

The model for Delta Hardware was based on past data. With all of its assumptions and approximations, there is no way to verify the validity of the model results without actually putting them into practice. Thus, the "solution" transmitted to the decision maker, including any what-if analyses of costs and factory production, has to be evaluated for viability by company experts.

STEP 4: COMMUNICATING/MONITORING THE RESULTS

The final step in the management science process is the *post-solution phase*. This phase involves two functions:

The Post-Solution Phase

1. Prepare a business report or presentation
2. Monitor the progress of the implementation

PREPARE A BUSINESS REPORT OR PRESENTATION

Effective communication of the results of a management science study is essential to its success. An analysis is of little use if those who will be making the decisions and implementing the policies do not fully appreciate its value. The decision maker should completely understand the team's approach to the problem, the assumptions and approximations made, and the logic of any recommendations.

Oral presentations (using slides, videos, or presentation software such as PowerPoint) and business memos or reports are the traditional forms of communication. In Section 1.5 we present guidelines for writing effective business reports.

MONITOR THE PROGRESS OF THE IMPLEMENTATION

After a business presentation or report has been submitted, management will be responsible for implementation of the recommendations. These policies may result in changes that might be resisted by members of the firm. The management science team should be ready to stand side by side with management to share responsibility for the procedures required for implementation.

Once the new policies have been implemented, they should be constantly scrutinized. Given the dynamic nature of most business environments, it is almost inevitable that changes to the model will be required over time. The management science team should be prepared to determine when changes to the model are necessary and make such changes swiftly when called upon.

1.5 Writing Business Reports/Memos

GUIDELINES FOR PREPARING BUSINESS REPORTS/PRESENTATIONS

Whether one is writing a report or preparing a presentation, it is important that the communication be well organized and presented in a clear manner that emphasizes the main recommendations of the study. The following are general guidelines for such presentations.

Be Concise

While not leaving out important details, get to the point. Managers do not like to read lengthy reports or attend lengthy presentations. In general, the fewer words needed to make a point the better, and the more the report is appreciated. Do not

fill the report with extraneous material. When choosing which what-if analyses to include, make sure the scenarios are plausible and have a reasonable likelihood of occurring.

Use Common, Everyday Language

The terminology and symbols used to represent decision variables and parameters in management science models may be familiar to the analyst, but avoid the use of technical terms and symbols in a report. For example, while the Delta Hardware problem included both the symbol, X_1 , which was used to represent the number of truckloads of paint shipped from Phoenix to San Jose, and the term *reduced cost*, neither should appear in a business report. Know your audience and express the information in terms they can understand.

Whenever possible, let someone else proofread the report carefully for clarity and style. The proofreader should also check the report to ensure that it contains no misspellings and that paragraphs are well constructed and written in complete sentences.

Make Liberal Use of Graphics

The use of properly labeled charts, graphs, and pictures, and the minimization of text, make a report much more readable and appealing to the eye. A business report or presentation is one place where the saying "a picture is worth a thousand words" is actually an underestimation of a picture's worth. Managers prefer visualizing results that allow them to make comparisons easily. No one wants to find results or recommendations buried in lengthy, hard-to-find paragraphs.

The actual presentation of figures is also important. All charts and graphs should be large, easy to read, and properly labeled, including the conditions under which the graph applies. Common sense should always guide a chart's preparation. For example, tables and graphs should not be split over two or more pages, if at all possible.

STRUCTURE OF A BUSINESS REPORT

Although there is no rigid structure for business reports, the following format has served the authors well in their industrial and consulting experiences.

Components of a Business Presentation

1. Introduction—problem statement
2. Assumptions/approximations made
3. Solution approach/computer program used
4. Results—presentation/analysis
5. What-if analyses
6. Overall recommendation
7. Appendices

Introduction—Problem Statement

The introduction should outline the problem that management and the management science team mutually agreed upon, so that there are no misunderstandings of the results discussed in the presentation. The actual length and style of the introduction will vary, depending on the audience for which the report is intended. Since the recipient is interested primarily in the recommendations, however, the introduction should be just long enough to explain the problem fully.

Assumptions/Approximations Made

This section could be included either as part of the introduction or as a separate section. Because the recommendations are based on a mathematical model that is an idealization of real life, the decision maker should be aware of any simplifying assumptions or approximations that are made. This allows the decision maker to make an independent judgment as to the model's usefulness.

Solution Approach/Computer Program Used

This section should be very brief (a sentence or two) and could also be part of a general introduction. In a slide presentation, it would most likely appear on one overhead outlining the procedure used. No details should be presented. A statement indicating that the problem was modeled as a linear program, a transportation model, or a periodic review inventory model may be all that is needed. For an audience not familiar with these terms, a brief one- or two-sentence description of the approach will suffice. Finally, a sentence detailing the computer program used (Excel, specialized software, etc.) lends credence to the validity of the results.

Results—Presentation/Analysis

This is the "meat" of the report and should be written concisely and clearly and include graphics. Charts and graphs should not only present the solution, but should also show *how the solution meets the restrictions of the problem*. Try to analyze the implications of the solution as they affect the business and note any unusual or striking conclusions that can be drawn from the results.

What-If Analyses

In this section, the management science team demonstrates to the decision makers that they have considered contingencies that might result from changes in the assumptions and parameters of the model. Some information can be obtained from sensitivity reports contained in standard computer output; other results may be generated by resolving the model to account for these changes. Although several possibilities may be analyzed, this section may lose some of its appeal if too many contingencies are considered.

Overall Recommendation

This section differs from the Results section in that it gives the best overall recommendations after considering the what-if contingencies. These recommendations may indeed differ from those of the basic model. These recommendations can be prominently displayed through the use of boxes, color, or some other highlighting device. Again, using charts, tables, and pictures where possible is preferable to presenting results in paragraph form.

Appendices

Material in appendices can be much more technical. An appendix is the place to put supporting computer output or hand calculations, or to detail any approaches used. Depending on the recipients of the report, an appendix may include a complete mathematical model formulation, replete with mathematical symbols and notation.

BUSINESS MEMO FOR DELTA HARDWARE

We now present a business memo for Delta management based on the results from the model developed and solved in Section 1.4. As with all memos presented in this text, it will be assumed to be prepared by a team of management science consultants known as the Student Consulting Group.

In the following memo, using a few short paragraphs, the problem is clearly laid out, the assumptions are stated, and the approach is given. The results are then presented and the major findings highlighted.

What-if analyses include a statement of the effect of changes in subcontractor pricing (which can be determined directly from the computer output) and a graph showing how the total cost is affected by the production levels of 6000, 7000, 8000, 9000, and 10,000 gallons at the Phoenix plant. An overall recommendation is then presented in an easy-to-read table. Finally, other factors that could substantially affect costs are recommended for future study.

For space reasons, no appendices are given. In addition to the computer print-out of the solution and total cost values for the various possible production levels at the Phoenix plant, such appendices might include (1) the complete mathematical model; (2) an analysis of the forecasted production level at Phoenix for the next month; and (3) calculations of the per gallon costs at the Phoenix plant. These appendices would be based on discussions of these topics developed earlier in this chapter.

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STUDENT CONSULTING GROUP

MEMORANDUM

To: Patricia Winters
Delta Hardware Stores

From: Student Consulting Group

Subj: Shipment Plan for Paint from the Phoenix Plant

Delta Hardware Stores is seeking a shipping policy for paint from its Phoenix plant and an ordering policy of paint from its subcontractor to meet demand at its warehouses in San Jose, Fresno, and Azusa. The objective is to minimize the overall total cost of next month's operations.

The current company policy is to ship only trucks fully loaded with 1000 gallons of paint from the Phoenix plant to the warehouse cities. To obtain the lowest shipping fees and a \$5 per gallon price for paint from your subcontractor, Delta's policy requires that shipments from its subcontractor must also be in 1000-gallon batches. You have directed that no more than 5000 gallons of paint be purchased next month from the subcontractor.

Since monthly production at the Phoenix plant has not been constant, production for the upcoming month was forecasted using production data of the past 12 months, excluding the period in which the plant was shut down for machine overhaul. Direct and indirect production and shipping costs attributed to the manufacture and distribution of the paint from the Phoenix plant were supplied by the accounting department.

Using these data, your problem was formulated as a transportation problem and solved using an Excel spreadsheet.

RESULTS

Based on a forecast of an 8000-gallon production level at the Phoenix plant for the coming month and the orders from the warehouse cities, we recommend the shipping pattern shown in Table I.

TABLE I Recommended Shipping Pattern for a Projected Production Capacity of 8000 Gallons

From	To	Gallons	Cost
Phoenix	San Jose	1000	\$4,050
	Fresno	2000	\$7,500
	Azusa	5000	\$18,250
Subcontractor	San Jose	3000	\$18,600
Total Cost			\$48,400

Shipments should be at these levels, unless the subcontractor lowers its ordering/shipping costs by more than \$0.50 per gallon to Fresno or by more than \$0.30 per gallon to Azusa. Below these values, it would be more cost effective for the subcontractor to send paint to Fresno or Azusa, respectively. As a result, Delta would decrease its shipment of paint from the Phoenix plant to those cities and increase its shipment of paint from Phoenix to San Jose by a similar amount.

Because monthly production levels at the Phoenix plant have varied, we have examined the effects of production levels between 6000 and 10,000 gallons. Figure I depicts the reduction in the total cost with increasing production levels from 6000 to 10,000 gallons at the Phoenix plant. These cost levels are attained as follows:

Achieving Minimum Total Cost

1. Fill the Fresno order from the Phoenix plant.
2. Fill as much of the Azusa order as possible from the Phoenix plant.
3. Use any remaining paint at the Phoenix plant to fill as much of the San Jose order as possible.
4. Meet the outstanding demand at any warehouse through shipments from the subcontractor.

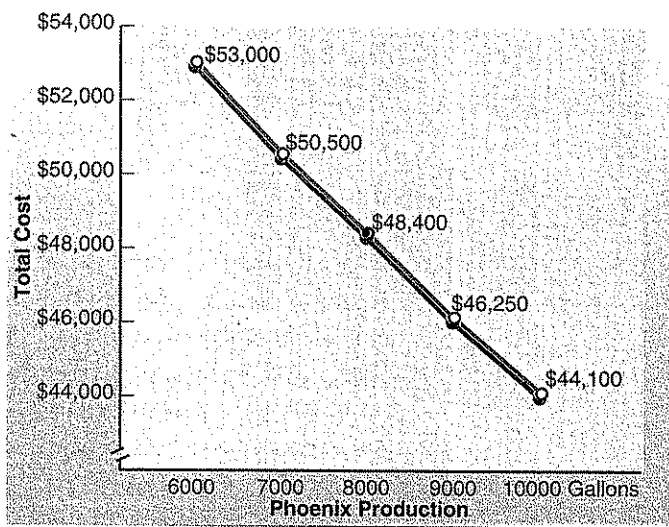


FIGURE I Total Cost vs. Phoenix Production

RECOMMENDATION

Table II summarizes the recommended shipping patterns for the month based on production levels at the Phoenix plant varying between 6000 and 10,000 gallons.

TABLE II Recommended Shipping Patterns

Plant Production	Shipments From	San Jose	To Fresno	Azusa
6000	Phoenix plant		2000	4000
	Subcontractor	4000		1000
7000	Phoenix plant		2000	5000
	Subcontractor	4000		
8000	Phoenix plant	1000	2000	5000
	Subcontractor	3000		
9000	Phoenix plant	2000	2000	5000
	Subcontractor	2000		
10,000	Phoenix plant	3000	2000	5000
	Subcontractor	1000		

PROPOSAL FOR ADDITIONAL STUDY

Production levels at the Phoenix plant may not be in 1000-gallon units. If production falls between 1000-gallon units, it may well be more cost effective to ship a large partial shipment and pay increased per gallon fees to the subcontractor than to pay the storage costs necessary to carry an inventory of a few hundred gallons of paint from this month to the next at the Phoenix plant. An analysis of these storage costs, partial truckload shipment costs from the Phoenix plant, and increased per gallon fees by the subcontractor should be conducted.

The Student Consulting Group is available to assist Delta Hardware in obtaining these data and determining optimal policies under these modified conditions.

1.6 Using Spreadsheets in Management Science Models

Spreadsheets have become a powerful tool in management science modeling. The following are just some of the reasons for their growing importance.

1. Data are often submitted to the modeler in a spreadsheet.
2. Data can easily be turned into information on the spreadsheet using formulas, embedded functions, and statistical or optimization subroutines.
3. Data and information can easily be turned into informative visual displays using spreadsheet charting and graphing functions.
4. Spreadsheets have become the de facto "language of business."

Although many spreadsheets are available on the market (including Quattro Pro, Lotus 1-2-3, and Microsoft Works), Microsoft Excel has emerged as the industry leader. Therefore, Excel is illustrated in every chapter throughout this text.