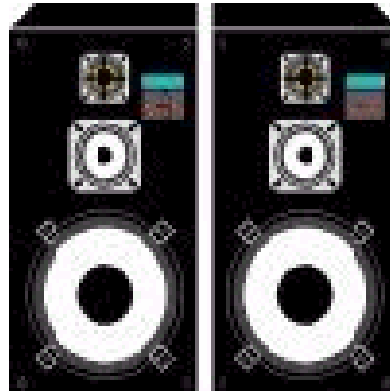


Sonic Speakers Facility Design



A College-Industry Council on Material Handling Education Case Study



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Developed in conjunction with Gross and Associates

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Project Summary

Student Teams will design a manufacturing, assembly and distribution center using good material handling practices. The project will require analysis and design of material flow, emphasizing design of a balanced assembly line, selection of appropriate material handling equipment, and a detailed description of the operation.

Report Format Suggestions

Cover Page - With project title, name(s).

Table of Contents - With page numbers.

Executive Summary - One page or less. Brief description of problem(s), approach, main findings and recommendations.

Introduction - Include an overview of the problem and operations. Briefly discuss the project thrust.

Problem Statement - Concise description of problem(s) that are addressed by this project. What is wrong? Who is being affected? Etc.

Approach and Methodology - This can have sub-sections. Justify your approach. What other approaches were available to you? This section should contain a literature review, with pertinent references cited from your reference section. Describe how you approached the problem - methods and procedures, assumptions, analysis techniques used, data sources. Why did you choose your approach?

Report Format Suggestions

Results - Provide a summary of numeric and qualitative results. Discussion of results and their sensitivity to changes in assumptions. Some graphs and charts would be good in this section. Detailed printouts or calculations should be put in an appendix. Note, all pertinent information must appear within the body of the report. The reader should only need to refer to the appendices to get more detailed information.

Recommendations and Implementation - Describe a clear list and discussion of your short-term and long-term recommendations. Follow this with an implementation plan. Discuss benefits for implementing your recommendations, as well as any limitations.

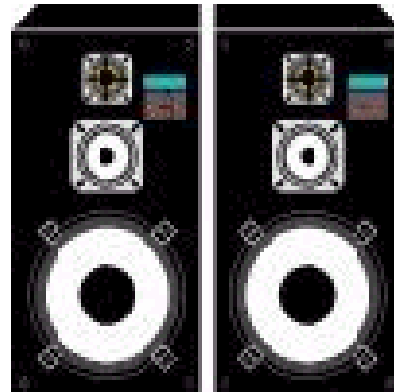
Conclusions and Acknowledgments.

Report Format Suggestions

References - (Including oral conversations, listed as “Personal Communication”.) Note, citations should be made throughout your report where appropriate.

Note - The Introduction section through the - Conclusions and Acknowledgment section should not exceed 15 pages. These 15 pages should stand alone, i.e., all critical information should appear within the 15 pages. The entire report, including appendices and executive summary, must not exceed 30 pages. The reader should not have to read the appendices unless he/she wishes to obtain more detailed information. You should follow the style of writing used in technical reports. (Concise and in third person.)

Sonic Speakers



Case Study Background & Objectives

Company Profile

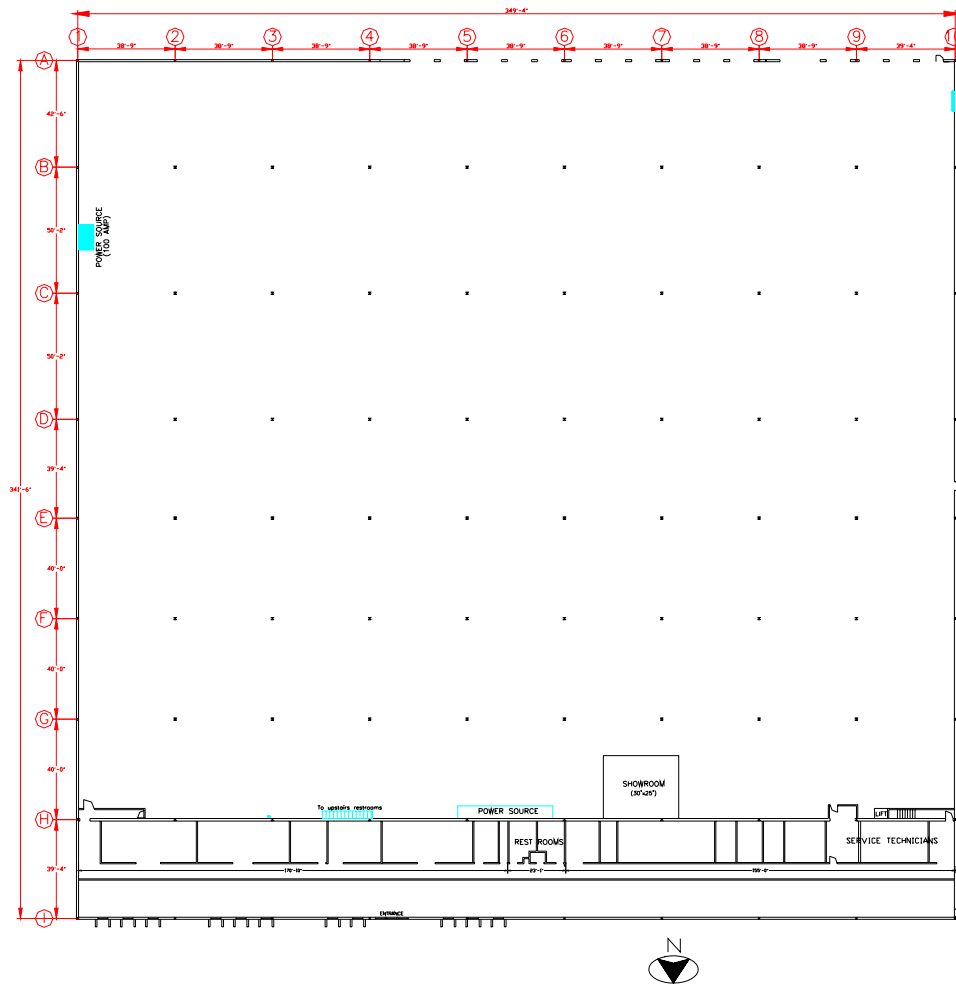
Sonic Speakers is a manufacturer and distributor of audio speaker systems. Their entire product line includes electronic sound systems, speaker systems, equipment cases and lighting equipment for professional use. They ship to both large and small retailers by way of a third party trucking company. Sonic outgrew its existing warehouse/ manufacturing facility and has acquired a new building. This new building will house offices, manufacturing, distribution and warehousing of finished goods, raw materials and packaging supplies. Sonic Speakers currently operates its manufacturing and shipping staff on a 10 hour schedule. They wish to remain on this schedule.

Facility Description

Sonic's new building is 120,000 sq. ft. facility with a clear stacking height of 20 feet. Included in the building is 15,000 sq. ft. of offices, 2900 sq. ft. for wood and carpet manufacture. The remaining 102,100 sq. ft will be used for warehouse space and the assembly system to be designed. There are 16 dock doors located on the south side of the building.

Empty Facility Space

(file available on case webpage)



Operational Details

The Sonic Speaker facility will receive in both raw materials and finished products. There are 3 types of raw materials: wood, which is used to make the panels for the speakers; carpet, which is used as speaker coverings; and assembly components, which are the non-Sonic manufactured parts for the speakers. These parts include the speakers, wires, transformers, screws, etc., which need to be stored as raw materials prior to assembly. The finished products, some of which are completed speakers, not assembled by Sonic in this facility, go directly to reserve storage.

In the wood production area, a work order (cut list) is released for the type of plywood required. The plywood is selected from storage and brought to a cutting area.

Operational Details

Using a CNC saw, the cut list is programmed and the wood is cut according to specifications. The software optimizes plywood usage to get the best combinations of fronts, backs, sides and tops of the various speaker boxes. Typically, for a given sheet of plywood, 80% is used for the currently ordered speaker SKUs while 20% is used for other speaker styles not included in the current order. Finished box components are palletized (by speaker group) and sent to WIP storage.

In the carpet processing area, a work order is released for the type of carpet and size of cut. The carpet rolls are picked and brought to cutting stations, where they are cut to the required lengths. The pieces of carpet are placed on pallets and sent to WIP storage.

Operational Details

Work orders are released for the assembly area, each containing product from WIP storage and component storage. The required materials are picked and brought to the assembly area. First the speaker boxes are assembled, except the back, then the carpet is glued to the box with the excess trimmed off. The unit then goes to electrical assembly where the speakers are placed in the box and wired. The speaker then gets its accessories (handles, casters, grills, etc.) installed. Once the speaker is fully assembled it is tested for operation (testing takes 1 minute/unit) before being packed into a carton and palletized by SKU. The completed speaker pallets are brought to finished goods storage.

Customer orders are sent to the floor for picking. All picks are

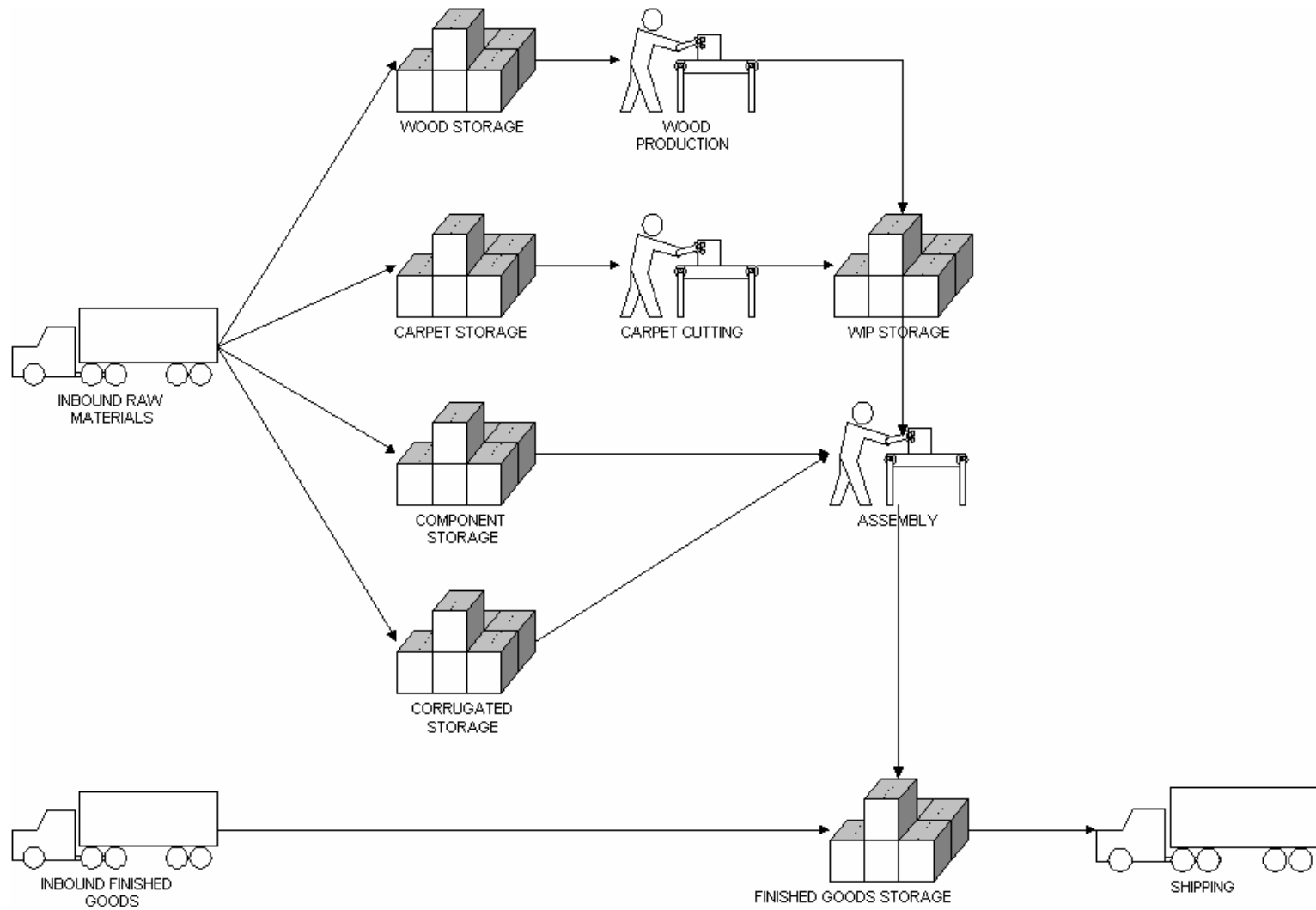
Operational Details

either full case or full pallet. Once the orders are finished being picked, they are staged, checked and manifested in shipping. All orders are sent by an LTL carrier.

Operational Details

- How Product is Received
 - Raw Materials
 - Wood
 - 4' x 8' plywood stacks
 - Stack height is 3 feet
 - Carpet
 - 8' long x 3' diameter rolls
 - Other Assembly Components
 - Palletized, standard 48" x 40" pallet; pallet height 5' including pallet
 - Finished Goods
 - Palletized, standard 48" x 40" pallet; pallet height 5' including pallet
- How Product Leaving Wood and Carpet Areas are Handled
 - Palletized, standard 48" x 40" pallet; pallet height 5' including pallet
- How Product Leaving Assembly is Handled
 - Palletized, standard 48" x 40" pallet; pallet height 5' including pallet
- How Product is Shipped
 - Palletized, standard 48" x 40" pallet; pallet height 5' including pallet

Basic Product Flow



Project Description

Sonic Speakers has hired you to design their new facility. Sonic has provided all the current storage and throughput data for this facility. The company anticipates steady volume growth of about 7% per year and an annual SKU growth of about 3%. It is assumed that order characteristics (lines/order, units/line, cartons/order) will remain the same.

Sonic is looking for you to help them develop the best material handling, storage and product flow for this facility including the assembly area. They have internally designed the carpet & wood processing departments and wish no re-engineering of these areas. They feel that these areas could sufficiently handle the required volume for the next 10 years.

Project Description

They have provided the space required and the direction of flow of product in these departments. The location of these departments have not been determined and should be placed where they best optimize the building space and the material handling infrastructure that you design for their facility.

Sonic hopes that this facility will last at least five years at the provided annual growth rate. They want you to provide them with the cost to enable them this five years and if they can make this building last longer.

Project Description – A Special Note on Ergonomics

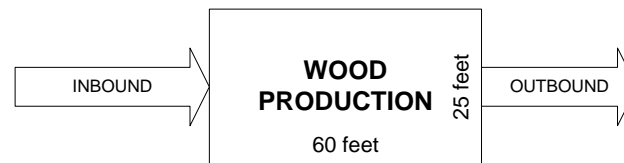
As the facility and the new assembly area are created, designers are urged to consider good ergonomic practices. Sonic Speakers has been concerned with an increasing incidence of reported injuries (both back and Cumulative Trauma Disorders – CTDs) as their workforce is aging. They wish that the facility design, particularly in the new assembly area, be focused on proper work heights with means to accommodate their workers of various sizes, ages and weights.

Project Description – A Special Note on Ergonomics

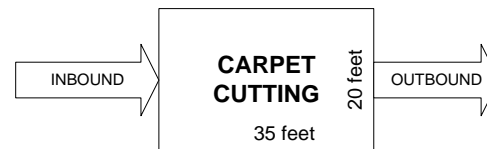
SS has expressed an interest in providing workers with lifting, reaching and other manual material handling aids to reduce workers' physical efforts in moving product at, to, and from their workstations. In addition, since the jobs in the assembly area are becoming more complex than they had been, they expect that the workstations' work areas and tool layout should be designed to simplify task activity and reduce the risk of CTDs, worker fatigue, and errors. SS hopes that using these cooperative approaches based on good ergonomic practices will lead to significant productivity improvements and reduction of risk and injury to their workforce.

Design Details

- Wood Production Area



- Carpet Cutting Area



Production areas include all inbound and outbound staging space, but not raw materials or WIP storage that are placed in a specially designated storage area.

Design Receiving Data

RECEIVING SUMMARY

	Raw Materials: Pre-Assembled or Pre-Processed				Finished Products
	Carpet	Plywood	Corrugated	Non-Sonic Manufactured Parts	Pre-Assembled Product
Average Day					
# of Trucks	0.2	0.2	0.25	1.5	3
# of Pallets/Stacks/Rolls	4	5	6	15	62
Peak Day					
# of Trucks	1	1	1	3	5
# of Pallets/Stacks/Rolls	20	22	24	25	104

Design Inventory Data

PEAK FINISHED GOODS INVENTORY

Range (Pallets)	# of SKUs	% of SKUs	# of Pallets	% of Pallets	Avg. Pallets/SKU
0 - 1	58	22.3%	36	2.1%	0.6
1 - 5	98	37.8%	334	19.3%	3.4
5 - 10	71	27.3%	523	30.2%	7.4
> 10	33	12.6%	838	48.4%	25.6
	260		1,732		

RAW MATERIAL INVENTORY

Type	# of SKUs	# of Pallets/ Rolls/Stacks
Carpet (Rolls)	8	31
Wood (Stacks)	14	48
Large Speaker Parts	32	123
Corrugated	47	142
Work in Progress	25	37

* Locations at or near the workstations need to be provide for small speaker parts such as wires and screws

Design Manufacturing Data

ASSEMBLY PROCESS: SPEAKER GROUP ASSEMBLY TIME MATRIX

Speaker Group	Finished Speaker Dimensions	Assemble Speaker Cases (Except Back)	Glue Drying	Carpet Attachment to Speaker Case	Put Speaker & Input Port into Speaker Case	Wire Speakers to Input Port	Close Back to Speakers	Attach Handles, Casters & Grills To Speaker	Testing	Carton, Label & Palletize
Speaker Group 1	24" x 18" x 18"	10 Min	60 Min	15 Min	4 Min	6 Min	2 Min	8 Min	1 Min	4 Min
Speaker Group 2	36" x 30" x 24"	12 Min	60 Min	16 Min	4 Min	6 Min	2 Min	8 Min	1 Min	4 Min
Speaker Group 3	48" x 30" x 24"	14 Min	60 Min	17 Min	4 Min	6 Min	2 Min	8 Min	1 Min	4 Min
Speaker Group 4	24" x 18" x 18"	12 Min	60 Min	17 Min	6 Min	9 Min	2 Min	10 Min	1 Min	4 Min
Speaker Group 5	36" x 30" x 24"	14 Min	60 Min	18 Min	6 Min	9 Min	2 Min	10 Min	1 Min	4 Min
Speaker Group 6	48" x 30" x 24"	16 Min	60 Min	19 Min	6 Min	9 Min	2 Min	10 Min	1 Min	4 Min
Speaker Group 7	36" x 30" x 24"	16 Min	60 Min	19 Min	8 Min	12 Min	2 Min	12 Min	1 Min	4 Min
Speaker Group 8	48" x 30" x 24"	18 Min	60 Min	20 Min	8 Min	12 Min	2 Min	12 Min	1 Min	4 Min
Speaker Group 9	54" x 30" x 24"	20 Min	60 Min	21 Min	8 Min	12 Min	2 Min	12 Min	1 Min	4 Min
Speaker Group 10	54" x 30" x 24"	22 Min	60 Min	22 Min	10 Min	15 Min	2 Min	14 Min	1 Min	4 Min

CURRENT WEEKLY PRODUCTION REQUIREMENTS

	Average Units	Peak Units
Speaker Group 1	115	127
Speaker Group 2	115	127
Speaker Group 3	100	110
Speaker Group 4	100	110
Speaker Group 5	100	110
Speaker Group 6	100	110
Speaker Group 7	85	94
Speaker Group 8	85	94
Speaker Group 9	85	94
Speaker Group 10	65	72

It is not expected that the current speaker groups or the ratio of production requirements will change with the addition of new skus.

ASSEMBLY PROCESS EQUIPMENT REQUIREMENTS

Assembling Speaker Cases:	Glue Gun, Screw Gun
Carpet Attachment to Speakers	Glue Gun, Staple Gun
Wire Speakers to Input Port	Wire Cutters
Close Back To Speakers	Screw Gun
Attach Handles, Casters & Grills	Screw Gun
Carton, Label & Palletize	Computer, Label Printer, Scan Gun, Packing Tape

MANUFACTURING RAW MATERIALS & WIP PICKING

	Average Day Work Orders	Average Day Pallets/Stacks/Rolls (Inbound)	Average Day Pallets (Outbound)	Peak Day Work Orders	Peak Day Pallets/Stacks/Rolls (Inbound)	Peak Day Pallets (Outbound)	Lines/Work Order
Wood Production	7	5	18	10	8	24	1
Carpet Cutting	7	7	10	10	10	14	1
Assembly	16	16	91	23	23	104	4

Design Movement Data

SHIPPING

	Average Day	Peak Day
# of Orders Shipped	59	83
# of Lines Picked	287	487
# of Cartons Picked	775	1686
# of Pallets Shipped	152	267
# of LTL Trucks	8	14

ORDER BREAKDOWN

Lines/Order	% of Orders
1	15.0%
2 - 3	45.0%
4 - 10	25.0%
11 - 20	13.0%
> 20	2.0%

PALLET BREAKDOWN

Pallets/Order	% of Orders
1	30.0%
2	45.0%
3 - 5	15.0%
6 - 10	8.6%
10 - 20	1.1%
> 20	0.3%

SHIPPING STATISTICS

% of Lines Picked Full Pallet: 5%

% of Cases Picked In Full Pallet: 8%

Equipment

- Students may use any material handling/storage equipment including but not limited to:
 - Pallet Rack – Single or Double Deep
 - Pushback Rack, Drive-In Rack
 - Lift Truck – Counterbalanced, Reach, Turret, Jacks
 - Case Flow Rack, Shelving, Carousels
 - Pallet Flow Systems
 - Dock levelers, Dock equipment
 - Conveyor – Powered and Gravity
 - Computers – WMS, scanners, RF technology
 - Mezzanines
 - Ergonomically-Designed Manual Handling and Workstation Leveling Equipment