMC - Existing Dock Study

**Existing Loading Docks Utilization (@ 100% efficiency ratio)**

Number of Deliveries to Dock (positions needed)

**Methodology**

- limited number of docks

**Number of Existing vs. Required Docks**

- Existing: 6

**Projected Utilization Ratio**

- 20%
The Ohio State University Medical Center- 2014
OSUMC - Future Clinical Expansion

- Inpatient: +420 Total IP Beds
- Outpatient Clinics: +158 Total Exam Rooms
- OR’s / Procedural Services: +23 Total Invasive RM
- Diagnostic Services: +7 Total Diagnostic Gantries
- Emergency Services: +48 Patient Beds
OSUMC- 2014 Medical Campus

Summary of Medical Center:

AGV System:
- 76 Transporters
- 1,300 AGV Carts
- 73 Service Points
- 45 Battery Charging STA
- 16 AGV Elevators
- 4 AGV Cart-washers
- 4,000 Cart Moves per Day

168% Magnitude of Expansion
OSUMC- Ground Floor Circulation
• 130,000 – 170,000 pounds of incoming materials per day
• 10,000 – 12,000 pounds of materials movement per hour
• Six 65 footers at a time
• All vehicles access DC simultaneously
• 96 hours of supplies stored on-site JIT
OSUMC - Future Dock Study

Future Service Plaza Docks Utilization (@ 100% efficiency ratio)

Current: 919 IP Beds + 60 Invasive Procedural RMs + 60 Diagnostic Modalities

Methodology:
limited number of docks

Projected Utilization Ratio
8

Number of Future vs. Required Docks

Future addition
* 420 Inpatient Beds
* 23 Invasive Procedural RMs + 7 Diagnostic Modalities
* 50 Beds Emergency Department
* 158 Outpatient Clinics / Exam RMs
OSUMC- Typical Diagnostic & Treatment Floor
OSUMC - Typical Patient Care Floor

1. SOILED LINEN
   - Bags dropped in Soil rooms by patients or caregivers.
   - Bags picked up by EVS staff in carts.
   - Soiled Carts parked for AGV pickup.
   - Soiled Carts unloaded from AGV.

2. General Waste/Recycle/Biohazard
   - Bags collected in AGV rooms.
   - Bags picked up by EVS staff in carts.
   - Soiled Carts parked for AGV pickup.
   - Trash Carts unloaded from AGV.
   - Sorting of waste types (trash, recycle, biohazard).
   - Extra space & labor needed to sort - $$$.

Waste & Linen Carts occupying space on Patient floor waiting for scheduled EVS pickup.

Waste & Linen Carts occupying space on Patient care area for long time.

Trash stays in Patient care area for long time.

VALUE ADDED MAP

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The Ohio State University Medical Center

Proposed OSUMC Waste Management & Service Plaza Functionality - OUT
The Ohio State University Medical Center

Proposed OSUMC Waste Management & Service Plaza Functionality - OUT
The Ohio State University Medical Center

Proposed OSUMC Waste Management & Service Plaza Functionality - OUT
Pneumatic Waste and Soiled Linen Removal (PWR) Process: year 2014 Concept

The Ohio State University Medical Center
The Ohio State University Medical Center

AGV & Pneumatic Waste Removal (PWR) System Integrated (Future)

### Hospital

<table>
<thead>
<tr>
<th>Patient Unit</th>
<th>Patient Floor</th>
<th>Elev</th>
<th>Service Floor</th>
<th>Waste Management</th>
<th>Docks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linen Chute in Soiled rooms</td>
<td>Linen Pneumatic Tube</td>
<td>Drop</td>
<td></td>
<td>1. SOILED LINEN</td>
<td>Upload</td>
</tr>
<tr>
<td>RMW (Yellow) in Soil Rooms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unloading</td>
</tr>
</tbody>
</table>

#### 1. SOILED LINEN
- **Collect**
  - Soiled Linen bags collected into linen carts

#### 2. General Waste/Recycle
- **Collect**
  - Trash received into compactor
  - Recycle received into compactor

- **Collect**
  - Special handling of bio-hazard waste

### Value Added Map
- Reduced load on AGV System and AGV Elevators
- Waste compacted and removed quickly
- Special handling of bio-hazard waste
- Carts unloaded from AGV at Soiled Dock for vendor pickup

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**EVS staff / nurse tech**

[Image of AGV and pneumatic tubes]
The Ohio State University Medical Center

Proposed PWR at Loading Dock
COST BENEFIT ANALYSIS

The Ohio State University Medical Center

- ROI Case Study
Life Cycle and Return on Investment – Cost Breakdown

AGV System Cost Breakdown – Upfront Investment

TOTAL NEW AGV SYSTEM FRONT COST

$ XX.XX – 32 VEHICLES

AGV System Costs:
- AGV Vehicles
- Carts
- Elevators
- Auto Doors
- Cart Washers
- Controllers
- Battery Chargers

EQUIPMENT
INSTALLATION
ENGINEERING
OPERATIONAL COST
Life Cycle and Return on Investment – Cost Breakdown

AGV System Cost Breakdown – Upfront Investment

TOTAL NEW AGV SYSTEM LESS PWR COST REDUCTION FRONT COST

$ XX.XX – 21 VEHICLE

EQUIPMENT
INSTALLATION
ENGINEERING
OPERATIONAL COST

AGV Vehicles
AGV Controllers
AGV Elevators
Cart Washers
Auto Doors
Carts
Battery Chargers
AGV Controllers
Life Cycle and Return on Investment – Cost Breakdown

AGV System Cost Breakdown – Upfront Investment

**SYSTEM WITHOUT PWR**

32 VEHICLES

**SYSTEM WITH PWR**

21 VEHICLE

COST DELTA, FRONT COST OF NEW AGV SYSTEM

$ XX.XX

EQUIPMENT INSTALLATION ENGINEERING
Life Cycle and Return on Investment – Cost Breakdown

PWR System Cost Breakdown – Upfront Investment

TOTAL PWR SYSTEM FRONT COST

$ XX.XX – 48 INLETS

2 MAIN SETS OF RISERS
WASTE, REGULAR
WASTE, RECYCLABLE
LINEN, SOILED
25 Year Life Span of a System – Direct Cost

Life Cycle and Return on Investment – Cost Breakdown

TOTAL AGV SYSTEM LIFE CYCLE COST

$ XX,XX
(2010 DOLLARS, NO ESCALATION INCLUDED)

Data, per 11 AGV Vehicles Eliminated
Life Cycle and Return on Investment – Cost Breakdown

25 Year Life Span of a System – Direct Cost

TOTAL PWR SYSTEM LIFE CYCLE COST

$ XX,XX
(2010 DOLLARS, NO EscALATION INCLUDED)
Life Cycle and Return on Investment – Cost Breakdown

25 Year Life Span of a System – Indirect Cost

TOTAL OPERATIONAL LIFE CYCLE SAVINGS PER PWR IMPLEMENTATION

$ XX.XX
(2010 DOLLARS, NO ESCALATION INCLUDED)
# PWR System Payback Period

<table>
<thead>
<tr>
<th>#</th>
<th>Expense</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AGV system cost reduction due to PWR installation</td>
<td>$</td>
</tr>
<tr>
<td>2</td>
<td>PWR System up-front investment</td>
<td>$</td>
</tr>
<tr>
<td>3</td>
<td>PWR System associated construction cost</td>
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<tr>
<td></td>
<td><strong>DELTA</strong></td>
<td>$</td>
</tr>
<tr>
<td>4</td>
<td>AGV system life cycle cost per year</td>
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<tr>
<td>5</td>
<td>PWR system life cycle cost per year</td>
<td>$</td>
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<tr>
<td></td>
<td><strong>DELTA per YEAR</strong></td>
<td>$</td>
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<tr>
<td></td>
<td><strong>Pay back period in years (without operational considerations)</strong></td>
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</table>
SUMMARY
What did we learn?
THE PERFECT STORM IS COMING

AN AGING POPULATION NEEDING SUPPORT + DECLINING WORKER SUPPORT + SOCIAL SECURITY BENEFIT INCREASES HAVE SURPASSED THE RATE OF INFLATION + SKYROCKETING COST OF HEALTHCARE
QUESTIONS?
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