SAMPLE REPORT
WAREHOUSE SPACE EVALUATION AND
OPERATIONAL DESIGN

Presented to: [redacted]

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1. Scope

The following report is Phase II – Development of Improved Facilities for the "Spare Parts Warehouse Operation and Design" project. The objective of this phase of the project is to:

- Increase warehouse storage capacity, while maintaining optimum space utilization.
- Develop a layout that improves the efficiency of the day to day operations, thereby optimizing warehouse productivity.
- Provide consideration for alternative picking and storage methods that would enhance future operations and productivity.
- Describe improved warehouse procedures that are feasible to the context of the current operations.
- Consider future growth factors and changes to inventory coverage to ensure the new design provides the necessary storage capacity.
- Integrate the [redacted] storage requirements.
- Provide a written explanation of all proposed design changes. This would include describing the productivity benefits associated with the new design.
- Prepare budget costs and implementation requirements for the submitted changes to the warehouse layout.

Based on the results and findings from Phase I of the project (June 8, 2009), JDH has developed a proposed re-organization of the [redacted] warehouse which we feel meets the stated project objectives.

2. Development of Improved Parts Warehouse

Using the analysis and gathered information in Phase I, and our experience with similar operations, JDH Warehousing has developed a report outlining our proposed re-design of the warehouse. The following sections present the analysis, methodology, new layout and explanation of the proposed design.

2.1 Current Storage Configurations and Product Sizing

The parts inventory is stored on shelves and racking (plus 10 blue bins for hoses). There are a variety of shelf and rack sizes in use. These are summarized in the chart below.

	Width	**Depth**	**Height**	**CuFt**	**Quantity**	**Total CuFt**
Shelf 1	3′	1′	7′	21	31	651
Shelf 2	3′	1′	8′	24	24	576
Shelf 3	3′	1.5′	7′	31.5	175	5,513
Shelf 4	3′	2′	7′	42	45	1,890
Shelf 5	4′	2′	7′	56	15	840
				Total	**290**	**9,470**
Rack 1	10.25′	3′	9′	277	8	2,216
Rack 2	10.25′	3′	12.5	384	13	4,992
Rack 3	12.3′	3.5′	17′	732	10	7,320
Rack 4	8.3	3.5	14.5′	421	8	3,368
Rack 5	12.3′	3.5′	14.5′	624	4	2,496
				Total	**43**	**20,392**

As stated in the Phase I report, the parts master does not contain any product sizing. Therefore an average product size has been calculated based on the total available storage space in the chart above, compared to the number of skus/bins within that storage space.

In this situation, the inventory file from May 12/09 list 5,070 different SKUs stored in shelf locations. Based on the fact that there is 9,470 cu ft of shelf storage, the average product storage requirements for these items is 1.86 cu ft (i.e. 9,470 cu ft / 5,070 skus).

There are also bin locations in the shelves that have zero inventories. This fact must also be considered in the product sizing methodology.

Since the inventory file does not list these items, a conservative estimate of 10% of the in-stock sku count will be used to account for the empty bin locations.

Therefore the sizing average for shelf items is based on 5,577 bin locations stored in 9,470 cu ft of space. This gives an approximated average sizing 1.7 cu ft of required space for shelf items.

The same methodology has been used to develop average sizing for rack stored parts. Once again using the May 12 inventory file, it is determined there are 1,464 skus stored in rack locations. Using the available rack storage cube of 20,393, the average space requirement for rack stored items would be 13.9 cu ft. With 10% factored in for items with zero inventories, the sku count increases to 1,610. Using this sku count, the average storage requirement for rack items drops to 12.7 cu ft.

2.2 Inventory Storage Requirements

In order to create a warehouse design, it is necessary to determine the inventory storage requirements. A number of factors need to be considered in this process.

The first consideration is to look at the current inventory levels and compare that inventory to 12 months of sales. This will identify the level of inventory coverage, as well as items that are stored in inventory, but are inactive.

In the Phase I report (section 4.5), a product activity analysis was presented with four categories of activity. This analysis was based on [redacted] sales only. The chart below has been updated to include [redacted] sales. The category definitions remain the same as in the Phase I report.

	SKUs Sold	In Inventory	% Coverage
Cat A	227	209	97%
Cat B	1,131	1,048	94%
Cat C	4,346	2,850	68%
Cat D	3,359	1,018	33%
Inactive*	0	1,430	100%
Total	9,063	6,555	

*No sales in the last 12 months

Management has indicated there is an initiative to improve inventory coverage by up to 15%. Based on this policy the warehouse storage requirements would need to support the storage of up to 7,324 skus. This assumes the number of inactive items remains as is.

The allocation of shelves and racking for these items is listed in the chart below. Overall, 78% of the SKUs in inventory are stored are stored on shelves.

	Shelf Loc	% of Total	Rack Loc	% of Total
Cat A	121	58%	88	42%
Cat B	765	73%	283	27%
Cat C	2,192	77%	658	23%
Cat D	791	78%	227	22%
Inactive	1,219	85%	211	15%
Total	**5,088**	**78%**	**1,467**	**22%**

2.3 Projected Storage Requirements

The storage requirements are based on current inventory plus a 30% increase in SKU coverage. This increase in SKU count is due to new items, improved inventory coverage and potential new business in the future.

Shelves

	Current Shelf Items	30% Increase	Cube Req	Shelf Units*
Cat A	121	157	267	8
Cat B	765	995	1,692	53
Cat C	2,192	2,850	4,845	147
Cat D	791	1,028	1,748	53
Inactive	1,219	1,219*	2,072	63
Total	**5,088**	**6,249**	**10,624**	**324**

* No increase
* Based on an average shelf unit size of 33 cu ft

Racks

	Current Rack Items	30% Increase	Cube Req	Rack Units*
Cat A	88	114	1,448	3
Cat B	283	368	4,674	10
Cat C	658	855	10,859	23
Cat D	227	295	3,747	8
Inactive	211	211*	2,680	6
Total	**1,467**	**1,843**	**23,408**	**50**

* No increase
* Based on an average rack size of 474 cu ft

Currently there are 43 racks being used for parts storage. The analysis shows that with a 30% increase in parts storage, there is a requirement for 7 more racks. In order to accommodate this situation, it is necessary to 'free up' 7 racks. As it is, racks R15 – R21 are being

used to store items that should be stored on shelves. There are a total 429 items in these locations. These items will be moved to shelf storage, allowing for more rack storage. This will increase the shelf requirements from 324 units to 347 shelf units.

2.4 Product Slotting

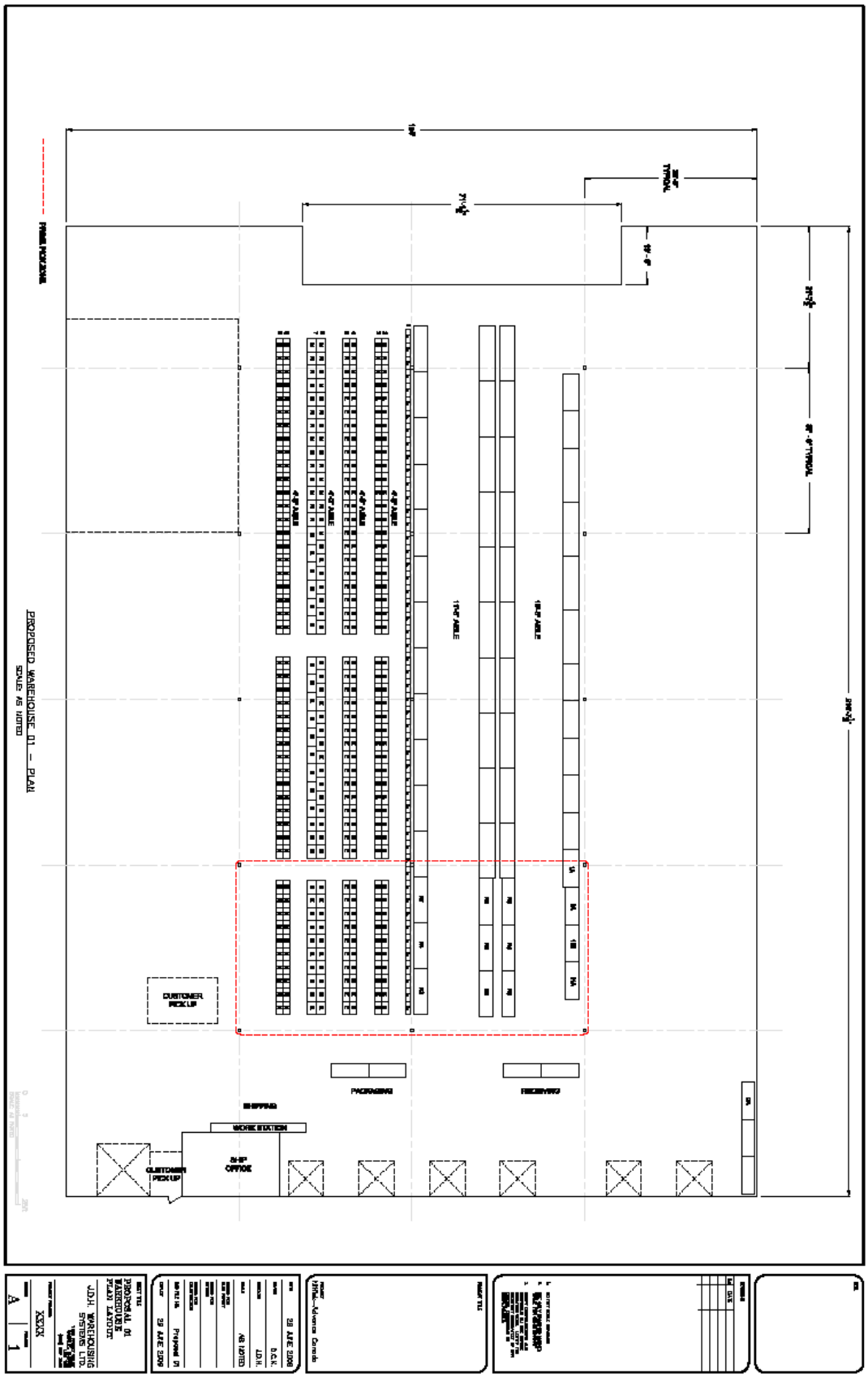
The chart below is based on 12 months of combined sales for [redacted] spare parts. Category A & B shelf items require only 61 shelf units, but will account for 71% of all pick requirements. Category A & B racked items need 13 bays of racking, which will account for 82% of all picks. This will represent the prime picking zone in the new warehouse design.

Category	**Shelves**			**Racks**		
	SKUs	**Picks**	**% of Total**	**SKUs**	**Picks**	**% of Total**
Cat A	121	10,653	27%	88	9,029	47%
Cat B	765	17,237	44%	283	6,765	35%
Cat C	2,192	10,547	27%	658	3,229	17%
Cat D	791	791	2%	227	227	1%
Total	3,869	39,228		1,256	19,250	

An Excel data file containing all the items that make up each category has been prepared for submission as part of this report.

2.5 Drawings

The following drawing depicts the proposed new layout for the [redacted] parts warehouse.


PROPOSED WAREHOUSE 01 — PLAN
SCALE AS NOTED
CUSTOMER PICK UP
SHIPPING
RECEIVING
WORK STATION
SHIP OFFICE
CUSTOMER PICK UP
JDH WAREHOUSING SYSTEMS LTD.
PROPOSAL 01 WAREHOUSE PLANT LAYOUT
XXXX
A
1
29 APR 2008
AS NOTED
JDH
Proposal 01

2.6 Explanation of Proposed Design

- The warehouse is approximately 32,000 sq. ft. Space allocated for shipping, receiving and packaging (i.e. staging area) is currently 8,550 sq. ft. This equates to approximately 25%. Ideally, the staging space allocation should equate to 10 – 15% of the total warehouse space.

- In the new design the staging area has been reduced to 5,700 sq. ft. (i.e. 18% space allocation).

- The receiving and packaging stations have been moved closer to the shipping/receiving doors, freeing up space for more inventory storage. There is a 10’ 6” cross aisle maintained between the two works stations and the shelves/racks. This will allow for easy forklift access.

- Racks 11A, 11B (receiving work station) and rack 9A (packaging work station) have been moved to the end of the row of racks closest to the east wall (next to rack 1A). These racks are currently being used for parts storage.

- Rack 0A will be moved to the south/east corner of the warehouse for storing packaging supplies.

- Racks R1 to R6 (which currently store [redacted] product), have been moved to the end of the current rows of racking. (i.e. R1 & R2 – next to R9, R3 & R4 – next to R7, and R5 & R6 – next to R8).

- May want to consider re-slotting the [redacted] parts that are stored in the racks closest to the east wall into the middle row of racking, and move the racked machine items to the outside row of racks. This will keep the spare parts all located in one section.

- Of the existing shelving, there are 31 units that are 3’ * 1’ * 7’ and 24 units of 3’ * 1’ * 8’. These have been reconfigured to provide one continuous row that runs down the center column next to the first row of racking. This provides 51 shelf units (the 4 left over will not be used). Just to note, the shelves on the drawing are designated as either E (for existing) or N (for new).

- The next existing size of shelving is 3’ * 1.5’ * 7’. There are 175 shelf units of this size. They make up the next 4 rows of

shelving. In order to complete these rows, 13 new shelf units of this size have been added.

- Rows 5 & 6 are made up of the shelves that are 3' * 2' * 7' (45 units) and 4' * 2' * 7' (15 shelf units). In order to complete these rows, 29 new shelf units (3' * 2' * 7') have been added.

- The last two rows are made up of new shelving sized at 3' * 1.5' * 7' for a total 94 shelf units.

- The new design contains a total or 422 shelving units. Based on the current available shelves (290 units), this represents an increase of 45% in storage capacity.

- The sizing analysis completed in the previous sections indicated that 347 shelf units were needed to support current and future operations. Therefore 422 shelves are about 22% higher than required. This will allow [redacted] a fair degree of flexibility. If only row 8 is added, the total shelf count will be 375 (within 8% of requirements). In the future, if more shelving is required, it will be very easy to add in 47 more shelf units (i.e. row 9).

- There are on average 7 levels of storage per shelf unit.

- The aisle widths between each row of shelving have been increased to 4' and the cross aisles have been set at 5'. This will provide easy access for the pickers to move through the shelves with their pick carts. This type of layout allows the pickers to move in one continuous pick route, as opposed to 'backtracking' down aisles as they do now. This will greatly reduce travel times and improve picking productivity.

- Products will be slotted by activity (i.e. fast moving items closest to the staging area). This will mean that for shelf stored items, the first section of shelving provides 90 shelf units for the fastest moving items. Based on the activity analysis in Section 2.4, 72% of all required picking will take place in this first section. This, combined with the new layout, will improve picking a minimum 2 – 3 times current rates.

- The same benefits occur for the racked stored items. Fast moving items will be stored closest to the staging. This means that by slotting Cat A and Cat B items in racks R1 – R10, 11A,

11B, 9a & 1A, 82% of all picking requirements will be contained in these 13 racks.

2.7 Alternative Solution - Horizontal Carousels

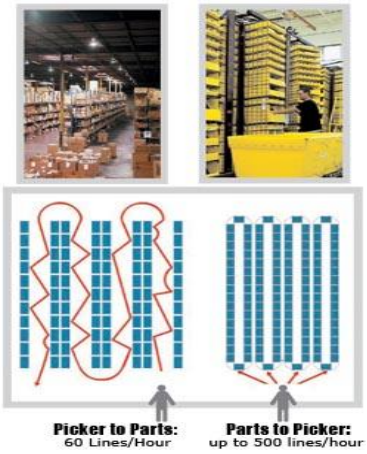
An alternative solution to picking from shelves would be to use horizontal carousels. A horizontal carousel consists of an oval track with rotating bins containing shelves that deliver items to the operator.

Often used in integrated workstations of carousels called a "pod." This allows an operator to pick from one active carousel while the others are pre-positioning to be picked the moment the operator is ready.

Typically there are 40 – 60 bins in a carousel. For 1.7 cu ft sized SKUs, the bins would be 2 ft wide*2ft deep*8' high. Therefore a 52 bin carousel would be 62 ft long and about 6 – 8 ft wide.

Based on the product sizing analysis for [redacted] shelf items, one carousel would store approximately 1,000 SKUs. This provides for a few alternatives. If just the faster moving items were to be stored in carousels, a pod of two carousels would make sense. On the other hand, if all active shelf items are stored in carousels, then the pod size would consists of 4 carousels.

Carousel solutions come with their own software and smarts to run the picking process. They do require interfacing with the company order entry system to be able to receive the pick requirements and to upload the pick confirmations. Also, when received items are 'inducted' into the carousel, there would have to be some sort of interface with the purchasing/inventory modules.



Traditionally these carousels offer improved productivity in the time it takes to pick an order. Each install varies, as do the productivity claims. Some initial discussions with vendors of horizontal carousels suggest that a solution for [redacted] would be able to support 2,000 lines picked per day by a single person. Also, less time would be needed to putaway receipts.

Two companies were contacted in order to establish budget costs for a carousel solution. The price range for a 4 carousel installation would be somewhere between $ 200k and $300k.

3. Operating Procedures

Although the majority of operating procedures will remain the same, there are opportunities to implement new procedures that will improve productivity. These include the following:

- Implementation of a new bin/location system. The suggested location system would be a seven digit alpha-numeric field. The first letter would represent the type of storage (i.e. shelf or rack), positions 2 – 3 would be the row number, positions 4 – 5 will be the storage bay, position 6 will be the level within the storage bay and position 7 will represent the position on the shelf. So for example, location S0110A6 would be a shelf location in row 01. It is the 10^{th} storage bay and the 6^{th} position on level A.

- Management has indicated that there will be minimum system support in terms of changes to the BAAN program. Despite this situation, there is one very simple system change that would improve picking efficiency. When the customer orders are entered in BAAN, they need to be sorted by bin location. This will allow the warehouse operator to move through the pick areas in sequence.

- As discussed in the Phase I report, the receiving process is very clerical and requires a lot keying of data. In the short term this will continue. Ultimately bar code scanning of this data will improve efficiency. The area that can be improved upon is in the putaway and slotting of product.

  Product putaway will become more efficient in the same way the new layout improves product picking. The receiving putaway cart should be set up to first separate shelf stored product and rack stored items. These items will then be further sorted in some sort of totes by row number. When it comes time to put the items away, the receiver will be able to move through the putaway process in an efficient manner. Also, since activity based slotting is part of the new design, most of the putaways will require less travel time.

  The other part of the receiving process that slows things down is looking for empty bins for new products. With the addition of new shelving and storage space, this should no longer be a problem.

- An item activity reporting system should be implemented and reviewed every three months by the warehouse. This will allow for re-slotting of products to make sure the fast moving items are in the correct shelf/rack locations.

- Sizing data for all items should be added to the item master listing. This will give management the ability to slot products in the optimum storage configurations. This will greatly improve space utilization.

- Although the BAAN system will not allowing grouping and batching of orders, the logistics manager should manually combine orders as much as possible. This, along with activity based product slotting and efficient pick routes will provide the most productivity gains.

  In the Phase I report, it was noted that 55% of the orders are single line items. These orders are best suited for batching. The manager can batch 10 of these orders, sequence them by location and issue them to floor. Other opportunities for batching would be for orders from the same customer, where all the orders are picked together and processed based on a scheduled ship date.

- In an effort to reduce backorders, management has initiated an effort to improve inventory coverage. Currently Cat A and Cat B items have very good inventory coverage (see Section 2.2). It is usually the Cat C and Cat D items that are backordered.

  When these situations occur, consideration should be given to shipping these items directly to the customer from the [redacted] location or from the supplier. This will save the warehouse all the processing time of receiving and re-shipping the backordered item.

4. Budget and Schedule

The following table represents the estimated capital and labour costs necessary to implement the proposed design changes. Costs are based on the assumption that current shelving will be used in the new layout where possible. It is estimated there is a need to purchase up to 136 new shelf units.

Labour costs for implementing the new layout will depend on what resources are available in-house and what will need to be outsourced. The major expenses will be for the purchase of new shelving. There are also labour costs to install the new equipment, and to re-locate existing shelves and racks.

Item	Cost/Unit	Qty	Total
Shelving			
3' wide * 1.5' deep * 7' high 3' wide * 2' deep * 7' high		107 29	
Sub - Total		136	$ 21,522
Installation			$ 3,095
Delivery			$ 575
Shelf and Racking Re-location			$ 5,000
Total			**$ 30,192**

Delivery - 2 - 3 Days
All prices are net, applicable taxes are extra
This quotation is valid for 5 days.

The implementation of the proposed solution would involve the following:

- Re-locate the packaging and receiving work stations.
- Move racks 11A, 11B, 9A & 0A to new locations.
- Racks R1 – R6 will then be moved to the ends of the existing rows of racks (see drawing). This will free up the space necessary to install the shelving for the Cat A & B shelf items.
- Create new bin locations for Cat A & B shelf items. Re-slot these items from their existing locations.
- Re-position existing shelving and install new shelving as per drawing.
- Set-up new bin location addresses for these shelves on the BAAN system.

- Move the rack items located in racks R15 – R21 to shelf locations.
- Re-slot Cat A & B rack items to the prime pick zone.
- Set-up the new bin location addresses for the rack locations.

It is estimated that the new layout could be set up and operational in 4 to 6 weeks (depending on available resources).