COOPERATIVE LAUNDRY

FEASIBILITY STUDY

# 363 - 67

AUTHOR: D. HARRIS

COMMUNITY SYSTEMS FOUNDATION
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SUMMARY OF MAJOR FINDINGS AND RECOMMENDATIONS

Implement A Cooperative Hospital Laundry with the Following Characteristics

Beds serviceable = 3500

Workload = 16,136,000 pounds yearly

Linens = Supply, standardized

Distribution = Total exchange cart

Capitalization Cost = $4,808,610

Operating Cost = $1,511,899/year or $0.0937/pound

Fee Structure = $0.10/pound

Projected Minimum Labor Savings over non-cooperative approach - five years hence = $474,000/year
INTRODUCTION

On March 3, 1967, representatives of thirteen hospitals in the Greater Detroit area assembled to inaugurate a joint feasibility study of a cooperative hospital laundry. Also represented at this meeting was the Greater Detroit Area Hospital Council, Inc. Those hospitals participating and in support of the study were as follows:

Brent General Hospital
Dearborn Medical Centre Hospital
North Detroit General Hospital
Oakwood Hospital
Park Community Hospital
Pontiac General Hospital
Saline Community Hospital
Sinai Hospital of Detroit
Sumby Hospital
St. Joseph Mercy Hospital - Ann Arbor
St. Joseph Mercy Hospital - Mt. Clemens
Warren Memorial Hospital
Wyandotte General Hospital

This report presents the analysis, conclusions, and recommendations resulting from the study.
Basis for Workload Projection

Guided by CSF engineers, participating (study) hospitals carried out the collection of sample data on linen consumption. After appropriate adjustments for sample period deviations from normal patient demand levels, the data collected indicated that the cooperative laundry would currently be expected to process 13,831,000 pounds of soiled linen annually. Based upon commonly quoted per bed and per patient day consumption rates, this poundage is considered reasonable.

However, since the cooperative laundry would not become operational until 18-36 months hence, allowances had to be made in planning for growth. To the extent that hospital growth plans were judged firm and highly probable, adjustments were made. This raised the total projected number of beds to be serviced should all 13 hospitals become participants to 3484 beds. The anticipated laundry workload increases proportionally to 16,136,000 pounds of soiled linen annually.

Consideration was also given to the possibility of servicing a different mix of hospitals than the 13 study participants. After a review of projections of overall area hospital facilities, it was felt that the current mix was representative of the mix which could be expected to prevail during the first few years of operation, in terms of total number of beds and annual poundage.

Accordingly, the basic design criteria was to plan a laundry facility which could service the linen needs of 3500 beds generating 16,136,000 pounds of soiled linen annually.

In planning this facility, considerations of scheduling and economy led to the selection of a one shift, six-day work week as the production basis for equipment and space planning. Once the equipment is acquired, its frequency of operation can be altered through changes in staffing to achieve different levels of output than initially planned. For example if the changes below were made, the following effects on capacity and service ability would occur:

<table>
<thead>
<tr>
<th>Operating Change</th>
<th>Additional Beds</th>
<th>Additional Poundage</th>
<th>Total Beds</th>
<th>Total Poundage</th>
</tr>
</thead>
<tbody>
<tr>
<td>One shift, six day —</td>
<td>594</td>
<td>2,741,000</td>
<td>4094</td>
<td>18,877,000</td>
</tr>
<tr>
<td>One shift, seven day —</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One shift, seven day —</td>
<td>1738</td>
<td>8,016,000</td>
<td>5832</td>
<td>26,893,000</td>
</tr>
<tr>
<td>Two shifts, five day —</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two shifts, five day —</td>
<td>1166</td>
<td>5,379,000</td>
<td>6998</td>
<td>32,272,000</td>
</tr>
<tr>
<td>Two shifts, six day —</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

However, since the full amount of growth is not anticipated, utilities and space for the storage of additional linen inventory (clean and soiled) has not been provided for all growth levels. Utilities and space should be adequate to absorb the first level of growth above (17% growth).

1 Projected to total study group of 13 hospitals and 2981 beds, based upon data received in the analyses from 12 hospitals representing 2587 beds.
**Processing Function Design Criteria**

Based upon the above criteria, plus analysis of the linen functional and finishing requirements likely to prevail for the anticipated mix of linens, the following design criteria were developed:

<table>
<thead>
<tr>
<th>Function</th>
<th>Number of Production Hours/Day</th>
<th>Pounds to Process Per Production Hour</th>
<th>Pieces to Process Per Production Hour</th>
<th>% of Total Daily Poundage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash</td>
<td>8.0</td>
<td>6500</td>
<td>--</td>
<td>100 %</td>
</tr>
<tr>
<td>Extract</td>
<td>7.5</td>
<td>6900</td>
<td>--</td>
<td>100 %</td>
</tr>
<tr>
<td>Full Dry &amp; Dry Fold</td>
<td>7.5</td>
<td>2400</td>
<td>4500</td>
<td>35.2%</td>
</tr>
<tr>
<td>Condition</td>
<td>7.5</td>
<td>4500</td>
<td>5360</td>
<td>64.8%</td>
</tr>
<tr>
<td>Flatiron &amp; Flatwork Fold</td>
<td>7.5</td>
<td>4400</td>
<td>5250</td>
<td>63.2%</td>
</tr>
<tr>
<td>Press</td>
<td>7.5</td>
<td>100</td>
<td>110</td>
<td>1.6%</td>
</tr>
</tbody>
</table>
**Transportation System Design Criteria**

Based upon available data, the following were the workload criteria for designing the transportation system:

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Beds (Projected)</th>
<th>Annual Poundage (Projected)</th>
<th>% of Total Annual Poundage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brent</td>
<td>116</td>
<td>548,624</td>
<td>3.4</td>
</tr>
<tr>
<td>Dearborn Medical Centre</td>
<td>67</td>
<td>322,720</td>
<td>2.0</td>
</tr>
<tr>
<td>North Detroit General</td>
<td>230</td>
<td>1,081,112</td>
<td>6.7</td>
</tr>
<tr>
<td>Oakwood</td>
<td>558</td>
<td>2,597,896</td>
<td>16.1</td>
</tr>
<tr>
<td>Park</td>
<td>146</td>
<td>693,848</td>
<td>4.3</td>
</tr>
<tr>
<td>Pontiac General</td>
<td>400</td>
<td>1,855,640</td>
<td>11.5</td>
</tr>
<tr>
<td>Saline Community</td>
<td>26</td>
<td>129,088</td>
<td>0.8</td>
</tr>
<tr>
<td>Sinai</td>
<td>640</td>
<td>2,985,160</td>
<td>18.5</td>
</tr>
<tr>
<td>St. Joseph Mercy-Ann Arbor</td>
<td>522</td>
<td>2,436,536</td>
<td>15.1</td>
</tr>
<tr>
<td>St. Joseph Mercy-Mt. Clemens</td>
<td>310</td>
<td>1,436,104</td>
<td>8.9</td>
</tr>
<tr>
<td>Sumby</td>
<td>80</td>
<td>371,128</td>
<td>2.3</td>
</tr>
<tr>
<td>Warren</td>
<td>52</td>
<td>242,040</td>
<td>1.5</td>
</tr>
<tr>
<td>Wyandotte</td>
<td>309</td>
<td>1,436,104</td>
<td>8.9</td>
</tr>
</tbody>
</table>

**Total**                        | 3484             | 16,136,000                  | 100.0                       |
LINEN STANDARDIZATION

The entire design of the laundry is based upon the premise that it will function as a linen supply service, owning the linens and providing all hospitals with identical linens for identical or highly similar functions. Linens have not been standardized as yet. It is recommended that the laundry not be placed into operation until such standardization is substantially achieved.

To achieve linen standardization, the following steps should be taken:

1. Each hospital should appoint at least one (but no more than two) representative to a Joint Linen Standardization Committee (already in progress). Preferably, nursing should be represented on the committee.

2. This representative should become completely familiar with every type of linen currently in use in his hospital, including its physical characteristics and its function. Most of the participating hospitals have prepared, as part of the study, descriptions of each item. These will be made available to the committee. Some hospitals have prepared sketches of specialty items which are difficult to describe. It is recommended that each hospital be permitted to participate in item standardization only if it has provided the committee with a complete item description. It is further recommended that item samples be brought to committee meetings as appropriate.

3. The representative should be given the authority to accept the standard linen item chosen to replace the individual items. Selection of a standard item entails how it is to be finished, as well as its physical characteristics.

4. A manual of standard linen items should be prepared which gives the item name, description (verbal or sketch), physical characteristics, type of finish, and functional purpose. Mechanisms should be provided to update and re-distribute the manual.

To assist in the process, CSF has already classified approximately 80% of all linens known to be in use (as reported by hospitals). These have been fitted to approximately 130 item categories, and represent not only the bulk of the workload, but those items of substantial similarity. This should facilitate standardization quickly on most of the items. The remaining 20% (over 200 items of low volume usage) have not been fitted to item categories as yet.

The economies to be gained by standardizing on linens can not easily be measured. The cost of segregating and processing seperately individual hospital linens would entail not only substantially more labor, but loss of most of the justification for high-volume production and materials handling equipment. The operation would also be far less smooth in terms of work flow. Judging from the experiences of other hospital cooperative laundries which do not offer standardized linen supply, annual operating cost would be at least 25% higher without standardization.
ORGANIZING SOILED LINEN

The processing system recommended is predicated on the assumption that soiled linen entering the cooperative laundry is organized into various processing categories prior to the wash function. Two basic reasons exist for pre-sorting incoming linen:

1. To group linens by type of wash formula (cycle time; supply; method)

2. To segregate linen so as to simplify and minimize handling subsequent to extraction (e.g. - condition vs. full dry; large vs. small flatwork; OR-OB vs. regular; bath towels vs. other full dry; etc.)

To minimize the cost of the pre-sorting of linen, it is recommended that the individual hospitals take responsibility for preliminary pre-sorting at the time of discard. This can be easily accomplished through the use of color-coded bags for each of several preliminary pre-sort categories. The following categories are recommended; consistent with consideration of avoiding more than usual handling by hospital personnel:

1. Patient room linen, excluding children's diapers (non-contaminated).

2. OR-OB wearing apparel (excluding scrub gowns).

3. Other OR-OB linens.

4. Other wearing apparel.

5. Nursery linens, excluding infant diapers.

6. Diapers (all).

7. Contaminated (soluble bags).

8. All other.

Upon entering the laundry, each bag would be stored in its cart for a period of time, then directed via monorail conveyor to an appropriate storage, pre-sort station. Depending upon the bag contents and the results of detailed planning as to final pre-sort requirements, linen would be further subdivided by pre-sort operators. Based upon the assumption of hospital preliminary pre-sort as discussed above, no need is currently seen for specialized mechanical pre-sort equipment to aid in the process (e.g. - carousels, classmats).

Linen bags would be dumped at one of (5) pre-sort stations onto one or more sort tables (depending upon volume of linen per station). Linen would be hand sorted directly into soiled linen slings of 200 pounds each, then loaded onto another monorail conveyor for pre-wash storage.

COST OF PRE-Sorting EQUIPMENT (including all conveyance) = $ 71,100

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EQUIPMENT AND PROCESSING FUNCTIONS

This section presents a summary of the major equipment required to perform each linen processing function internal to the cooperative laundry. Processing is considered to begin with washing and end when linen is in a form amenable to preparation for distribution (e.g. - cart loading, pack making). Also, shown are the basic functional or performance specifications of importance in the selection of specific equipment brands. Justification of the choice of one alternative processing method over another is given where appropriate. The basis for quantity selection is also given (e.g. - number of washers). Costs are estimated based upon manufacturer quotations, and include allowances for freight, equipment placement (excludes utility connection), and price inflation. (It is anticipated that prices will be as much as 10% higher at time of purchase than current prices).

The materials handling equipment (e.g. - slings, monorails, belt conveyors) required to perform each function or store in-process work is presented only in terms of summary cost estimates. Materials handling equipment required to convey linens from one function to another is dealt with separately. Heavy emphasis has been placed upon the acquisition of materials handling equipment where justified to minimize labor and create a smooth work flow.

WASHING

Demand = 6500 lb./hr.

Based upon 8.0 production hrs./day. All other functions based upon 7.5 production hours per day. Assumes washers operating while operators on relief.

Equipment Loaded Capacity Requirements = 6460 lb. (rated)

Based upon production rate equivalent to slightly more than (1) load per hour per machine. 1.25 loads/hr./machine on the average should be obtainable. However, the design criteria allows for under-capacity loads, differences between actual and rated machine capacities, and demand growth.

Recommended Equipment Mix:

7 - 800 lb. washers (4 - 200 lb. pockets each) (rated)
2 - 400 lb. washers (2 - 200 lb. pockets each) (rated)
1 - 60 lb. washer-extractor combination (1-60 lb. pocket) (rated)

Central Supply System (automatic formula - supply injection control)

WASH EQUIPMENT COST = $212,900
Washers are recommended over washer-extractor or washer-extractor-conditioner combination units for the majority of production because:

1. Optimal mechanized materials handling economies can only be obtained through the use of a specific type of washer.

2. Construction is simplified in that there is no need to provide special foundations to alleviate vibration problems associated with the combination units.

3. The materials handling equipment which can be integrated with the specified wash and extract equipment will permit the use of fewer personnel in total, even allowing for the fewer number of load handlings associated with the combination units.

4. The stated performance specifications with respect to conditioning of the washer-extractor-conditioner combination units are not considered acceptable.

The small washer-extractor combination unit is recommended to handle small speciality loads which would interfere with the economies to be gained through mechanized materials handling and gang-processing.

Recommended Design Specifications for Large Washers:

1. Top loading through hoppers extending through ceiling into mezzanine above. Linen to be dropped into hoppers from sling storage. No physical contact with linen. Washwheel to be gang unloaded (all pockets simultaneously).

2. Bottom unloading into slings placed in truck tubs. Truck tubs to be mechanically positioned under washers. No physical contact with linen. Washwheel to be gang unloaded (all pockets simultaneously).

Cost of materials handling equipment specifically associated with wash function (slings, drop rail sections, fixed rail, truck tubs, trolleys, hoppers, air cylinders, etc.) = $66,320
EXTRACTING

Demand = 6900 lb./hr.

Equipment loaded capacity requirements = 1600 lb. (rated)

Based upon production rate equivalent to (5) loads/hour/machine and allowing for same contingencies as washers.

Recommended Equipment Mix:

8 - 200 lb. hydraulic extractors (rated)

EXTRACTOR EQUIPMENT COST = $75,600

Hydraulic extractors are recommended over centrifugal extractors to achieve the specified production rate and produce a compressed load for ease of material handling prior to conditioning or drying.

Recommended Design Specifications for Hydraulic Extractors:

1. Arrayed so as to achieve gang loading and unloading of up to (4) extractors. To be loaded and unloaded mechanically with linen in slings.

Cost of material handling equipment specifically associated with extract function (slings, drop rail sections, fixed rail, trolleys, etc. = $13,230

DRYING AND CONDITIONING

Demand = 4500 lb./hr. - condition
2400 lb./hr. - full dry

It is recommended that all flatwork and press work be conditioned prior to finishing.

Equipment Loaded Capacity Requirements = 2100 lb. (rated)

For conditioning, based upon production rates of 7.5 loads/hour at 300 lb. per load (average).

For full drying, based upon production rate of 4.29 loads/hour at 300 lb. per load (average).
Recommended Equipment Mix:

5 - 400 lb. gas-fired tumblers (rated)
1 - 100 lb. steam tumbler (rated)

**DRYING & CONDITIONING EQUIPMENT COST = $54,600**

Gas-fired tumblers are recommended over steam for majority of production due to greater productive capacity of gas and lower initial cost. The small steam tumbler is recommended to handle certain materials subject to damage in a gas-fired tumbler.

**Recommended Design Specifications for Gas-Fired Tumblers**

1. Tip-up.
2. Pass through.

It is recommended that tumblers be arrayed so as to be compatible with:

1. Air blowing of full dry work to hoppers positioned above dry fold equipment.
2. Sling loading of conditioned large flatwork for transport to shake out area.
3. Sling loading of conditioned small flatwork for transport to small flatwork ironers.

**Cost of materials handling equipment specifically associated with drying and conditioning function (slings, drop rail section, fixed rail section, etc.) = $11,070**
PLATIRONING (Mangling)

Demand = 2300 pieces/hour - large flatwork

2950 pieces/hour - small flatwork

Large Flatwork Equipment Requirements:

Detailed analysis of workload mix has indicated need for (3) high production ironers to finish and fold large flatwork. These ironers should be apronless, large roll (8), properly ventilated, and equipped with the following accessories:

1. Type "A" spreader.
2. Feed tension device.
3. Folder.
5. Classifier.

These ironers will be capable of processing all large flatwork plus a small amount of the small flatwork assuming:

1. Pre-conditioning of all large flatwork (previously recommended)
2. Shake out of all large flatwork after conditioning. Full lay-up not required.
3. Ironer ability to dry large sheet with 45% moisture retention at 150-170 feet/min.
4. Actual operating rate of 120-125 feet/min. with back-to-back feeding. (Requires use of 5 man crew plus stated accessories).

Small Flatwork Equipment Requirements:

Detailed analysis of workload mix has indicated need for the following equipment to finish and fold small flatwork:

(1) - 4-roll flatiron - no accessories
(1) - 4-roll flatiron - equipped with 5-lane stacker
(2) - small piece automatic folders
With the above equipment, sufficient capacity exists to process all small flatwork, assuming:

1. Pre-conditioning of all small flatwork (previously recommended).

2. Direct (trough) feeding of small flatwork in multiple lane combinations (2-5). Shake out or lay-up not required.

3. Actual feeding rates of 40-50 feet/min., but capability of drying a large sheet at 120 feet/min. with 45% moisture retention.

4. Optimal scheduling of crews, plus utilization of small amount of excess capacity of large flatwork ironers and crews.

Additional Equipment Requirements:

1. Due to the high capital cost of flatirons, the attempt has been to project the minimum required investment based upon known needs and assumptions of high efficiency in both processing and scheduling. Experience dictates that an operation of the magnitude of the cooperative laundry should possess additional or "buffer" flatiron capacity as protection against mechanical failure of regular flatirons, plus protection against scheduling imbalances, workload fluctuations, or workload growth. For this purpose, it is recommended that a review be made of the existing flatirons in the hospitals participating in the cooperative laundry venture, and that one be acquired which is no more than 5 years old, is apronless, is in good condition, can meet the performance specification of "dry large sheet at 100-110 feet/min. with 45% moisture retention," and costs no more than $10,000 to purchase.

2. To prepare finished flatwork for loading of standardized quantities onto carts going to the hospitals, a tieing operation should be integrated with the finishing operation to prepare bundles for cart loading. The requirements for flatwork are (3) tieing machines, assuming the conveyance of finished items to the tieing operators in an orderly manner.

COST OF FLATWORK FINISHING AND TIEING EQUIPMENT = $285,700

Cost of materials handling equipment specifically associated with flatwork finishing function (slings, shake-out tables, truck tubs, belt conveyor, fixed rail, trolleys, portable troughs, etc.) = $12,790
FULL DRY FOLDING

Demand = 3700 pieces/hour or 2000 lb./hr. - all except bath towels

800 pieces/hour or 400 lb./hr. - bath towels

Equipment Requirements:

Non-towel work: 5 - Hopper - fold combination units with movable canvass to regulate work flow (400 lb./hopper)

OR

5 - Hoppers (400 lb./hopper)

10 - Tip-up basket - fold table combination units (200 lb/basket)

Based upon productive rates of 430 pieces/hour/fold operator, above represents both sufficient capacity to store in-process work being air blown from tumblers and sufficient work area for required number of fold operators. Required number of operators and fold stations assumes work well organized and conveyed to and away from fold operators.

Towel Work: 1 - Hopper (400 lb./hopper)

1 - Automatic towel folder (capacity = 800 pieces/hour)

Based upon productive rate of 800 pieces/hour for one operator using towel folder. Assumes towels conveyed to operator, no sorting required by operator, and folded towels conveyed away from operator without travel.

Additional Equipment Requirements:

1. To prepare finished full dry work for loading of standardized quantities onto carts going to hospitals, a tying operation should be integrated with the folding operation to prepare bundles for cart loading (excluding OR-OB full dry requiring inspection). The requirement for full dry tying is (1) tying machine, assuming the conveyance of finished items to tying operator in an orderly manner, plus the ability to meet a small amount of overflow by use of anticipated surplus time at the finished flatwork tying stations, (requires all tiers to be in close proximity to each other).

2. The dry fold operation proposed is predicated upon the orderly flow of linens to the fold operators via hoppers and other mechanical devices. An integral part of this system already referenced above is a pressurized air system for blowing full dry linens into the hoppers. By locating the origin of the system adjacent to the full dry tumblers, it also becomes a conveyance device from one function to another. The system must possess directional capability also (ie. - linens can be directed to hoppers on a selective basis).

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COST OF FULL DRY FOLD AND TIEING EQUIPMENT = $22,500
Cost of materials handling equipment specifically associated with full dry folding and tying function (pressurized air system, conveyor-hoppers included in processing equipment cost) = $13,650

PRESSING

Demand - 110 pieces/hour

The above demand is based upon the sample usage data obtained, but is suspected of being as much as 50% below actual consumption levels, based upon previous experience. Assuming the above demand to be correct, conventional presswork equipment requirements would require (6) press equipment configurations and (6) press operators. The capital equipment cost would be approximately $24,000. At the probable rate of demand, (11) configurations would be required and (11) operators.

In contrast, reports have been received of the current development and testing of a "hot box" press unit, capable of processing up to 250 pieces per hour at a capital investment of approximately $15,000. The unit would require (2) operators. The unit requires the use of polyester/cotton garments. Although the purchase cost of these garments is considerably higher than conventional cotton (approximately 50%), a survey conducted by a linen supply company and the Linen Supply Association of America indicates that the cost per garment-use is approximately 25% of that for cotton due to a greater garment life. The survey reports the total processing and linen consumption costs for the "hot box"/polyester-cotton system to be 50% of the cost of the conventional press/cotton system. Based upon these survey results, the uncertainty as to the actual demand, the fact that the cooperative laundry is operationally two-three years away, and the potential savings involved if the "hot box" is found practical, it is recommended that this approach be fully investigated. For the present, the equipment requirements and costs are projected on the assumption that the "hot box" will be implemented and the demand will require essentially the full "hot box" capacity.

COST OF PRESSWORK EQUIPMENT = $15,750

Cost of materials handling equipment specifically associated with presswork (monorail, truck tubs, etc.) = $4,300
OTHER MATERIALS HANDLING

In addition to the materials handling equipment specifically associated with the linen processing functions described above, it will be necessary to acquire additional equipment. Primarily, this will be for the purpose of conveying linens from one function to another. Since the basic system recommended entails the use of sling storage of in-process linens from pre-sort through to finishing (excluding full dry and press work), it is recommended that power and free overhead monorail be used to convey the majority of linens from one function to another. This will avoid both excessive floor congestion and extraneous staff for transporting linens.

Unaccounted for so far is the conveyance system for transporting finished flat and full dry work to cart loading, pack assembly, and linen inspection-repair areas. The cost of this additional equipment, plus other essentials such as inspection tables, pack assembly tables, miscellaneous carts, etc. is estimated here. This cost excludes the cost of equipment specifically used to store or distribute finished linens, as it is accounted for in the section on linen distribution.

COST OF OTHER MATERIALS HANDLING EQUIPMENT = $23,100
LINEN TRANSPORT, PLANT LOCATION, AND LAND

As part of the feasibility analysis, a detailed investigation was conducted of alternative distribution-retrieval systems and plant location. Only the most pertinent results are presented here.

Clean Linen Distribution and Retrieval

The distribution system should be an exchange cart system (as opposed to a bulk linen delivery system). Covered carts should be exchanged daily at each feasible direct delivery area in the hospital. Hospital personnel should make the exchange. A feasible direct delivery area is one which normally receives enough linen daily to justify the use of a cart 2' x 4' x 6' or 2' x 5' x 6". The total linen distribution system costs, including in-hospital distribution, will be $50,300 per year less under an exchange cart system than a bulk system.

A full day's set of carts should be exchanged daily between the cooperative laundry and the hospitals at central distribution points located near the point of cart entry. (Daily delivery and pick up of carts). A full set is defined as the total number of carts in each hospital. The aggregate full set requirement is estimated to be 150 carts.

Linen should be placed on carts at the cooperative laundry based upon daily maximum consumption quotas established in conjunction with the hospitals. Any linen not consumed should be left on the cart when the exchanges are made. This will return unused linen to the laundry for recirculation. After retrieval of unused linen, returned carts should be passed through a cleaning process. Quotas should be established in units of (10) on most items to facilitate ease of counting via bundling.

Consideration should be given to the cooperative laundry providing pack assembly service for OR-OB linen packs (excluding packs containing instruments, gloves, etc.) and daily discharge (or admission) packs. It is recommended that daily room packs not be assembled. Space, equipment, and staff have been planned for this function on a nominal basis, due to limited information and the increasing use of disposable linens in the speciality areas. No conclusive statement as to the justification of disposable linens can be offered at this time.

To avoid delivery schedule conflicts between the various personnel handling delivery carts (i.e., hospital and driver; driver and cart loaders), (5) full sets of carts should be in circulation, distributed as follows:

3 - In hospital
   1 - At use areas
   2 - In central storage (1 full - 1 empty, or 2 full)

2 - In cooperative laundry (or in transit)
   1- Full or being loaded
   1-Empty (stored on overhead monorail)

COST OF CLEAN LINEN DELIVERY and RETRIEVAL SYSTEM EQUIPMENT* = $196,750

* excludes delivery-retrieval trucks, which are on rental basis
Note: This cost would be reduced to the extent that existing delivery carts in the participating hospitals are acceptable. Until the actual credits are known, the above cost should be planned. Based upon current knowledge of existing carts, it is estimated that $25,000 in credits (or refunds) will be possible.

To accomplish distribution of full carts and retrieval of empties for the (13) participating hospitals, it will be necessary to lease the following trucking equipment (cost estimates shown).

(i) tractor-trailer combination (2-40' vans) - $822/mo. + $0.15/mile

(2) 20' vans - $600/mo. + $0.11/mile

A delivery-retrieval schedule (clean linen) has been developed, based upon the participation in the cooperative laundry of the (13) study hospitals at their projected size capacity. Based upon this schedule, the above trucks would be almost fully utilized one eight hour shift per day, seven days per week.

To accomplish loading of carts at the laundry in an orderly manner, it is recommended that bundled finished linen and packs coming from the finishing areas be stored on interim shelving. All identical items should be placed together. Items should be grouped locationally by similarity of use area (e.g. nursing station linens vs. nursery linens). Delivery carts should then be circulated to retrieve specific item requirements.

COST OF INTERIM SHELVING = $33,750

Soiled Linen Retrieval

The discussion of linen preliminary pre-sorting by hospital personnel has recommended the bagging of soiled linen. The soiled bags should be retrieved daily by the cooperative laundry from a central storage point within the hospital. This would leave hospital personnel responsible for transporting soiled bags to this point via truck, chutes, or both. The central storage point should be near the receiving-retrieval dock, as driver time has been scheduled assuming minimum driver walking to get linen.

The soiled linen bags should be transported to the laundry in soiled linen truck tubs of special design. Three sets of truck tubs should be in circulation at all times, with one always in the hospital for loading soiled linen bags. These trucks should be loaded by the hospital personnel responsible for collecting soiled linen bags, again to minimize driver time at the hospital. The number of truck tubs per set is projected at 110.

COST OF SOILED LINEN RETRIEVAL SYSTEM EQUIPMENT = $33,000
To accomplish retrieval of soiled linen for the (13) participating hospitals, it will be necessary to utilize the same amount of trucking equipment as leased for clean linens. The projected delivery schedule also shows the need for one full shift operation of these trucks, seven days per week. It is recommended that soiled linen be retrieved on an afternoon shift operation rather than leasing another full set of trucking equipment. The leasing cost for another set ($1,422/month) would be far more than the shift premium for afternoon drivers.

Summary of Transportation Cost

Trucking Costs (leases + all vehicle expenses) = $42,672/yr.

Driver Costs* = 46,044/yr.

TOTAL = $88,236/yr.

= $0.0054/lb.

* 6 full time positions, 7 days/week, 2 shifts, 5% shift differential

Plant Location and Land Cost

The major criteria for the selection of a general location area were the availability of utilities (water, sewer, gas, electric), the cost of land and the cost of transportation. The latter led to detailed consideration of the effect of alternate locations upon delivery time, truck requirements, driver requirements, and variable (mileage) costs. Assumptions of necessity were made as to the mix of specific hospitals participating in the laundry. Although it is recognized that all study participants may not become laundry participants and that others not in the study may wish to join the laundry, it was found that from a transportation cost point of view the study mix represented the "worst possible" or highest cost situation. Further, the study mix offers a combination of "core city" and "outlying suburban" hospitals, a mix considered typical.

The location was not considered highly sensitive to utility availability and land cost in that a) utilities were available in all areas feasible from a transportation cost view point, b) utility availability and land cost can change over several years time, and c) land cost is likely to be variable within the general area selected by the distribution cost analysis. In other words, uncertainty about a changing future led to the selection of a general location sector based upon more certain information (e.g., mileage, truck rental rates, mileage costs). In particular, the cost of land should not be heavily weighted when it is feasible that the land will be donated or nominally leased.

Because of relatively low mileage rates quoted by truck leasing firms, transportation cost was not as highly sensitive to slight shifts in location as may have been expected. The transportation costs estimated in this report are based on the assumption of a location somewhere near the Southfield Expressway, bounded by its intersection with the John Lodge Expressway on the north and the Edsel Ford Expressway on the south. Having considered population migration trends and the future...
hospital picture as presented by representatives of the Greater Detroit Area Hospital Council, Inc., this location sector seems preferable from all viewpoints. To be more specific, a location in the vicinity of the Southfield Expressway - Ford Road intersection is best from a transportation cost minimization viewpoint.

Land requirements (including parking and some growth allowance) are estimated at 70,000 sq. feet. Due to uncertainty as to the condition and specific location of the actual land, cost can only be estimated as:

\[
70,000 \text{ sq.ft.} \times \$3.00/\text{sq.ft.} = \$210,000 = \text{LAND COST}
\]
PLANT STAFFING

Processing Staff

To meet the projected demand through the use of the equipment previously recommended, the following staffing complement is recommended. Where possible staff has been computed on the basis of standard work measurement data. Requirements in terms of number of positions and number of personnel are shown. Number of personnel exceeds number of positions for 6 and 7 day per week functions. All positions are projected as 6 day per week except those associated with linen distribution and retrieval (7 day) and linen maintenance (repair-labeling) (5 day). Excluded from "Plant Staff" are truck drivers. This requirement and cost has been covered under "total transportation cost."

<table>
<thead>
<tr>
<th>Position Title</th>
<th>Number of Positions</th>
<th>Number of Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hopper Loader</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Pre-Sort Operator</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Wash &amp; Extract Men</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Tumbler Operator</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dry Fold</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Flatiron Finish Operator</td>
<td>30</td>
<td>58</td>
</tr>
<tr>
<td>Tiers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Pack Assembly</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Press Work Operators</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Cart Loaders</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Truck Loaders-Janitors</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Linen Maintenance</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total Regular</td>
<td>83</td>
<td>97</td>
</tr>
<tr>
<td>Absenteeism Allowance*</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>TOTAL PROCESSING PERSONNEL</td>
<td></td>
<td>110</td>
</tr>
</tbody>
</table>

* Assumes use of temporary and on-call personnel to maintain position complements during allowable absenteeism of regular employees (vacation, holiday, etc.). Assumes liberal fringe benefit program of up to 31 days allowable absenteeism/employee.
The brackets above indicate areas where it is desirable to train employees in all functions covered under the positions bracketed together. This has been done where personnel interchangeability can be achieved and is essential if workload scheduling problems and higher staff levels are to be avoided. Detailed staff cyclical schedules which preserve a 40 hour work week per employee should be developed during implementation.

The cost of the processing staff is projected under the assumption that the staff will average $2.00/hour in wages at least by the end of the first year of operation, if not immediately. This level is considered an inevitable reality. Washmen should receive 5-10% more per hour than other processing staff. In addition, a liberal fringe benefit program is envisioned (e.g. - vacation, holiday, and sick day allowance; health, life, and disability insurance, etc.) which together with employer expenses (workmens comp., FICA) will increase the average wage 20%.

\[
\text{PROCESSING STAFF ANNUAL COST} = 110 \text{ EMPLOYEES @ } \$4,992/\text{yr./emp.} = \$549,120/\text{yr.}
\]

Maintenance Staff

A modern complex production facility of the type proposed must have a full time staff to provide routine and emergency service to equipment and to maintain utilities at proper conditions. Recommend:

1. Chief Engineer @ $9,000 = $9,000
2. Maintenance men @ $6,500 = 13,000

Total (including fringe - 20%) = $26,400

This cost is in addition to building and machinery maintenance overhead (e.g. - insurance, parts, contractors).

Administrative Staff

The following administrative staff is recommended:

1. General Manager - Responsible for all phases of cooperative laundry management, including production, production control, distribution, hospital relations, cost control, purchasing, personnel, etc. Must be an experienced manager of people and production-service facilities (not necessarily laundries), capable of and dedicated to providing service, direction and control.

1. Production Manager - Reports to General Manager and holds responsibility for planning, organizing, directing, and controlling all phases of linen processing and handling in plant. Should be experienced in supervision of laundry production.
(2) Production Foremen  Responsibility for expediting production and providing line supervision to processing staff in selected areas. One assigned to linen distribution preparatory function (cart loading, pack assembly). One assigned to finishing area production (tumblers through finishing). In addition, one of the washroom personnel should be designated as working foreman.

(1) Transportation-Hospital Liaison Coordinator  Responsibility for maintaining the distribution and retrieval systems (scheduling, expediting, etc.); developing and maintaining cart linen service quality standards; auditing and recording linen inflow and outflow (by weight, by hospital); spot checking hospital compliance with procedures; solving supply problems of a non-production nature; auditing and maintaining linen inventory levels; supervising drivers. Achieving and maintaining linen standardization requires highly diplomatic, analytically-oriented individual.

(2) Industrial Engineers  Responsible for analysis and development relating to production schedules, job standards, job descriptions, job training procedures, incentives, work methods, work simplification. Test and examine new or alternative equipment, methods. Assist line management in development of management control procedures. Continually seek new levels of economy.

(1) Statistical-Clerk-Bookkeeper  Responsible for hospital billing, analysis of usage, losses, other statistical reporting, payroll preparation, other bookkeeping.

(1) Secretary-Clerk  Responsible for correspondence and miscellaneous clerical duties.
The projected cost of the above staff is projected as follows (including fringe @ 20%):

<table>
<thead>
<tr>
<th>Position</th>
<th>Rate</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Manager</td>
<td>$16,800</td>
<td>$16,800</td>
</tr>
<tr>
<td>Production Manager</td>
<td>$10,800</td>
<td>10,800</td>
</tr>
<tr>
<td>Production Foremen</td>
<td>$8,400</td>
<td>16,800</td>
</tr>
<tr>
<td>Coordinator</td>
<td>$8,400</td>
<td>8,400</td>
</tr>
<tr>
<td>Industrial Engineers</td>
<td>$13,200</td>
<td>26,400</td>
</tr>
<tr>
<td>Statistical Clerk</td>
<td>$6,600</td>
<td>6,600</td>
</tr>
<tr>
<td>Secretary Clerk</td>
<td>$4,800</td>
<td>4,800</td>
</tr>
</tbody>
</table>

Total Administrative Staff Cost = $90,600/year

TOTAL PLANT STAFF COST (Excluding Drivers) = $666,120/year
Space Allotment & Requirements

It is recommended that the laundry be designed with these major areas or levels at the following requirements per area:

- **Mezzanine** - 18,500 sq.ft.
- **Main Floor** - 62,500 sq.ft.
- **Basement** - 4,000 sq.ft.
- **Total** - 85,000 sq.ft.

The following is recommended allocation of the above space by major function or equipment:

<table>
<thead>
<tr>
<th><strong>Mezzanine</strong></th>
<th><strong>Main Level</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Soiled Storage (overhead)</td>
<td>Washroom (seperated)</td>
</tr>
<tr>
<td>Pre-Sort Stations</td>
<td>Finishing</td>
</tr>
<tr>
<td>Linen Identification</td>
<td>Fold</td>
</tr>
<tr>
<td>Central Supply System</td>
<td>Bundle</td>
</tr>
<tr>
<td>Clean Water Storage</td>
<td>Pack Assembly</td>
</tr>
<tr>
<td>Hopper Loading</td>
<td>Inspection</td>
</tr>
<tr>
<td>Restrooms</td>
<td>Repair</td>
</tr>
<tr>
<td></td>
<td>Clean Linen Storage</td>
</tr>
<tr>
<td></td>
<td>Empty Cart Storage</td>
</tr>
<tr>
<td></td>
<td>Full Cart Storage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Basement</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Boilers</td>
<td>Airconditioning</td>
</tr>
<tr>
<td>Heat Reclaimer</td>
<td>Air Compressors</td>
</tr>
<tr>
<td>Heat Exchanges</td>
<td>Auxiliary Heat System</td>
</tr>
<tr>
<td>Water Softeners</td>
<td>Auxiliary Generator</td>
</tr>
<tr>
<td>Shop</td>
<td>Utility Connections-Meters</td>
</tr>
<tr>
<td>Storeroom</td>
<td>Restrooms</td>
</tr>
</tbody>
</table>

COMMUNITY SYSTEMS FOUNDATION
Space & Utility Costs

The total cost of building and utilities covers not only the physical construction, but such ancillary expenses as all utility equipment (production, storage, processing), steam and return lines, water lines, air lines, gas lines, connection to machinery, elevator, ventilating fixtures, lighting fixtures, toilets, sprinklers, sewer lines, architectural-engineering fees, contingencies, etc. The cost is estimated below and is projected on the basis of experience in similar facilities. It should be taken as a liberal allowance which attempts to account for recent trends in building labor and material costs. Working with an experienced, competent A-E firm should produce a total facility within the guideline cost below.

\[
\text{SPACE & UTILITY COST} = 85,000 \text{ sq.ft.} \times \$32/\text{sq.ft.} = \$2,720,000
\]

Basic Specification Guidelines

Building - Avg. carrying capacity of 150-250 #/ft²

- Ceiling height - all 15'-17'
- Platforms: 2 covered (1 - soiled unloading; 1 cleaned load/unload)
- Elevator to Mezzanine and Basement
- Windows = All 4 sides for natural light and ventilation, but up high

Utilities - (Basic specs. - full details to be developed)

Water - Demand = 6800 lb./hr. (assumes 7.5 production hr./day as safety factor)

Consumption

Average¹

\[
\begin{align*}
\text{Hot} & : 3.0 \text{ Gal./lb.} \times 6800 \text{ lb./hr.} = 20,400 \text{ Gal./hr.} \\
\text{Cold} & : 1.5 \text{ Gal./lb.} \times 6800 \text{ lb./hr.} = 10,200 \text{ Gal./hr.} \\
\text{Total} & = 30,600 \text{ Gal./hr.} = 510 \text{ Gal./Min.}
\end{align*}
\]

¹ Based upon standards provided by American Institute of Laundering. Total actual consumption rate between 3.5 gal./lb. and 4.5 gal./lb.
Softening

Recommend zero hardness, softening of all water.

Softeners

Sufficient capacity = 2 x 510 gal./min. = 1020 gal./min. (max. demand)
Required -4 softeners having peak capacity = 280 gal./min. each
Regeneration = 1 hour (rotational)

Storage (Hot)

Sufficient capacity = 0.5 x 20,400 gal. = 10,200 gal.
Recommended 10,000 gallon hot water tank.

Heating

Reclaiming (use heat reclaimer)

Plan on reclaiming heat from 28,000 gal./hr. of waste water @ 130°F.

Exchangers

Plan to heat 40,000 gal./hr. of water from 75°F to 160°F

Tank Heater

Plan to heat 40,000 gal./hr. of water from 160°F to 180°F

Recovery rate requirements = 2 x 20,400 gal./hr. = 40,800 gal./hr. -- ok

Waste Flow

Plan drainage requirements based upon simultaneous dumping of 50% of washers

Steam

Recommend generation @ 125 p.s.i. - Total boiler horsepower and steam lb./hr. requirements to be developed after selection of specific equipment. Approximate boiler horsepower requirements to heat hot water = 431 BHP. Approximate lbs. of steam required to heat 20,000 gal./hr. = 20,000 lbs.
Electricity

Requirements to be developed after selection of specific equipment (based on rated motor horsepower of equipment). Recommend average load = 60% of connected load; peak load = 80% of connected load (per American Institute of Laundering).

Gas & Compressed Air

Requirements to be developed after selection of specific equipment.

Layout

A detailed layout of equipment placement is in the final stages of preparation. Preliminary layout has been done to determine the overall space requirements elaborated above. The determination of materials handling requirements have been made on the basis of projected distances between functions and projected spatial requirements to store in-process work. An unscaled block flow diagram of the basic plant and its major functional areas is shown here:

BLOCK FLOW DIAGRAM
INVENTORY

Inventory Level

A common problem in hospital laundries is insufficient linen. The amount of linen to be in circulation at all times depends upon the operating policies or criteria which are consistent with the goals of the organization. It is assumed that the basic goal of the cooperative laundry is to provide each member hospital with high quality, uninterrupted service, with a minimum amount of restrictions or internal hospital activities, and at the lowest possible cost.

To achieve these goals, the following criteria are recommended as the basis for the perpetual maintenance of an inventory equivalent to a seven day supply of all hospital linens:

1. Sufficient inventory to permit the laundry to "absorb" day to day fluctuations in actual linen usage, plus no Sunday processing, so as to always maintain a constant production workload six days per week.

2. Sufficient inventory to absorb periodic mechanical failure or other causes of plant shutdown for up to 48 consecutive production hours without loss of service.

3. Sufficient inventory to always have at least a full day's supply of clean linen in each hospital, but not in circulation.

4. Sufficient inventory to always have a full day's supply of clean linens in the laundry on carts ready for delivery.

5. Sufficient inventory to always have a full day's supply of linen in circulation in each hospital (in use, at using areas available for use, or soiled in bags).

6. Sufficient inventory to always have at least a full day's supply of soiled linen at the laundry ready to be pre-sorted.

7. Sufficient inventory to always have a full day's supply of linen in process throughout the plant, spread over the various processing functions.

The above criteria are designed to maximize the probability of meeting the service goals, allowing for the many unexpected events which could throw the system out of balance if inventory were too tight (e.g. - hospital late on cart exchange, driver sick, flatiron temporarily down, etc.). It is extremely important that the recommended level be maintained. This will require frequent physical inventory (quarterly recommended), plus a tightly controlled perpetual inventory system.
Based upon the above recommendations, the value of the perpetual inventory is projected at $490,000. Initial capital outlay will be somewhat lower due to anticipated absorption by the laundry of some individual hospital linen at time of start-up. Since it has been recommended that the laundry operate with its own linens which have been standardized on the basis of joint hospital requirements, the laundry can only buy back those linens which meet standardization criteria and are in good condition. Allowing for such buy back at 50% of purchase price new, the following total capital outlay is projected:

Cost of Initial Linen Inventory = $472,500

Linen Replacement Cost

It is inevitable that linen losses will be incurred through decay, damage, inadvertent discard, and theft. The extent of these losses can in part be predicted on the basis of previous experience. They can also be controlled through the establishment of strict controls and policies, such as perpetual inflow - outflow analysis procedures, inventory monitoring procedures, discard policies, inspection policies, etc. Under the assumption of sound procedures and policies to control losses, it is projected that unavoidable losses and subsequent replacement should run no more than $242,040 per year. Based upon this projection, it is recommended that the member hospitals be routinely charged $0.015 per soiled pound used. To the extent that replacement cost exceeds this amount, the difference should be pro-rated at the end of the year as a function of individual hospital losses (as measured by its cumulative inflow/outflow ratio).

Cost of Linen Replacement = $242,040/year
START-UP COST

Start-up cost refers to the following cost factors essential to account for:

1. Legal-financial fees (organizational costs)
2. Systems Consultants (planning, implementation)
3. Revenue losses due to the phasing of hospital entry.
4. Operating inefficiencies during "debugging" of the system.

These costs are estimated at $250,000 assuming hospital phasing at the rate of 2-3 per month, and staff phasing (excluding administrative and maintenance) over three months.

TOTAL START-UP COST = $250,000
OTHER IMPLEMENTATION CONSIDERATIONS

In addition to the hospital requirements discussed earlier (standardization, handling of internal delivery and retrieval of linens and linen carts, participation in perpetual inventory, sell back acceptable linens), other requirements exist.

- Assure the presence of a receiving dock which can be accessed by linen trucks backing up. Power tailgates will be provided on trucks to allow for dock height differences, but not to lower and raise individual carts for truck loading and unloading (too time consuming).

- Dispose of present equipment. At the present time, sufficient information is not available to determine specific pieces of equipment which can be purchased by the laundry from the individual hospitals. Buy back of some carts and (1) flatiron has already been discussed. It is doubtful that much other existing equipment will be acceptable, except possibly the small washer-extractor, 1-2 tumblers, scales, and miscellaneous tubs and tables. An estimate of existing production equipment salvage value has bee prepared for those hospitals which provided information. These estimates are as follows:

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Estimated Equipment Salvage Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brent</td>
<td>$ 550</td>
</tr>
<tr>
<td>Oakwood</td>
<td>20,550</td>
</tr>
<tr>
<td>Sinai</td>
<td>3,400</td>
</tr>
<tr>
<td>St. Joseph Mercy-Ann Arbor</td>
<td>16,700</td>
</tr>
<tr>
<td>St. Joseph Mercy-Mt. Clemens</td>
<td>6,520</td>
</tr>
<tr>
<td></td>
<td><strong>$47,720</strong></td>
</tr>
</tbody>
</table>

- Assure the availability of space in the hospital to store clean and soiled linen not in circulation and waiting to be delivered or retrieved. This will require the use of current surplus storage area, current laundry-linen area, or new space. The space estimate requirements per hospitals are as follows:
<table>
<thead>
<tr>
<th>Hospital</th>
<th>Clean Storage (Carts)</th>
<th>Soiled Storage (Carts)</th>
<th>Total Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brent</td>
<td>110 - sq.ft.</td>
<td>82 sq.ft.</td>
<td>192 sq.ft.</td>
</tr>
<tr>
<td>Dearborn</td>
<td>66</td>
<td>41</td>
<td>107</td>
</tr>
<tr>
<td>North Detroit</td>
<td>242</td>
<td>144</td>
<td>386</td>
</tr>
<tr>
<td>Oakwood</td>
<td>506</td>
<td>351</td>
<td>857</td>
</tr>
<tr>
<td>Park</td>
<td>132</td>
<td>103</td>
<td>235</td>
</tr>
<tr>
<td>Pontiac</td>
<td>374</td>
<td>268</td>
<td>642</td>
</tr>
<tr>
<td>Saline</td>
<td>44</td>
<td>21</td>
<td>65</td>
</tr>
<tr>
<td>Sinai</td>
<td>594</td>
<td>412</td>
<td>1006</td>
</tr>
<tr>
<td>Sumby</td>
<td>110</td>
<td>62</td>
<td>172</td>
</tr>
<tr>
<td>St. Joseph (Ann Arbor)</td>
<td>440</td>
<td>330</td>
<td>770</td>
</tr>
<tr>
<td>St. Joseph (Mt. Clemens)</td>
<td>286</td>
<td>206</td>
<td>492</td>
</tr>
<tr>
<td>Warren</td>
<td>66</td>
<td>41</td>
<td>107</td>
</tr>
<tr>
<td>Wyandotte</td>
<td>286</td>
<td>206</td>
<td>492</td>
</tr>
</tbody>
</table>

- Assure the availability of space at the use areas to store the linen carts. This will require approximately 10 sq.ft. of floor space per use area having its own cart (e.g., nursing station, surgery, outpatient, emergency, etc.) Carts should be stored in out-of-the-way, controlled areas (e.g., old linen closets - not halls).

- Make necessary adjustments in internal staffing. The amount of in-hospital staff will have to be determined when decisions are reached regarding exchange cart implementation, location and nature of linen pack assembly, soiled bagging implementation, etc. If the recommendations in this report are followed, no hospital should require more than (1) full-time person per 275 beds to deliver and retrieve linens and carts. Many of the hospitals will require considerably less (1 or 2) full time personnel to handle the internal transport function, and should attempt to delegate this function to current non-laundry staff (e.g., housekeeping, messenger service, stores). Assuming no full linen pack making is done in the hospital (excludes possibility of other packs containing linen and assembled in central supply), supervision
requirements will be nominal and should be delegated to non-laundry supervision (e.g., housekeeping, stores, central supply, etc.). However, someone in the hospital management structure should be appointed to represent the interests of the hospital in the cooperative laundry. Current laundry staff (if any) should be reviewed for reassignment to the cooperative laundry (if qualified and willing) or elsewhere in the hospital.
FINANCIAL SUMMARY

Capitalization Cost

Production and Transport Equipment: *

Pre-Sort $ 71,100

Washroom:

Wash $279,220
Extract 88,830 368,050

Finishing Area:

Dry-Condition $ 65,670
Flatiron 298,490
Dry Fold 36,150
Presswork 20,050 420,360

Other Materials Handling 23,100
Transport Equipment 263,500

TOTAL EQUIPMENT $1,146,110

Building and Utilities 2,720,000
Land 210,000
Linens 472,500
Start-up Costs 250,000
Contingencies 10,000

TOTAL CAPITALIZATION COST $4,808,610

*Includes integrated materials handling equipment; excludes trucks (on rental basis).
Operating Costs

Given below is a summary of the projected annual operating cost for the cooperative laundry. Included is an estimate of the average annual interest on capitalization. The assumptions to compute this interest are as follows:

- 100% of the Capitalization Cost Will be Financed.
- Interest Rate = 6%
- Payoff Period = 25 Years.

Depreciation is computed on a straight line basis. The average economic life for all equipment, excluding utilities, is 15 years. The average life for buildings and utilities is 40 years. Salvage value in both cases is taken at 10% of original cost.

Direct utility and supply costs (consumption for linen processing) are estimated based upon the experience of other laundries of similar nature and size. Building and machinery overhead is estimated similarly, and should cover the cost of insurance, repairs, and maintenance other than regular staff direct labor. Administrative overhead is estimated and should cover such costs as forms; office furniture, supplies, and equipment rental; data processing service, accountant and legal fees; telephone, guard service, travel, etc. The line item for transport covers all non-labor expenses such as truck rental, insurance, gas oil, maintenance, etc.

All other expenses have been discussed in the body of the report. It should be realized that this is a projection of the operating statement and not an estimate of revenue requirements.
<table>
<thead>
<tr>
<th>Expense Classification</th>
<th>Annual Cost</th>
<th>Cost/Pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor (including fringe)</td>
<td>$712,164</td>
<td>$0.0441</td>
</tr>
<tr>
<td>Plant (all but drivers)</td>
<td>$666,120 - $0.0413</td>
<td></td>
</tr>
<tr>
<td>Transport (drivers)</td>
<td>46,044 - 0.0028</td>
<td></td>
</tr>
<tr>
<td>Supplies</td>
<td>50,020</td>
<td>0.0031</td>
</tr>
<tr>
<td>Utilities</td>
<td>75,840</td>
<td>0.0047</td>
</tr>
<tr>
<td>Transport</td>
<td>42,672</td>
<td>0.0026</td>
</tr>
<tr>
<td>Linen Replacement</td>
<td>242,040</td>
<td>0.0150</td>
</tr>
<tr>
<td>Building &amp; Machinery Overhead</td>
<td>8,070</td>
<td>0.0005</td>
</tr>
<tr>
<td>Administrative Overhead</td>
<td>20,000</td>
<td>0.0012</td>
</tr>
<tr>
<td><strong>TOTAL DIRECT</strong></td>
<td>$1,150,806</td>
<td>$0.0713</td>
</tr>
<tr>
<td>Indirect:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td>$231,117</td>
<td>$0.0143</td>
</tr>
<tr>
<td>Equipment Depreciation</td>
<td>68,766</td>
<td>0.0043</td>
</tr>
<tr>
<td>Building &amp; Utility Depreciation</td>
<td>61,200</td>
<td>0.0038</td>
</tr>
<tr>
<td><strong>TOTAL INDIRECT</strong></td>
<td>$361,093</td>
<td>$0.0224</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$1,511,899</td>
<td>$0.0937</td>
</tr>
</tbody>
</table>
Revenue Requirements

Revenue requirements are computed on the assumption that the purposes of revenue are:

- To cover all actual operating cost
- To create a stable cash flow & meet unexpected contingencies
- To retire the initial debt
- To have sufficient funds available to replace plant and equipment when economic life is reached

Accordingly, four revenue factors are envisioned:

1. Direct Annual Operating Cost = $1,150,806/year $0.0713/lb.
2. Debt Retirement, including interest = 341,117/year 0.0211/lb.
3. Plant and Equipment Replacement Funding = 80,680/year 0.0050/lb.
4. Cash flow - Contingency Factor = 41,954/year 0.0026/lb.

TOTAL PROJECTED REVENUE REQUIRED $1,614,557/year $0.1000/lb.

The Plant and Equipment replacement funding factor is based on 3 assumptions:

1. It is desirable to fund equipment in full at least for the first economic life cycle.

2. It is not essential to fund building and utility replacement in full. Partial funding to protect against major utility problems is desirable.

3. Depreciation funding should be done assuming:
   - 2% annual inflation on cost
   - 5% annual interest on funds
   - 10% salvage value at economic life

To fund equipment replacement in full, $66,773/year ($0.0041/lb) would be required. To fund building and utility replacement in full, $47,475/year ($0.0029/lb.) would be required. The recommended combined funding level is $80,680/year ($0.0050/lb.).
Fee Structure

It is proposed that participants be assessed a fee of $0.10/lb. for every pound of soiled linen brought to the laundry. This would be the base charge for all routine work. Two other contingency charges could also be assessed:

1. Cost of reprocessing rejected linen (after repair and/or rewash). Recommend pro-rating reprocessing poundage @ 10c/lb. based upon bed count.

2. Cost of excessive linen replacement. As discussed earlier, recommend that actual replacement cost above anticipated be charged to those hospitals whose outflow/inflow ratios exceed normal (anticipated) tolerances. A charge formula can be developed.

There is no point, at this time, for charging for press work on a per piece basis.

RECOMMEND CHARGE PER POUND SOILED LINEN = $0.10
ORGANIZATIONAL CONSIDERATIONS

Corporate Organization

It is recommended that a non-profit corporation be created to house the proposed cooperative laundry. Since this is an enterprise solely for and created by hospitals, it is in reality a physical extension of each participating hospital. As such, it may be possible to obtain a federal income tax exemption under Section 501(c)(3) of the Internal Revenue Code or under pending legislation regarding joint hospital ventures.

The tax exempt status should be applied for immediately upon incorporation. The application should advance the position that the laundry is intended to be a "research laboratory" for hospital linen servicing, as well as a direct service of hospitals, owned and operated by hospitals. The former argument can be supported by the presence of a full-time industrial engineering staff engaged in the scientific analysis of present and potential production methods. CSF can assist in advancing the former argument.

Based upon the experiences in this area of other hospital cooperative laundries, there is some hope that a favorable ruling can be obtained either immediately or at least prior to actual start of service. This issue should not be considered a decisive factor in the decision to create the laundry.

The corporation can be created solely to provide linen service, or as a functionally broad-based corporation intended to house multiple joint hospital ventures, of which linen service is one. There are indications that the latter is preferable. CSF recommends this approach in the interest of expediting other joint ventures it believes to be feasible, and in the belief that this will help to gain tax exempt status.

Competent legal advice should be obtained in this area. The Detroit firm of Clark, Klein, Winter, Parsons and Prewitt, Attorneys-at-Law, have researched the cooperative laundry organization issue extensively and have advised on the incorporation of the hospital cooperative laundry being created in the Saginaw-Bay City area.

To obtain financing, it appears that the participating hospitals will have to jointly and severally guarantee the loan. Also they will probably be required to commit themselves to "substantially meeting their linen requirements" via the cooperative laundry for the life of the loan. Competent financial counsel should be retained to advise on requirements, alternatives, and costs.

The corporation should be organized so as to permit ingress and egress of hospitals, provided financial requirements are maintained. Participating hospitals should appoint one or more persons to represent them on the Board of Trustees of the joint venture corporation. This could be a hospital Board member and the hospital administrators.
Table of Organization

The following table of organization is recommended:

Members or Stockholders

Board of Trustees

Legal And Financial Counsel

General Manager

Hospital Advisory Committees
(Linen Standardization, etc.)

Hospital Coordination

Industrial Engineering

Maintenance

Production Manager

Clerical

Financial & Statistical

Transportation Staff

Foreman

Production Staff
COST COMPARISON: COOPERATIVE VS. INDIVIDUAL LAUNDRY

Comparison to Reported Cost

The comparison of costs for alternative means of meeting the same demand is difficult for two reasons:

1. There are usually differences in what is included in "cost."
2. There are usually differences in operating policies, quality of service, etc.

However, in the interest of the study participants, an attempt must be made to compare the cost of meeting linen needs in the cooperative laundry vs. in the individual hospital laundry or through other present means.

During the survey, hospitals were asked to make an assessment of their recent costs. The response to this request has only been partially fulfilled by some, and not at all by others.

No meaningful comparisons can be made of "total cost" due to the quality and incompleteness of the data. However, it is felt that a reasonably valid cost comparison can be made between the most important of all cost factors—direct labor per pound of linen processed—for those hospitals which have provided this data and which process their own linen. For the hospitals presently using commercial linen services, the comparison to total cooperative laundry cost is somewhat easier. However, it should be realized that commercial charges do not account for total hospital cost.

The hospitals having reported direct labor cost per pound and their data are as follows:

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Cost/Pound (Labor)</th>
<th>Qualifying Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oakwood</td>
<td>$ 0.0488</td>
<td>Laundry personnel only</td>
</tr>
<tr>
<td>Sinai</td>
<td>0.0495</td>
<td>All direct labor</td>
</tr>
<tr>
<td>St. Joseph - Mt. Clemens</td>
<td>0.0614</td>
<td>Laundry personnel only</td>
</tr>
<tr>
<td>Wyandotte</td>
<td>0.0499</td>
<td>All Direct labor</td>
</tr>
</tbody>
</table>

For purposes of comparison to the direct labor costs projected for the cooperative laundry, a downward adjustment should be made in the cooperative laundry labor costs, as they are based upon 1969-1970 projected labor rates. On the average, these rates are projected to be 26% higher than current rates, accounting for increases in fringe benefit costs also.

Adjusting the projected cooperative laundry direct labor cost "backward" to current wage rates yields a "current" cost of $0.0359/lb for direct labor (plant and transport). To this should be added the cost of linen transport in the hospital (delivery/retrieval) as this cost would be born separately by each hospital.
Analysis of the data provided on transportation workload inside the hospital indicates that a ratio of one full time employee for 275 beds would be an ample basis for providing internal staff to deliver and retrieve exchange carts, and retrieve bagged soiled linen in the absence of soiled linen carts.

On this basis, the additional cost of in-hospital transport would be $0.0029/lb, producing a total cooperative laundry system direct labor cost at current wage rates of $0.0388/lb. This is substantially less than any of the individual hospitals labor costs reported, even under the assumption that the reported labor costs include all linen related labor (maintenance time, pack assembly time, etc.).

The hospitals having reported the cost of commercial linen service and their data are as follows:

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Billing Cost/Pound</th>
<th>Qualifying Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warren</td>
<td>$0.1050</td>
<td>Reports additional expenditures of $0.041/lb for in-hospital labor. Total reported=$0.1461/lb.</td>
</tr>
<tr>
<td>Dearborn</td>
<td>0.1780</td>
<td>No data on additional in-hospital labor.</td>
</tr>
<tr>
<td>Saline</td>
<td>0.1970</td>
<td>No data on additional in-hospital labor.</td>
</tr>
</tbody>
</table>

The most meaningful comparison for these hospitals is that between the above commercial rates and the projected cooperative laundry fee structure—$0.10/lb. Adding the in-hospital personnel transport allowance discussed above, these hospitals should compare their total cost to $0.1029/lb.

**Comparison to "Ideal" Individual Hospital Costs**

CSF has performed a considerable number of industrial engineering studies in individual hospital laundries in the Detroit area. Many of these studies have led to substantial reductions in individual hospital cost. All have led to a thorough documentation of what costs might be under prevailing labor rates.

It is of interest to compare the projected cost of the cooperative laundry to the "typical" cost of a hospital having undergone intensive industrial engineering analysis and cost reduction. A review of the past CSF studies has led to the following information being determined as "typical" for the hospitals included:

- Direct labor cost/lb (1965) - $0.0412
- Average laundry employee wage rate (1965) - $1.48/hour + 15% fringe

COMMUNITY SYSTEMS FOUNDATION
The direct labor cost/lb above includes the cost of laundry personnel only and excludes in-hospital transport. Typically, these would be production, transport, supervisory, and clerical personnel. In contrast, the costs which are projected for the cooperative laundry include all of the same factors, plus the additional expenses of perpetual full-time maintenance and industrial engineering personnel.

To compare the "typical best" individual hospital costs to those of the cooperative laundry, some additional information and assumptions are required:

- Average laundry employee wage rate (1967)\(^1\) - $1.65/hr. + 15% fringe
- Average laundry employee wage rate (1969-70)\(^2\) = $2.00/hr. + 20% fringe
- Average hospital linen replacement costs\(^3\) - $0.188/lb
- Average hospital linen external transport cost = 0

Average other hospital laundry costs (supplies, utilities, overhead) equal to projected cooperative laundry other costs. Valid data not available for comparison.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Labor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant</td>
<td>$0.0333</td>
<td></td>
<td>$0.0413</td>
<td></td>
</tr>
<tr>
<td>Transport - laundry</td>
<td>$0.0466</td>
<td></td>
<td>$0.0590</td>
<td></td>
</tr>
<tr>
<td>Transport (trucks, mileage)</td>
<td>0.0026</td>
<td></td>
<td>0.0028</td>
<td></td>
</tr>
<tr>
<td>Linen Replacement</td>
<td>0.0150</td>
<td></td>
<td>0.0150</td>
<td></td>
</tr>
<tr>
<td>TOTAL COMPARISON COST</td>
<td>$0.0535</td>
<td></td>
<td>$0.0617</td>
<td></td>
</tr>
<tr>
<td>INDIVIDUAL OVER COOP.</td>
<td>+ $0.0119</td>
<td></td>
<td>+ $0.0161</td>
<td></td>
</tr>
</tbody>
</table>

Notice that while the 1969-70 cooperative laundrycost above increases 13.2% over its 1967 level, the 1969-70 individual hospital cost increases 16.7%. This is because the cooperative laundry is designed to be a less labor intensive system than an individual hospital laundry system can ever be. Whereas direct labor costs in a hospital laundry typically account for 60% of the total operating cost, the projected cooperative laundry labor cost accounts for only 47% of total.

\(^1\) Based upon survey data.

\(^2\) Projected (basis for projecting coop. laundry cost)

\(^3\) Based upon survey data—reasonably expected to remain higher than coop. laundry due to less strict controls.
Of interest is the trend in growth of cost difference indicated above:

![Graph showing cost difference over time](image)

Finally, a further extrapolation has been made of the CSF study data to project the labor cost in five years of meeting the linen needs of the thirteen study participants via individual hospital laundries, each operating with the minimum amount of labor possible, given the separate work loads. The cost of this approach, assuming wages of laundry workers continue to grow at current rates, would exceed in direct labor cost alone the cooperative laundry direct labor costs by $474,000 annually. This is equivalent to $135/bed/year for each of the study hospitals at projected bed levels.

**Conclusion**

Implement the cooperative laundry.