Calculating the financial impact of an automated waste/linen handling system installation in healthcare settings

Upgrading hygiene, improving indoor air quality, minimizing labor and promoting a clean visual aesthetic while controlling or reducing costs have moved to the fore as key issues facing hospital architects, builders, trustees and others involved in improving patient outcomes through the smart design and construction of new facilities.

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AUTOMATICALLY UPGRADE PATIENT SAFETY

Recent studies and meta-studies have concluded that thousands upon thousands of patient sicknesses and fatalities that occur annually while under medical care in United States healthcare facilities annually are due primarily to either a lack of effective infection controls, substandard facility and staff hygiene, human error or a combination of some or all of these factors. Significant attention is being paid to procedural and technological improvements to safeguard patients and improve outcomes. Yet the installation of an automated system for the handling of non-regulated waste and soiled linens – which has been garnering increasing attention – positively impacts the overall hygiene of a facility, streamlines the waste/linen handling function and ultimately contributes to improving patient outcomes.

These systems quietly whisk waste and soiled linens out of view to a central location for easy disposal, recycling or laundering. Staffers place bundles of waste into the system via access-controlled load stations set into the wall on each floor. The bundles are pneumatically conveyed through chutes installed behind the walls to the compactor. Similarly, a separate chute may be installed to convey soiled linens directly to the laundry room.

Although many professionals welcome the impact of such a system. It's benefits, though compelling, must be considered in the context of the entire facility and its cost structure. The purpose of this white paper is to determine whether the installation of an automated waste/linen system is a worthwhile investment.

COST BENEFIT ANALYSIS (CBA) REVEALS TANGIBLE RETURNS

This Cost Benefit Analysis (CBA) is intended to provide financial information and thought provoking ideas to decision makers considering the procurement, utilization, and maintenance of a pneumatically driven, computer controlled, Waste Handling System (WHS) typically installed in a modern hospital building complex (new or renovation projects). When considering a WHS within a hospital environment, the system is

PRESUPPOSITIONS

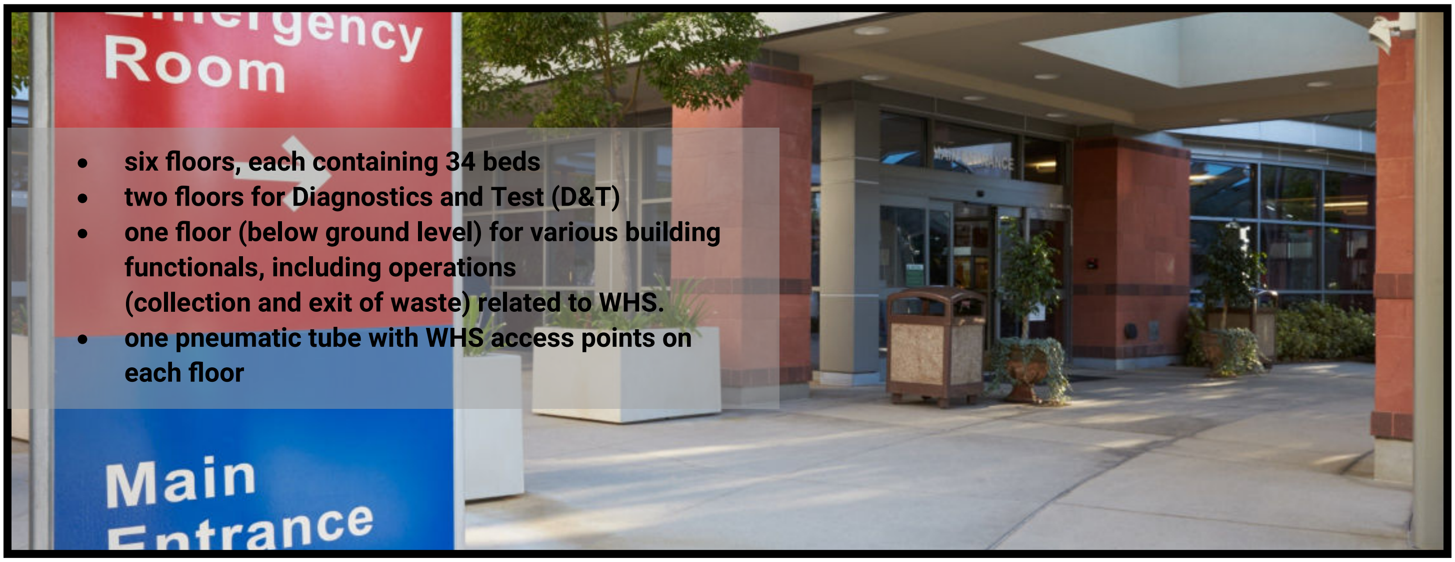
Note the following presuppositions for this white paper:

- As a typical building format for a suburban location, a single unit hospital campus with 200 beds in one nine-story tower is used as the model and the basis for cost calculations, unless otherwise noted. The reader may extrapolate the data and conclusions contained herein based upon his/her application if significantly different from the model.
- The model hospital is a for profit business involving significant capital investment essential to the functionality for the success of the business mission.
- The information used in this white paper is based on a variety of published and non-published research sources including the esteemed Messrs. David Ketchins of University of Texas Medical Branch at Galveston, TX and healthcare construction industry consultant Larry Lammers as well as from an informal survey of more than 50 professionals directly from the using community.
- Since energy, labor and other costs vary geographically, nominal values have been incorporated into the calculations. The reader may extrapolate the data and conclusions to accommodate differences, such as in Boston, MA, for example, where energy and labor costs may reach 25% above normal.
- There are many intrinsic values associated with a WHS that are not associated with material benefits/cost such as aesthetics, patient and guest confidence in their care, enhanced marketing opportunities for the hospital and improved relations with the community and government. Only factors contributing directly to a material return are addressed herein.

not simply a new way to provide the same functionality (managing waste), but rather it is a technological advancement that more efficiently manages the entire waste and linen handling processes. Thus, the primary goal of the hospital procurement selection team, when considering a WHS is to determine and evaluate its significant benefits and compare them with its significant costs (life cycle) as well as with the costs of simply maintaining the status quo. Once an assessment of the benefits and costs are detailed, an accurate determination of the economic viability of an automated waste/linen system may be made.

THE MODEL HOSPITAL

This Cost Benefit Analysis and its calculations (unless otherwise noted) are based on a model hospital designed with a building format typical of many suburban locations. The model hospital is a single unit hospital campus with 200 beds in one, nine-story tower with one below ground level floor. The distribution within the facility is as follows:



- **six floors, each containing 34 beds**
- **two floors for Diagnostics and Test (D&T)**
- **one floor (below ground level) for various building functionals, including operations (collection and exit of waste) related to WHS.**
- **one pneumatic tube with WHS access points on each floor**

Set in Houston, Texas, the model hospital is a for profit business providing services to its customers. If services (direct (medical) and indirect (e.g. waste management)) can be provided more efficiently, then the hospital is likely to realize cost reductions, productivity improvements, patient satisfaction enhancements and other benefits translating to increased profitability.

Compared to the typical hospital operating a manual waste handling system, a WHS will reduce the FTE requirements by 75%, which translates to an annual savings of 7.5 FTE.

ANALYSIS OF BENEFITS

Labor Savings

The highest payoff ratio from a WHS system within a hospital is derived from reductions in labor requirements. With a manual approach, these resources are typically required to transfer waste horizontally on the floor, vertically from floor to floor and lastly to the final collection point (focus point typically on ground level floor). With a WHS, the manpower required to collect and move waste horizontally to the access points of the WHS is not likely to be affected. However, by eliminating the vertical movement through the facility, the productivity of these resources is likely to increase significantly. Multiple field sources agree the model hospital will require four workers to support this function for the first and second shifts.

The third shift will require two workers for a total of 10 Full Time Employees (FTE), with one worker per shift handling ground floor operations. Compared to the typical hospital operating a manual waste handling system, a WHS will reduce the FTE requirements by 75%, which translates to an annual savings of 7.5 FTE.

To monetize the savings, and considering that geographic location is a significant determinant of the FTE rate, a semi-skilled member of the Environment Service Dept. in Houston will earn approximately $18.00/hr. (gross and including all benefits) for a unit value of approximately $36,000.00/FTE annually. Multiply by 7.5 FTE yields a working figure of approximately $270,000.00/yr. in savings from labor alone.

Factoring the annual growth of labor costs, a Cost Of Living Adjustment (COLA) of 3% is added ($8,000.00/yr). For other locations (e.g. Boston), the labor savings may be estimated as approximately 1.25 * this value, or approximately $338,000.00/yr. In San Francisco, Calif., the savings may be estimated as approximately 1.3 * or $350,000.00 (ref, http://quickfacts.census.gov/qfd/index.html; based on standard household income levels and a comparison to Houston ($36,000.00) for determining specific multipliers).

Equipment Savings

Modern hospital facilities typically use dedicated waste handling carts for waste logistics. Each floor will utilize these waste-handling carts as follows:

- ***Bedded Flooring (six floors): four units each floor (total: 6*4, 24)***
- ***D&T Flooring (two floors): two units each floor (total: 2*2, 4)***
- ***Below Ground Floor (one floor): two units each floor (total: 2)***
- ***Total Sum: 24 + 4 + 2 = 30***

With 30 carts at a purchase price of approximately $1,500.00 ea., the total initial procurement cost would be $45,000.00. Lifecycle (life use for a typical cart) for these carts is approximately four years for a distributed burden of $11,000.00/yr. (45/4). Equating this to the FTE value yields a benefit of 11/36 or 0.3 FTE annually.

Sophisticated and expensive elevators are heavily utilized in a hospital environment. Typically there are two sets of elevators, one set for visitors and another set for hospital patients, staff, and operations (these units are bigger, heavier, and more expensive). A typical cost function for the latter type of elevator is as follows: $24,000.00/stop: nine story building: $216,000.00/unit initial cost.

Typically, our normalized model will have at least two (sometimes three) of these units. Therefore, initial procurement cost (for two elevators) will be approximately $432,000.00. Certification, licensing, and inspection involve an additional $25,000.00, for a total initial cost of approximately $457,000.00. Elevator maintenance and semi-annual inspections are also expensive, averaging a total annual expense of approximately $45,000.00. This cost will likely grow by 5% annually to cover unexpected failures and associated fixes. By reducing the utilization of these elevators, the WHS reduces their maintenance demands thereby reducing costs and improving facility efficiency via reduced wait times. Multiple field sources agree that a typical percentage usage of these elevators by employees functioning directly or indirectly in waste handling services is 10% (usage basis). However, combined with increased building efficiency and shorter wait times for physicians and other professional staff, this efficiency upgrade delivers a powerful payback that translates not only to reduced costs but also to the potential for improved patient outcomes. Based on these factors, the reduced maintenance costs due to the WHS are estimated to be approximately $28,000.00/yr. (with a growth function of 5%). This equates to 0.78 FTE/yr. savings.

Quantifying Indoor Air Quality Improvements

By quickly and efficiently restricting waste from trafficked areas, the WHS minimizes the movement of dangerous contaminants across HVAC zones and minimizes its exposure to patients, staff, and visitors. With the spread of contaminants from floor to floor being dramatically curtailed, the potential spread of contagions is also dramatically curtailed. While accurately quantifying the number of sicknesses prevented may not be feasible at this time, the impact on worker sick time may be substantial. With approximately 750 employees in the model hospital, if the WHS prevents each employee from missing only one work day per year, the resulting reduction in absenteeism would account for 750 less sick days taken per year. The WHS may also permit reductions in insurance liability premiums. Combining savings due to potential reduction in liability insurance and reduced sick time, the payoff is conservatively estimated at 0.5 FTE annually.

Summary of Material Benefits

LABOR	EQUIPMENT	INDOOR AIR QUALITY
7.5 FTE	0.3 FTE + 0.78 FTE = 1.08 FTE	0.5 FTE
		Total Sum: 9.08 FTE

Concluding the benefit portion of this report for our model hospital, a WHS is likely to deliver savings of approximately nine FTE's on an annual basis (before detailing annual debits). This equates to a saving of approximately $325,000.00/yr.

Analysis of Debits

Debits for the procurement, utilization, and maintenance of the WHS presuppose only those "new" expenses that would not be incurred otherwise. The most significant of these expenses include the following: energy to run the system (electricity) and resources to maintain the system (people and goods). Any replacement (upgrade, end of lifecycle, or failure) of hardware and or software is addressed as maintenance. The hospital may also outsource all or most of the maintenance for further potential cost and labor savings. Other costs may include training (part of operations), material support from operations (e.g. standardized garbage bags), periodic certification by the Original Equipment Manufacturer (OEM; this is highly recommended to ensure the system is fully optimized) and IT related operations (the system may be seamlessly "connected" to the IT infrastructure).

Electric Power

The control system for the WHS is specified to ensure efficient operation based on monitored and anticipated usage. When not in use (for extended periods of time) the system "powers down" at a standard, pre-determined schedule. Power up will be performed in a controlled and orderly manner that prevents system stress and minimizes power consumption. This process also ensures maximum life cycle of functional elements. Monitoring devices (sensors) constantly provide operation states to the user and to the system itself.

Power consumption is driven primarily by the size of the fan motor (Horse Power, HP). For the model hospital, a single 250HP motor is typically specified (permitting an operational safety factor of approximately 15%). Power consumption is also based on the system being in full operational mode during 2 hrs./24 hrs.; low level operation during 6 hrs./24 hrs. (33%f full power) and not functioning during 16 hrs./24 hrs. This schedule of operations is possible due to both the computerized control system and by proprietary Envac chute designs (Q Chute). Full operation is anticipated at (2 + 2) hrs/day or four hrs.

By normalizing the power usage, the approximate annual cost of power may be calculated. Electric rates are based on several factors, including geographic location, peak and non-peak daily periods, winter/summer rates, and distribution charges. For Houston, Texas, the rate is, nominally, approximately $0.085/kWh, averaged to address seasonal differences for simplification. The 250 HP motor will have an hourly cost function of 144 kWh for full operation mode. Therefore:

- ***Estimated cost for each hour of full use: $12.24/hr.***
- ***Estimated cost for each day: (12.24*4) $49.00/day***
- ***Estimated annual cost: (49*365) $18,000.00/yr. (rounded)***
- ***FTE Value (18k/36k) 0.5 FTE***

Maintenance: Labor

Maintenance comprises two factors, labor and materials. The labor cost of maintenance during the first year of operation nominally approximates 1 hr./day for engineering and four hrs./day for semi-skilled engineering. Normalizing the engineer time to FTE units, the skilled engineer would be equivalent to 1 * 2 or 2 hrs./day. Combining values yields a weekly cost function of: (2 + 4) * 7 or 42 hrs./week. This equates to approximately 1.05 FTE/year for maintenance. Anticipating a labor growth function of approximately 1 hr./week (combined) to accommodate increased maintenance requirements during each successive year equates to an implied growth function of approximately .025 FTE/yr. Nominally, the future FTE value is likely to level off at approximately 1.25 (10 years) FTE/year. It must be noted that superior design, installation, proper maintenance, and utilization contribute to ensuring these values remain consistent. Based on these factors, conservatively, the average anticipated FTE corresponding to 10 years of Labor Maintenance is 1.15 FTE/year.

Materials

Cost of hardware and materials will be relatively insignificant during the first five years of operation. Nominally, a cost function of approximately 0.27 FTE/year ($10,000.00) is anticipated. This function is likely to increase during the 5-10 year period to nominally 0.7 FTE ($25,000.00). During the 10-25 year period, an average of 1.4 FTE ($50,000.00) cost function for hardware is anticipated (these figures not adjusted for inflation). To be conservative, 0.75 FTE/year is factored for the cost of hardware. Though the numbers reflect an average over a defined period it is likely that very few resources may be invested in hardware in some years while conversely, significant resources may be invested in other years.

Information Technology

The final significant cost function is related to any new burden (labor or material) associated with the Information Technology Dept. The WHS is capable of being integrated with the IT function to enhance the efficiency of and ability to monitor and control the system while permitting OEM distant end support in real time. The in-house cost for this functionality is estimated at approximately .25 FTE for initial integration and 0.15 FTE for continued support. The initial investment of 0.25 FTE will be distributed yielding a nominal annual IT cost of 0.175 FTE.

POWER	MAINTENANCE	IT
0.5 FTE	Labor 1.15 FTE Material 0.75 FTE	0.175 FTE
		Total Sum: 2.575 FTE

Global Sum: (9.08 – 2.575 FET = 6.505 FTE/year
NET ANNUAL RETURN: $234,180.00

CONCLUSIONS

Optimizing the waste/linen management functions delivers an impressive array of benefits. From quantifiably concrete and substantial cost reductions in labor and equipment to powerful yet less quantifiable benefits in superior hygiene, aesthetics, patient satisfaction and care, worker productivity, environmental considerations and more, an automated WHS may be an essential element in any modern hospital or healthcare facility. By delivering net annual returns of $234,180.00, it is also a smart investment that yields substantial bottom line returns year after year.

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