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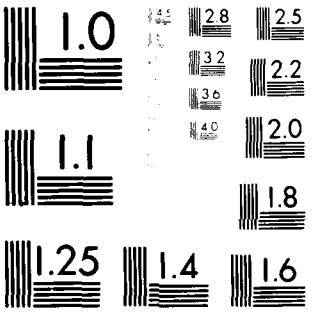

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COMMERCIAL VESSEL SAFETY

ECONOMIC COSTS

APPENDIX A
ESTIMATION PROCEDURES FOR COSTS AND COST IMPACTS OF MARINE SAFETY REGULATIONS

Planning Research Corporation
Systems Services Company
7600 Old Springhouse Road
McLean, VA 22102

DECEMBER 1979
FINAL REPORT

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Prepared for

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD
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16. Abstract

The effort documented in this report provides methods and procedures for the U. S. Coast Guard's economic assessment of regulatory actions under the Commercial Vessel Safety Program. Three distinct tasks were undertaken: a survey of cost-benefit methodologies; development of a methodology and procedures for estimating the costs of regulatory actions; and an exercise of the procedures.

The methodology survey involved a literature search of studies, reports, regulations and economic models. The direction of the survey was divided into two major parts. First, the determination of applicable procedures for estimating direct costs to industry and Government. Second, the determination of cost impacts as they are passed through the economy.

The development of a methodology and procedures for assessing the costs and cost impacts of Coast Guard regulations involved the development of step-by-step procedures in a "how to" manual format for regulations that effect: vessel design, vessel equipment, vessel staffing, vessel licensing, vessel inspection and vessel operating costs. The procedures describe, for each cost element, what to look for in developing costs, pitfalls to be avoided and sources for cost inputs. Input-output techniques, using the University of Maryland's INFORUM model, are used to trace the cost impacts of regulatory actions.

Three exercises were carried out to test the manual procedures on current Coast Guard regulatory issues. The subjects of the exercises were: Example I: Proposed Tankerman Regulations; Example II: Double Hull Retrofit for Existing Tank Barges; Example III: Vessel Delays at the Hackensack River Portal Bridge. (NOTE: These exercises are unpublished)

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Prepared for:

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For

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SECTION I
INTRODUCTION

This manual is designed to aid in the regulatory evaluation process. Its primary goal is to provide Coast Guard analysts with systematic procedures for estimating and comparing costs and benefits of alternative Coast Guard regulatory actions. A secondary goal is to provide procedures whereby the regulatory staff can trace the interindustry and economy-wide impacts of regulation costs.

To these ends, this manual contains:

(1) Procedures for calculating costs and benefits and cost factors for use when applicable.

(2) Formats for categorizing and tallying the costs and benefits of alternative regulations.

(3) Procedures for tracing major impacts of costs throughout the economy.

In summary, the overall objective of this manual is to apprise decision-makers of the relative consequences of regulatory actions. The regulatory staff can satisfy this objective by adhering to the guidelines contained in the following sections. Three examples of applications of these procedures, two that address proposed Coast Guard regulations and one that examines an ongoing operational problem, are presented in Appendix B.

This manual has 10 sections. A brief description of each section is provided as a quick reference guide to assist the reader in locating manual segments of immediate interest.

SECTION I. INTRODUCTION

A brief description of the objectives of the manual.

SECTION II. METHODOLOGY OVERVIEW

A discussion of how marine safety cost-benefit analysis relates to overall risk management in reducing marine accidents, to include basic steps in conducting cost-benefit analyses.

SECTION III. ASSUMPTIONS AND DEFINITIONS

This section is used to define the scope and ground rules of the cost-benefit analyses to be conducted. It itemizes commonly used techniques and assumptions employed in cost-benefit analysis.

SECTION IV. COST CATEGORIES AND ELEMENTS

Provides a listing of cost categories and cost elements used to collect costs of regulatory actions.

SECTION V. FORMATS FOR COST MEASUREMENT

Formats contained in this section provide the structure for calculation of all total costs to be incurred by industry and government to implement a regulation.

SECTION VI. COST PROCEDURES AND FACTOR DEVELOPMENT

This section explains how to develop cost factors, techniques to be employed in making cost estimates and guidance on what to look for in developing regulatory costs for vessel design, equipment, staffing, licensing, inspection and regulatory operating changes.

SECTION VII. COST FACTORS

This section contains a collection of selected cost factors which may be employed to fill in formats contained in section V (in selected cases, particularly vessel operating costs).

SECTION VIII. FLEET FORECAST

This section contains forecasts of changes in U.S. and world fleet sizes by vessel groupings. This is useful in estimating costs to different vessels that are impacted by regulatory changes.

SECTION IX. COST IMPACT PROCEDURES

This section explains procedures [illegible]ace the impacts of regulatory-generated costs and prices as they pa[illegible]rough the economy to ultimate consumers. It is designed to show macro and microeconomic impacts associated with regulatory action where measurable. Discussion focuses on use of a computerized input-output model titled INFORUM.

SECTION X. EXPECTED IMPACTS OF CVS REGULATIONS

This section contains an example which helps the analyst trace cost impacts of regulatory actions. It is particularly useful when regulatory cost impacts are not large enough to be measured on the computerized input-out model (INFORUM) used to trace cost impacts throughout the economy.

SECTION II
METHODOLOGY OVERVIEW

The application of cost-benefit techniques to regulatory analysis enables the regulatory staff to determine if the value of what is produced by the regulation, e.g., increased safety, is greater than the value of the resources consumed. It is axiomatic that the benefits and costs of regulations can be valued only if they can be counted.

Figure 1 graphically depicts the flow of this relationship between risk assessment and cost-benefit analysis as it relates to the total risk management decision process. A brief walk-through of the blocks in this flow chart reveals the following methodology points:

Block 1 - Events: A typical type of event to trigger a requirement for regulatory analysis is a vessel casualty. Vessel casualty types supported by historical frequency data include:

- Collision
- Grounding
- Fire/Explosion
- Ramming
- Capsizing
- Foundering
- Flooding
- Weather Damage
- Structural Failure
- Other

Block 2 - Identified Problem: If a specific problem can be pinpointed, e.g., vessel groundings and breakups associated with oil spills, it is possible to develop competing alternatives to either solve the problem or mitigate the consequences.

Blocks 3A & B - Controllable/Uncontrollable Elements: A distinction must be made between those actions which are controllable such as vessel equipment and those which are not such as weather.

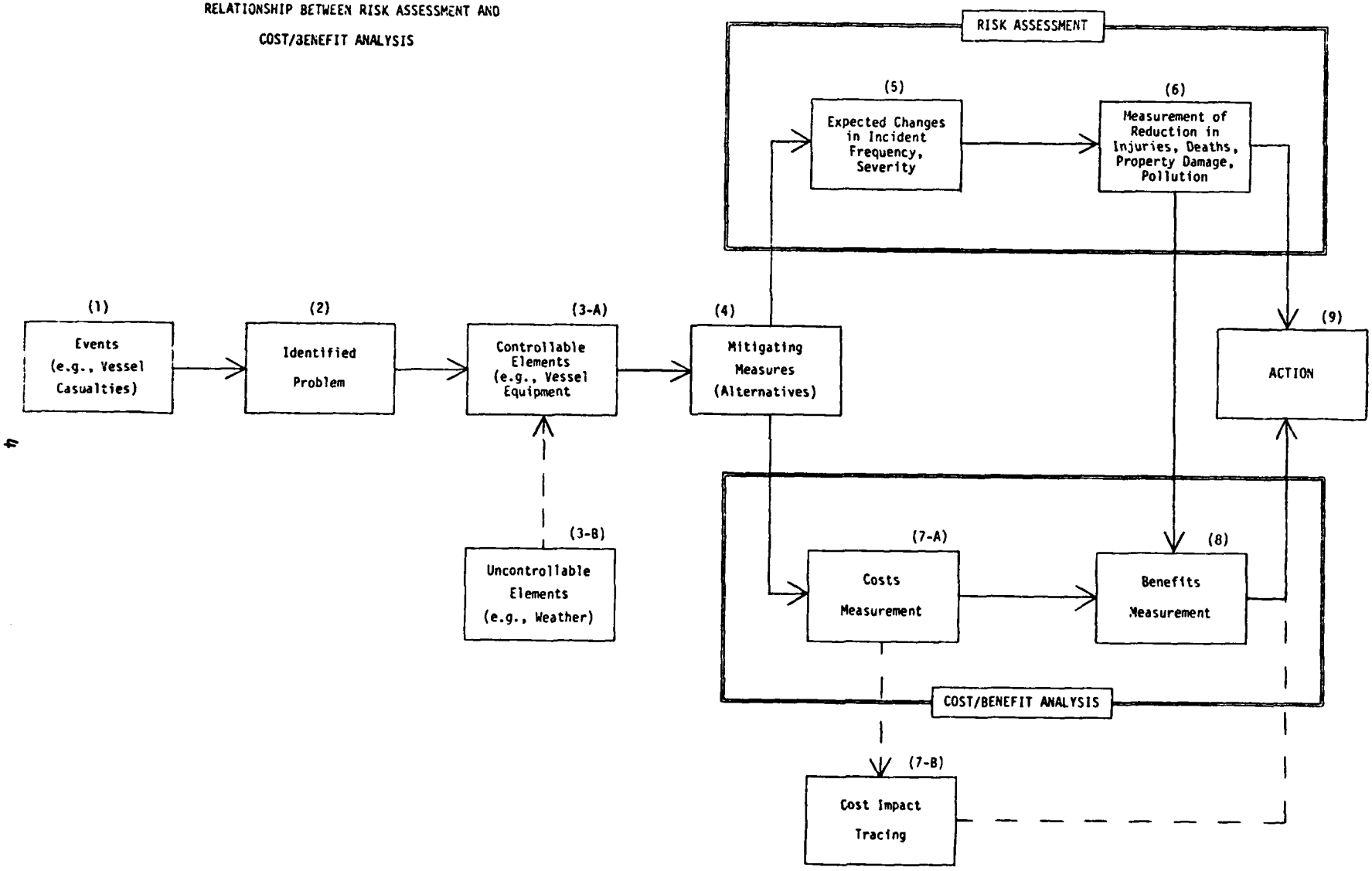
Block 4 - Mitigating Measure: For any given problem with controllable elements, there may be several competing alternatives to improve safety such as vessel design changes, improved training, or operational procedure changes. It is also possible that a single regulation will have been selected with no alternatives under consideration. It is also important that the status of alternatives be clearly delineated.

FIGURE 1

RISK MANAGEMENT — A DECISION PROCESS

RELATIONSHIP BETWEEN RISK ASSESSMENT AND

COST/BENEFIT ANALYSIS



Block 5 - Expected Changes In Incident Frequency: Initially, the vessel population subject to potential regulatory action must be identified by type and size and by U.S. and foreign flag. A risk analysis must identify the probable change in frequency of incidents for implementing mitigating measures (e.g., 10 less collisions per year).

Block 6 - Measurement of Reduction In Injuries, Deaths, Etc.: The risk analysis must also identify specific reductions in loss of life, injuries, property damage, cargo spills, and environmental damage expected to result from alternative mitigating measures.

Block 7A - Cost Measurement: This segment of the analysis identifies the total costs over an extended period of time (25 years) to industry and government to implement alternative mitigating measures.

Block 7B - Cost Impact Tracing: These procedures are designed to trace the costs identified in block 7A as they are passed by price changes throughout the economy. Other cost impacts may be traced such as high unemployment which may result in a particular industrial sector because of regulatory action.

Block 8 - Benefits Measurement: After risk analysis procedures have resulted in computations of reduced losses in life, property damage, etc., the benefit analysis estimates a dollar value where possible for avoided loses.

Block 9 - Action: If sufficient evidence indicates mitigating measures are feasible and benefits exceed costs of implementation, the decision maker is in a position to either proceed with regulatory action or request the results of the analysis be subject to additional sensitivity testing. However, at this point, the decision maker should have sufficient data to decide to either act or take no action.

The level of detail in which the risk analysis can be conducted limits the level of detail that can be achieved in the cost-benefit analysis. For example, using the Vessel Casualty Reporting System (VCRS) data base to develop before and after casualty frequencies associated with potential regulatory actions, has a major drawback. This data base groups all cargo vessels of 15,000 deadweight tons or more into one category. Therefore, operating cost factors for cargo vessels must necessarily be lumped onto a 15,000 DWT and over cost category to conform to this data base.

This manual focuses upon cost-benefit procedures to be used in the risk management process. The key steps involved in the use of cost-benefit procedures are:

1. Identify all cost elements impacted by an alternative regulation.

2. Count the number of vessels by type and size impacted by the regulation for existing vessels, new vessels to be constructed over the time horizon of the analysis, and vessels retiring during the time horizon.

3. Determine the incremental per vessel cost of the regulation by applying or developing the correct cost factor for each cost element and vessel size and type.

4. Discount the total costs incurred by the appropriate discount factor for each year of the analysis.

5. Follow essentially the same sequential procedures for calculation of benefits.

The general procedural steps for identifying cost impacts of regulatory changes are separate and substantially different from cost-benefit procedures. In cost-benefit analysis, the cost and benefits associated with a regulatory alternative are aggregated without regard to the individual or group to whom they accrue. The magnitudes of the estimated costs and benefits are then compared. Based solely on abstract efficiency criteria, determination of who pays the costs or reaps the benefits of alternative actions is not applicable in determining the best alternative. It is legitimate, however, for decision makers to take equity criteria into account and separate the dollar value of costs and benefits according to who in society bears them.

The importance of this to the regulatory staff is that the cost and benefit measurements must be performed separately from the impact analysis. This separation avoids the problem of double counting which arises when costs or benefits accruing initially to one group, but passed on to other groups, are included more than once in measurement calculations. Cost impact procedures are discussed in section IX.

SECTION III
ASSUMPTIONS AND DEFINITIONS

A. CVS Program

The cost-benefit procedures described in the following sections focus on analyzing regulatory alternatives which fall under the aegis of the Commercial Vessel Safety (CVS) Program. Procedures for estimating the cost of five types of CVS regulations are described in Section VI. They are vessel design criteria, vessel equipment criteria, vessel staffing and licensing criteria, vessel inspection requirements, and operational controls. Similarly, the cost formats described in Section V are designed for CVS regulatory analysis.

B. U.S. Versus World

Whenever a cost-benefit analysis is undertaken, the regulatory staff must identify the group for which costs and benefits will be measured. Usually, U.S. government cost-benefit analyses are undertaken on behalf of the United States, but not other nations. Accordingly, the procedures found in this manual focus on costs borne by U.S. individuals and groups. Costs borne by foreign groups are addressed only if there is reason to believe they will affect U.S. citizens economically.

Although foreign costs are not appropriate for inclusion in the cost-benefit analysis, they are often of interest due to the fact that the Coast Guard works closely with the Intergovernmental Maritime Consultative Organization (IMCO). While emphasis in this manual is on U.S. costs, the procedures are directly applicable to determining foreign costs. In the event the regulatory staff is interested in these costs, a forecast of foreign flag vessels engaged in world trade is presented in Section VIII.

C. Burden

The costs of CVS regulations may be borne initially by many different groups. However, for the great majority of regulations, the measurable costs will fall on two major groups: the commercial shipping industry which must comply with the regulations and the U.S. Coast Guard which develops, administers, and enforces the regulations. This manual concentrates on procedures for estimating costs to the commercial shipping industry.

Even though the procedures and formats are designed especially for commercial shipping industry costs, the regulatory staff must not completely ignore costs to other groups. For example, a licensing regulation which necessitates starting a new training school may have significant costs which are not paid by the shipping industry but by the Maritime Administration. The procedures for estimating the industry costs are directly applicable to problems of this sort.

Often, certain costs of a regulation will be insignificant or impossible to measure. Nevertheless, these costs should be described in detail by the regulatory staff. This enables the policy maker to have the most complete information possible.

D. Time Horizon

Any cost-benefit analysis must have a time horizon. There will be costs attributable to a CVS regulation not only in the year the regulation is passed, but as long as it is in effect and vessels are complying with it. Theoretically, the time horizon of the regulatory analysis should be the effective life of the regulation, whether it is 50, 100 or 200 years. Realistically, the time horizon must be limited. The recommended approach in this manual is to limit the time horizon to 25 years. This figure was chosen for several reasons:

1. It is considered by many experts to represent the average retirement age of most commercial vessels.

2. Beyond 25 years, the quality of fleet forecasts declines precipitously.

3. Costs discounted after 25 years are increasingly insignificant.

Despite these reasons, it must be acknowledged 25 years is conventional rather than an objective figure. If the regulatory staff wants to use another time horizon, the cost formats can be readily adapted.

E. Discounting

Because the costs and benefits of a CVS regulation accrue over many years, it is important to explicitly recognize the time value of money in the cost-benefit analysis. Money is a productive resource which commands interest payments for its use; a dollar today is worth more than a dollar to be received at some later date. Consequently, costs payable in the future are valued at a lower rate than costs payable now. Similarly, dollar benefits expected 10 years hence, are worth less than benefits accruing sooner.

The appropriate discount rate allows the regulatory staff to convert dollar amounts of costs and benefits expended or received in different years into their

present value. The recommended discount rate in this manual is 10 percent. This rate is intended to represent the returns to the private sector foregone by complying with a regulation rather than investing in other projects. A 10 percent discount rate conforms to current Department of Transportation and Office of Management and Budget practice. The Office of Management and Budget guidelines for the use of discount rates are published in circular No. A-94 Revised.

The Office of Management and Budget requires the use of a discount rate in evaluating Government decisions concerning the initiation, expansion or renewal of projects and programs for which measurable costs extend over three or more years. OMB defines the discount rate as the interest rate used to calculate the present value of expected yearly costs. In most cases, all costs are to be stated in constant dollars.

To use the discount rate to determine present values requires the calculation of discount factors corresponding to the chosen discount rate for each year of analysis. For the convenience of the regulatory staff, the average discount factors corresponding to a 10 percent discount rate for a 25-year time horizon are displayed on Formats 4 and 6, pages 33 and 35. These factors are appropriate for use when annual costs are incurred throughout the year. Other discount factors should be employed whenever annual costs are incurred on a different schedule, for example, once yearly. Multiplying the costs (or benefits) in each year by the appropriate discount factor for that year yields the present value of the costs (or benefits) discounted at a rate of 10 percent.

The regulatory staff may be interested in using a different discount rate. In this case, the formula to be used in calculating the corresponding discount factors, plus a detailed description of the mechanics involved can be found in Richard S. Brown, et al. Economic Analysis Handbook. NTIS AD-A020859, June 1975, pp. 12-23. For additional discussion of discounting and the choice of a discount rate, a recommended reference is Principles of Engineering Economy, by Eugene L. Grant and W. G. Ireson, Ronald Press Company, 1960.

F. Inflation

Cost-benefit analysis is complicated by the fact prices usually exhibit an increasing trend over time. This price trend or rate of inflation can only be estimated. To ensure consistency in the analysis of alternative regulations and in comparative studies, this manual recommends all dollar estimates of costs and

benefits be made in constant dollars. This means the estimates will be in terms of the general purchasing power of the dollar as of the base year of the analysis (year 0).

This recommendation is predicated on the fact that application of a standard 10 percent discount factor to constant-dollar costs (or benefits) adjusts for an average rate of inflation over the 25-year time horizon. In the unlikely event the regulatory staff expects costs or benefits will not escalate at or near the average price growth rates, special adjustments for inflation can be made. The details of these adjustments plus inflation-adjusted discount factors can be found in Richard S. Brown, Economic Analyis Handbook, pp 88-90 and appendix E.

G. Escalation Factor

Data for many of the cost elements necessary for any regulatory analysis will often be unavailable for the current year and/or base year of the analysis. Since all cost elements must be converted to the same base time period, it will be necessary to apply an appropriate escalation factor to the most recent, available data. No single annual escalation factor is applicable for all cost elements or for all periods of time over which the available data must be inflated. The recommended procedure is to develop an appropriate escalation factor for each cost element or a weighted average factor for a group of cost elements. Such factors may be based upon expert judgment or may be developed through a time-series analysis of available published data. For example, the regulatory staff may need an escalation factor by which to project future shipbuilding costs. In the absence of a more rigorous approach, the solution is as follows. Review a number of previous Maritime Administration Annual Reports. Analyze the trend in published shipbuilding costs, calculating an annual rate of change. Then, using this rate as the basis, develop an escalation factor that will project current costs to a future level.

H. Uniform Annual Cost

Once all estimated regulation costs have been discounted back to the base year of the analysis, these discounted costs when summed yield the total discounted or present value cost of the regulation. This total can be compared with other regulations analyzed over the same time period. Total discounted cost cannot be used for comparison when regulations are analyzed for different time periods.

To assure consistency, the use of the uniform annual cost technique is recommended to circumvent the problem of different time horizons. Basically, uniform annual cost is a method to uniformly distribute the discounted regulation costs over the time horizon of the analysis. The uniform annual cost of a regulation

can be compared legitimately with the uniform annual costs of competing alternatives analyzed over any time period.

The procedure for calculating uniform annual cost is as follows: divide the total discounted regulation cost by the sum of the discount factors for years 1 through 25. The sum of the discount factors associated with a 10 percent discount rate is 9.427.

I. Selected Readings

The regulatory staff may discover its interests are best served by a review of the literature addressing these issues and assumptions surrounding cost-benefit analysis. The following list identifies some pertinent writings which should enhance the regulatory staff's view of cost-benefit analysis.

Baumol, W.J. "On the Discount Rate for Public Projects," in Robert Havemann and Julius Margolis, Editors. Public Expenditures and Policy Analysis. Chicago: Rand McNally College Publishing Co., 1970.

Brown, Richard S., et al. Economic Analysis Handbook. Alexandria, Virginia: Naval Facilities Engineering Command, June 1975.

Hirshleifer, J., Investment, Interest and Capital. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970.

Klausner, Robert F., "The Evaulation of Risk in Marine Capital Investments," Engineering Economist, 14 (Summer 1969), 183-214.

Layard, Richard, Editor. Cost-Benefit Analysis. New York: Penguin Books, Ltd., 1977.

Miller, M.H., and Franco Modigliani, "Cost of Capital to Electric Utility Industry," American Economic Review, 56 (June 1966), 333-91.

Mishan, E.J. Cost-Benefit Analysis. New York: Praeger Publishers, 1976.

Modigliani, Franco, and M. H. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," American Economic Review, 48 (June 1958), 261-97.

_____, "The Cost of Capital, Corporation Finance and the Theory of Investment: Reply," American Economic Review, 48 (September 1958), 655-69; "Taxes and the cost of Capital: A Correction," ibid., 53 (June 1963), 433-43; "Reply," ibid., 55 (June 1965), 524-27; "Reply to Heins and Sprenkle," ibid., 59 (September 1969), 592-95.

Office of Management and Budget Circular Number A-94. Subject: Discount Rates to be Used in Evaluating Time Distributed Costs and Benefits, 1972.

Schwab, Bernhard, and Peter Lusztig, "A Comparative Analysis of the Net Present Value of the Benefit-Cost Ratios as Measures of the Economic Desirability of Investments," Journal of Finance, 24 (June 1969), 507-16.

Solomon, Ezra, "The Arithmetic of Capital-Budgeting Decisions," Journal of Business, 29 (April 1956), 124-29.

Van Horne, James C., The Function and Analysis of Capital Market Rates. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970.

Zechauser, R., et al. Benefit-Cost and Policy Analysis 1974. Chicago: Aldine Publishing Co., 1975.

SECTION IV
COST CATEGORIES AND ELEMENTS

The cost formats contained in Section V are keyed to a set of cost categories and subcategories which will be referred to as cost elements. (See Figure 2.) The purposes for separate cost categories within which to collect costs are twofold:

- To segregate costs by function.
- To provide a checklist against which alternative regulations can be measured.

Cost elements fall into three broad categories: research and development; investment; and operating. The elements of each of the categories will be discussed in turn. The list of cost elements is specific to CVS regulations although it is unlikely any one CVS regulation would impact all the elements. The cost elements may not be completely appropriate for analysis of regulations of other programs. In this case, the regulatory staff can augment the list as necessary.

The costs included in the analysis are limited to those directly attributable to the regulation. Costs incurred regardless of whether a regulation is implemented are included from the analysis. In addition, costs expended prior to the implementation of a regulation are considered "sunk" and should be excluded. An exception may be made under the following circumstances: (1) Government has indicated the regulation is under consideration and anticipates implementation in the near future; and (2) industry or Government implements the regulation, prior to its effective date to minimize the costs of implementation. For example, industry may incorporate a design change to a vessel under construction to avoid a more costly change later in the construction phase. Each exception must be considered individually and carefully justified.

Research and Development (R&D) - Includes all costs for research and development directly attributable to the regulation and expected to be incurred in or after the base year of the analysis.

Investment - Includes all capital costs for construction, modification, acquisition of equipment, and facilities attributable to the regulation. These costs should include the cost of financing the investment. For purposes of industry cost procedures, investment is subdivided into two parts to differentiate between investment costs for: (a) new vessel construction, and (b) retrofits of existing vessels. This distinction is important since the costs to implement a regulation may

FIGURE 2

COST CATEGORIES

Industry

I. R&D Costs

II. Investment Costs
- A. New Construction
  - (1) Non-recurring
  - (2) Recurring
- B. Retrofit or Modification
  - (1) Non-recurring
  - (2) Recurring

III. Operating Costs
- A. Personnel
- B. Maintenance and Repair
- C. Insurance
- D. Fuel, Lubricants and Water
- E. Stores and Supplies
- F. Material and Indirect Support
- G. Cargo Handling
- H. Port and Canal Fees
- I. Indirect Support
- J. Overhead
- K. Training

In-House

I. R&D Costs

II. Investment Costs
- A. Non-recurring
- B. Recurring

III. Operating Costs
- A. Personnel
  - (1) Civilian
  - (2) Military
  - (3) Other
- B. Materials, Supplies, and Utilities
- C. Contractual Services
- D. Government Furnished Services
- E. Maintenance and Repair
- F. Administration
- G. Other

vary considerably for a vessel undergoing construction versus one already operating.

For investment a further distinction is made between non-recurring and recurring costs. This distinction is made to differentiate between investment costs of a one-time (non-recurring) nature expected to last the entire useful life of a vessel and those investments (recurring) with shorter economic or technological lives than the vessel (e.g., replacing radar equipment every 10 years). Separating investment into recurring and non-recurring costs for each year of the analysis allows the regulatory staff to be confident costs over the whole life of the project will be measured.

Operating Costs - Include all the costs of the regulation recurring on an annual basis. Vessel operating cost elements are tailored to the level of detail contained in operating cost factors found in Section VII and include additional cost elements potentially impacted by a regulation such as training. Each vessel operating cost element is defined below.

Personnel - This category is made up of two subcategories: crew wage costs including overtime, payroll taxes and fringe benefits, and crew subsistence costs.

Maintenance and Repair - Includes normal and special maintenance costs including annual routine dry-docking expenses.

Insurance - Commercial vessels carry up to four kinds of insurance: hull and machinery insurance against damage to the vessel; protection and indemnity for protection against liability for crew injury or death; war-risk coverage; TOVALOP or comparable pollution insurance for protection against fires, cleanup costs and liability for damage from cargo spills.

Fuels, Lubricants and (Fresh) Water - Includes all vessel fuel, lubricants and stored fresh water.

Stores and Supplies - Includes consumable and expendable items such as rope, paint and cleaning materials.

Cargo Handling - Includes stevedore costs, terminal use charges, receiving clerks and checkers, watchmen, dunnage, fire insurance and other cargo handling related costs.

Port and Canal Fees - Includes expenses for pilotage, customs entrance fees, tonnage tax, tug service, immigration fees, quarantine inspections, canal fees, line handling and other port and canal use related charges.

Material and Indirect Support - Included here are the costs of spares and repair parts and expenses for support facilities.

Overhead -These expenses can be broken down into administration, management, facilities, service agents, and data expenses and include costs of accounting, legal, medical and police service, supplies and other costs to the shipping company not directly associated with a particular vessel, cargo or voyage.

Training - This includes any regular training costs incurred annually. Examples are tuition, transportation and lodging expenses for crew training courses and any expenses associated with on-board training exercises like periodic drills or crew tests.

Note cost categories and elements for in-house (government) activities are roughly analogous to those listed for industry.

SECTION V
FORMATS FOR COST MEASUREMENT

A. General

The procedures, data sources, cost factors, problems to be aware of and other facets of cost measurement for the five types of commercial vessel safety regulations are described in Sections VI and VII. The purpose of this section is to explain the use of cost formats to be employed in cost-benefit analysis.

The cost formats are designed to help the regulatory staff keep track of the different industry and in-house costs of a regulation and the impacted vessel population; provide an easy way for the regulatory staff to add all the separate costs to arrive at the final cost of a regulation; present the results to others (for example, for budgetary justification or OMB approval); and compare the costs of alternative regulations.

This section will explain, step by step, the uses of the different formats and how to fill in the blanks. To facilitate the explanation an example regulation will be used. Blank formats which can be copied for use by the cost analyst can be found at the end of this section.

Before the formats are discussed in detail, it is worthwhile to point out two key considerations involving their use. First, cost-benefit analysis of regulations is concerned with the incremental costs directly attributable to implementation of the regulation. Costs which will occur regardless of whether the regulation is implemented should not be included. Secondly, the analysis applies only to future costs which the decision to implement the regulation can affect. Costs expected to be expended prior to the beginning of the time frame of the analysis are considered "sunk" and must not be included. An exception may be made when costs are incurred in anticipation of a regulation's implementation. In this case, include these costs in the first year of the analysis.

Formats 1 through 4 allow the regulatory staff to develop total costs expected to accrue to industry as the result of implementing a regulation. Formats 5 and 6 are designed to capture in-house government costs. Format 7 merges industry and government costs attributable to implementing a regulation and allows for comparison of alternatives. Use of the formats is best demonstrated by means of a hypothetical regulation.

B. Example Regulation

After June 1982, new and existing oil tankers, gas, and chemical carriers will be required to have certain emergency steering gear control systems which meet specific design criteria. In addition, the manual steering gear must be tested after prolonged use of the automatic pilot; specific maintenance checks and tests must be conducted within 12 hours of departure; and emergency steering drills must be conducted at least once every 3 months.

Suppose for the sake of illustration the regulatory staff has already done all the preliminary cost work. The data sources have been investigated and the regulatory staff has obtained estimates of all pertinent in-house and per vessel costs of the regulation and the number of vessels that will comply and when they will do so. What remains to be done is insert the information into the blanks on the cost formats and perform the necessary addition and multiplication to arrive at the final discounted cost of the regulation.

One of the first things the regulatory staff must do in measuring industry costs is to separate the impacted vessel population into classes by size and by type. The reason behind this is costs of a regulation will often be different for different sizes and types of vessels. For the example regulation, the regulatory staff has divided the impacted vessel population into five classes because of significant differences in costs:

Class 1 - Oil tankers >125,000 DWTs

Class 2 - Oil tankers 75,000 to 125,000 DWTs

Class 3 - Oil tankers <75,000 DWTs

Class 4 - Gas carriers, all sizes

Class 5 - Chemical carriers, all sizes

The illustration of the cost formats will be developed in detail for only class 1 vessels. The procedures for filling in the costs formats for the other vessel classes are identical, although the numbers will be different.

For vessel class 1 (oil tankers >125,000 DWTs) it is assumed the regulatory staff has discovered:

1. It costs $60,000 for a tanker under construction to be fitted with the required emergency steering equipment.

2. It costs $88,000 for an existing tanker to go into the shipyard and have the required equipment installed.

3. The required steering gear equipment must be replaced every 10 years. However, vessels over 20 years old will not replace the old equipment.

4. Vessels in operation which have installed the equipment will incur $10,000 per year in additional maintenance and repair costs because of the steering equipment. This includes the cost of the tests which must be conducted 12 hours before departure and after prolonged use of automatic pilot.

5. Vessels in operation which have installed the equipment will incur $5,000 per year in training costs in the use of the equipment and in performing the required quarterly emergency steering drills.

6. There are 6 existing tankers of >125,000 DWTs which must comply with the regulation. Three will have the equipment installed in 1981, and three will have it installed in 1982. In 1997, one of these vessels will retire, another will retire in 1998, another in 1999, another in 2000, and two in 2001. The retiring vessels will be replaced by new vessels in the year the old ones retire.

7. Two new vessels will be constructed in 1981, one in 1983, two in 1985, one in 1989. Because of the retiring vessels mentioned above (number 6), one new vessel will be constructed in 1997, another in 1998, another in 1999, another in 2000, and two in 2001 as replacements for the retiring vessels.

8. For ease of calculation, it will be assumed the only in-house cost to be incurred will be personnel services of a contracting firm for a total of $200,000 per year to randomly check and test the improved steering gear.

After the estimates have been made, the next step is to learn where to place this information on the cost formats. The cost formats should be filled in sequentially starting with Format 1 and ending with Format 7.

C. Format 1: Industry Cost Categories

The first four lines on this format are designed to give the regulatory staff places to identify (1) the regulation under analysis using a few key words (e.g., improved emergency steering); (2) the type of vessel to be analyzed on this format (e.g., tankers); (3) the size of the vessels under analysis on this format (e.g., >125,000 DWTs); and (4) the vessel class identification number, an arbitrary number given by the regulatory staff for identification purposes only (e.g., vessel class 1).

Next, the regulatory staff must fill in the blanks next to all the cost categories listed for which he or she has estimated the per vessel cost of the regulation. For the working example, R&D Costs are left blank either because they are not impacted by the regulation or because the regulatory staff has been unsuccessful in estimating the R&D cost changes. When the latter occurs, the regulatory staff must describe the expected costs in as much detail as possible.

For Investment Costs (New Construction), the regulatory staff places $60,000 in the appropriate blank. This means it costs $60,000 to have a tanker >125,000 DWTs under construction or on order comply with the example regulation.

Investment Costs (Retrofit or Modification) are incurred when existing vessels must comply with the regulation by retrofitting or when equipment, etc. installed on a new vessel in compliance with a regulation must be replaced or modified during the lifetime of the vessel. When existing vessels must retrofit only once, the investment costs are considered non-recurring. In our example regulation, existing vessels must retrofit by 1982 and both existing and newly constructed vessels must replace the equipment every 10 years. Hence, the regulatory staff fills in $88,000 as the investment cost of retrofit and notes in the time period blank that these costs will recur every 10 years for both existing and new vessels.

Operating Costs by definition are always recurring on an annual basis. Operating costs are separated into two parts: operating costs - new construction and operating costs - retrofit or modification. The reason for separation is the possibility that for some regulations the change in operating costs will differ according to whether the vessel is newly constructed or already operating. Total delay costs are the unitemized operating costs associated with any vessel delays attributable to the regulation, e.g., vessel inspections requiring vessels to be out of service an additional day. In the example, there are no vessel delay costs. Instead, the itemized operating costs of the regulation, which are the same for both new and existing vessels, are $10,000 per year for maintenance and repair and $5,000 per year for training for a total of $15,000 per vessel per year in increased operating costs because of the regulation.

D. Format 2: Industry Cost Category Totals

Format 2 is designed to let the regulatory staff take the different cost categories found on Format 1, combine them separately with the number of vessels that will incur the costs and the years they will be incurred in, to arrive at the total cost-by-cost category of the regulation in each year of the analysis for that particular vessel class. There are several things to note about Format 2.

1. Like Format 1, it leaves a space at the top for the regulatory staff to identify the regulation with a few key words, the type and size of vessels to be analyzed on this format, and the vessel class identification number.

2. For each cost category impacted on Format 1, there are separate Format 2's. For our example, four cost categories are impacted on Format 1: Investment Cost (New Construction), Investment Cost (Retrofit or Modification),

Operating Costs (New Construction), and Operating Costs (Retrofit or Modification).

3. The cost category put in the blank at the top of column 5 must correspond to the cost category filled in on the top of the format.

4. This format, and following ones, constrains the analysis to a 25-year time horizon. This can be modified by the regulatory staff by contracting or expanding the format. Year zero is the first year of compliance. In the example, the first year of compliance is 1981 and this is put in the blank next to year zero. Labelling year zero with the actual year aids the regulatory staff in knowing the years in which vessels are constructed or retired.

5. Columns 1 and 2 are included as an option for the regulatory staff to fill in. In many cases, the cost of a regulation will be estimated by (1) determining the per vessel cost before the regulation of a typical or base vessel in that vessel class; (2) determining the per vessel cost of the base vessel after the regulation; (3) subtracting to obtain the change in the per vessel costs due to the regulation. When this method is employed by the regulatory staff, Format 2 enables the regulatory staff to clearly present the operation performed. In the working example, the cost changes due to the regulation have been estimated without resort to comparisons of before and after costs and, consequently, columns 1 and 2 of Formats 2B, 2C, 2D and 2E remain blank. Format 2A covering R&D costs is not needed for this example.

In order to more fully explain columns 3, 4 and 5, it is appropriate to describe all the format 2's for the example regulation, beginning with Format 2B: Investment Cost (New Construction).

Format 1 shows the per vessel investment cost of new vessel compliance with the regulation is $60,000 for tankers of >125,000 DWTs. The next step is to determine the number of new vessels that will incur this investment cost and in what years. This vessel population information will be inserted in column 4 in the appropriate years. It is known two new vessels will be constructed and come on-line in 1981, year 0; one in 1983, year 2; two in 1985, year 4; one in 1989, year 8. In addition, because of replacement of existing vessels, one new vessel will be constructed and will come on-line in 1997, year 16, one in 1998, year 17; one in 1999, year 18; one in 2000, year 19; and two in 2001, year 20. Each of these newly constructed vessels, by assumption, will incur the investment costs ($60,000) in the year they enter service. Thus, both columns 3 and 4 of Format 2B can be filled in.

To obtain the total annual investment costs (new construction) of the regulation for vessel class 1, multiply columns 3 and 4. For year 0 (1981), we get a total investment cost (new construction) of $120,000 ($60,000 x 2) because two new vessels are constructed and enter into service in 1981. Identical operations will give the investment cost (new construction) for every year in which a new vessel (of class 1 type and size) is constructed.

Format 2C deals with Investment Costs (Retrofit or Modification). The investment costs of retrofit are $88,000 and vessels must replace the emergency steering equipment every 10 years. The next step is to determine how many vessels will retrofit in each year of the 25-year time horizon.

Three existing vessels will retrofit in 1981, year 0 and three in 1982, year 1, so three goes in column 4 for years 0 and 1. The three existing vessels retrofitting in 1981 will retrofit again (to replace the old equipment) 10 years later in 1991, year 10. In addition, the two new vessels constructed in 1981, year 0 (see format 2B for investment costs (new construction)) must also retrofit in 10 years, that is, in 1991, year 10. In total, 5 vessels will be retrofitting in 1991, year 10 (3 + 2).

The existing vessels retrofitting in year 1 (1982) must retrofit again in year 11 (1992). No new vessels were constructed in year 1 (1982) and, consequently, there will be only three vessels retrofitting in year 11. Note, these three vessels will not retrofit again in another 10 years (year 20) because by then they will all be either retired or over 20 years of age.

In year 12 (1993), the vessel constructed in year 2 (1983) will have to replace its emergency steering equipment. The two vessels constructed in year 4 (1985) will replace in year 14 (1995) and the vessel constructed in year 8 (1989) will replace in year 18 (1999). Note the vessels constructed in years 16, 17, 18, 19 and 20 will also replace after 10 years or in years 26, 27, 28, 29 and 30. These years are beyond the time horizon and, hence, the replacement costs of these vessels will not be included in the analysis.

To obtain the total annual investment costs (retrofit or modification) of the regulation for vessel class 1, multiply columns 3 and 4. For year 0 (1981), we get a total investment cost (retrofit) of $264,000 ($88,000 x 3).

Format 2D deals with Operating Costs (New Construction). As soon as a vessel complies with a regulation it incurs $15,000 in additional operating costs due to the regulation for every year of compliance until the vessel retires. Remember on Format 2B for investment costs (new construction), two vessels are constructed in year 0, one in year 2, two in year 4, one in year 8, one in year 16, one in year 17, one in year 18, one in year 19, and two in year 20.

Thus, two vessels (the ones built in year 0) will incur the operating costs of the regulation in year 0 and 1. In year 3, the vessel built in year 3 will be added making a total impacted vessel population of 3 until year 4 when another vessel is constructed and bears the additional operating cost of the regulation. In year 8, the number of vessels incurring the costs becomes six to include the new vessel built that year. In each of years 16, 17, 18 and 19, the vessel population rises by one to reflect the vessels built in those years. In year 20, it rises to 12 because of the two vessels built in year 20. The impacted vessel population remains at 12 until year 24. Note, if the time horizon were longer, care would have to be taken to subtract retiring ships from the vessel population.

To obtain the total annual operating costs (new construction) for years 0 through 24, multiply column 3 (the per vessel cost of $15,000) by column 4 (the impacted vessel population in each year).

Format 2E deals with Operating Costs (Retrofit). The per vessel operating costs are $15,000 per year (from Format 1). Furthermore, three existing vessels retrofit in year 0 (1981) and begin to incur the additional annual operating costs in that year. In year 1 (1982), three more existing vessels retrofit, making the total vessel population incurring the operating costs equal to six. It stays at six until year 16 when the existing vessels begin to retire. One retires in year 16, one in year 17, one in year 18, one in year 19, and two in year 20. By years 20 to 24, no existing vessels are expected to still be in operation. To obtain the total annual operating costs (retrofit), multiply the per vessel operating costs (column 3) by the impacted vessel population (column 4).

E. Format 3: Industry Summary (Single Class)

Format 3 serves as a summary sheet for the costs of the regulation to a particular vessel class (in this example, vessel class 1, tankers >125,000 DWTs). It contains columns in which the regulatory staff can place the R&D costs, investment costs and operating costs found in column 5 of the individual Format 2's.

Because there are no estimated R&D costs for the example regulation, column 1 is blank. Column 2 presents the findings from column 5 of Format 2B, Investment Costs (New Construction). Column 3 presents Operating Costs (New Construction); column 4, Investment Costs (Retrofit); and column 5, Operating Costs (Retrofit).

To obtain the total cost of the regulation to vessel class 1 in each year, add horizontally columns 1, 2, 3, 4 and 5. This completes the use of Formats 1, 2 and 3 for vessel class 1. The regulatory staff must then perform the same procedures for

every other vessel class (or vessel size and type division). Once this has been done, the regulatory staff is in position to move to Format 4 and determine the annual cost of the regulation to the total impacted vessel population.

F. Format 4: Industry Summary (All Vessels)

There are several points to be made about Format 4. This format deals with all vessel classes impacted by the regulation. Hence, the only identifying heading at the top of the format is for the name of the regulation.

This format allows the regulatory staff to present the results for nine vessel classes. In the event there are more, the form can be expanded to include more columns.

For the working example, there are five vessel classes:

Class 1 - oil tankers >125,000 DWTs

Class 2 - oil tankers 75,000 - 125,000 DWTs

Class 3 - oil tankers <75,000 DWTs

Class 4 - gas carriers, all sizes

Class 5 - chemical carriers, all sizes

For the sake of simplification, it is assumed the regulatory staff has gone through all the cost procedures and has filled in Formats 1 through 3 for vessel classes 2, 3, 4 and 5. The regulatory staff has found (somewhat unrealistically) for vessel class 2, total annual regulation costs are $300,000 in each year from year 0 to year 24; for vessel class 3, total annual regulation costs are $200,000 in each year, for vessel class 4, $100,000 in each year; and for vessel class 5, $400,000 in each year.

In column 1, Format 4, the regulatory staff places the annual regulation costs for vessel class 1 obtained from column 6 of the associated Format 3. In column 2, the costs to vessel class 2 are presented. Column 3 presents the costs to vessel class 3, column 4, the costs to vessel class 4; and column 5, the costs to vessel class 5. To obtain the total costs of the regulation for all vessel classes, the regulatory staff sums across columns 1 through 9 and places the resulting figures in column 10.

The next step involves discounting these costs. Column 11 presents the discount factors (mid-year) corresponding to a discount rate of 10 percent. Column 12 is left blank to allow the regulatory staff to use another discount rate if desired. To obtain the discounted annual costs of the regulation, the regulatory staff must multiply column 10, the undiscounted annual costs, by column 11, the discount factor at a 10 percent discount rate. Note, if the regulatory staff is using another discount rate, column 10 should be multiplied by column 12 instead of column 11.

The results of multiplying columns 10 and 11 are placed in column 13. These costs are still identified with a certain year. To obtain the total discounted industry regulation cost for all 25 years of analysis, vertically add the numbers contained in column 13.

This total discounted industry regulation cost (in our example, $13,268,000) can be divided by a cumulative discount factor to obtain a measure of uniform annual regulation cost. The cumulative discount factor is found by vertically adding the discount factors for years 1 through 24 (column 11 if a 10 percent rate of discount is used; column 12 otherwise). Note that the discount factor for year 0 (1.000) is omitted. For the working example, the cumulative discount factor is 9.427, the total discounted industry regulation cost is $13,268,000 and the uniform annual regulation cost is $1,407,450 ($13,268,000 9.427).

G. Formats 5 and 6: In-House Costs (Categories and Summary)

Format 5 is designed to collect in-house costs within the U.S. government which accrue as the result of implementing a regulation. In this example, it is assumed that $200,000 per year of contractual services is incurred to spot check and test emergency steering gear. Format 6 arrays costs and allows for discounting procedures similar to those discussed under Format 4.

H. Format 7: Comparison of Alternatives

Format 7 is designed to aid the regulatory staff in comparing the costs of alternative regulations. It allows space for a short description of the alternative regulations, identification of the impacted resources, the earliest date of compliance and a short description of the expected benefits or reasons for the regulation. The last column presents both the industry and in-house uniform annual cost of the regulation which are found on the bottom lines of Formats 4 and 6.

Note Format 7 has space for only 10 alternative regulations. Again, if more than 10 are to be compared, the format can be expanded by adding more rows at the bottom of the form.

FORMAT I

INDUSTRY COST CATEGORIES

Regulation: Improved Emergency Steering
Vessel Type: Tanker
Vessel Size: >125,000 DWT
Vessel Class: 1

I.	R & D COSTS		
II.	INVESTMENT COSTS (New Construction)		
	A. Non-recurring		$60,000
	B. Recurring		
	(Time Period _____)		
III.	INVESTMENT COSTS (Retrofit or Modification)		
	A. Non-recurring		
	B. Recurring		88,000
	(Time Period Every 10 years)		
IV.	OPERATING COSTS (New Construction)		
	A. Total Delay Costs		
	B. Itemized Operating Costs		
	1. Personnel		
	2. Maintenance and Repair	$10,000	
	3. Insurance		
	4. Fuel, Lubricants and Water		
	5. Stores and Supplies		
	6. Material and Indirect Support		
	7. Cargo Handling		
	8. Port and Canal Fees		
	9. Overhead		
	10. Training	5,000	
	Total Itemized Operating Costs		15,000
V.	OPERATING COSTS (Retrofit or Modification)		
	A. Total Delay Costs		
	B. Itemized Operating Costs		
	1. Personnel		
	2. Maintenance and Repair	10,000	
	3. Insurance		
	4. Fuel, Lubricants and Water		
	5. Stores and Supplies		
	6. Material and Indirect Support		
	7. Cargo Handling		
	8. Port and Canal Fees		
	9. Overhead		
	10. Training	5,000	
	Total Itemized Operating Costs		15,000

Explanatory Notes:

REGULATION Improved Emergency Steering
VESSEL TYPE TANKER
VESSEL SIZE >125,000 DWT
VESSEL CLASS 1

FORMAT 2-A

INDUSTRY COST CATEGORY: R & D COSTS*

($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Annual R & D Costs of Regulation Per year (5) (3) x (4)
0 ~~1981~~					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

* I from Format 1.

REGULATION Improved Emergency Steering
VESSEL TYPE Tanker
VESSEL SIZE >125,000 DWT
VESSEL CLASS 1

FORMAT 2-B

INDUSTRY COST CATEGORY: INVESTMENT (NEW CONSTRUCTION) ($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Investment (New Cons) Costs of Regulation Per year (5) = (3) x (4)
0/~~1~~			60	2	120
1					
2			60	1	60
3					
4			60	2	120
5					
6					
7					
8			60	1	60
9					
10					
11					
12					
13					
14					
15					
16			60	1	60
17			60	1	60
18			60	1	60
19			60	1	60
20			60	2	120
21					
22					
23					
24					

* II From Format 1

REGULATION Improved Emergency Steering
VESSEL TYPE Tanker
VESSEL SIZE >125,000 DWT
VESSEL CLASS 1

FORMAT 2-C

INDUSTRY COST CATEGORY:
INVESTMENT COSTS (RETROFIT OR MODIFICATION) *
($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Investment (Retrofit) Costs of Regulation Per year (5) (3) x (4)
0 (1981)			88	3	264
1			88	3	264
2					
3					
4					
5					
6					
7					
8					
9					
10			88	5	440
11			88	3	264
12			88	1	88
13					
14			88	2	176
15					
16					
17					
18			88	1	88
19					
20					
21					
22					
23					
24					

* III from Format 1

REGULATION Improved Emergency Steering
VESSEL TYPE Tanker
VESSEL SIZE >125,000
VESSEL CLASS 1

FORMAT 2-D
INDUSTRY COST CATEGORY: OPERATING COSTS (NEW CONSTRUCTION) *
($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Operating (New Cons) Costs of Regulation Per year (5) (3) x (4)
0/1981			15	2	30
1			15	2	30
2			15	3	45
3			15	3	45
4			15	5	75
5			15	5	75
6			15	5	75
7			15	5	75
8			15	6	90
9			15	6	90
10			15	6	90
11			15	6	90
12			15	6	90
13			15	6	90
14			15	6	90
15			15	6	90
16			15	7	105
17			15	8	120
18			15	9	135
19			15	10	150
20			15	12	180
21			15	12	180
22			15	12	180
23			15	12	180
24			15	12	180

* IV from Format 1

REGULATION Improved Emergency Steering
VESSEL TYPE Tanker
VESSEL SIZE >125,000 DWT
VESSEL CLASS 1

FORMAT 2-E
INDUSTRY COST CATEGORY:
OPERATING COSTS (RETROFIT OR MODIFICATION) *
($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Operating (Retrofit) Costs of Regulation Per year (5) = (3) x (4)
0/~~1981~~			15	3	45
1			15	6	90
2			15	6	90
3			15	6	90
4			15	6	90
5			15	6	90
6			15	6	90
7			15	6	90
8			15	6	90
9			15	6	90
10			15	6	90
11			15	6	90
12			15	6	90
13			15	6	90
14			15	6	90
15			15	6	90
16			15	5	75
17			15	4	60
18			15	3	45
19			15	2	30
20					
21					
22					
23					
24					

* V from Format 1.

REGULATION Improved Emergency Steering
VESSEL TYPE Tanker
VESSEL SIZE >125,000 DWT
VESSEL CLASS 1

FORMAT 3
SUMMARY OF INDUSTRY COST CATEGORIES *
($ THOUSANDS)

Year	Total Annual R & D Costs (1)	Total Annual Investment Costs (New Construction) (2)	Total Annual Operating Costs (New Construction) (3)	Total Annual Investment Costs (Retrofit) (4)	Total Annual Operating Costs (Retrofit) (5)	Total Annual Cost of the Regulation (6) (1)+(2)+(3)+(4)+(5)
0 1981		120	30	264	45	459
1			30	264	90	384
2		60	45		90	195
3			45		90	135
4		120	75		90	285
5			75		90	165
6			75		90	165
7			75		90	165
8		60	90		90	240
9			90		90	180
10			90	440	90	620
11			90	264	90	444
12			90	88	90	268
13			90		90	180
14			90	176	90	356
15			90		90	180
16		60	105		75	240
17		60	120		60	240
18		60	135	88	45	328
19		60	150		30	240
20		120	180			300
21			180			180
22			180			180
23			180			180
24			180			180

* From Column 5, Format 2-A, 2-B, 2-C, 2-D and 2-E.

FORMAT 4

INDUSTRY REGULATION COSTS—SUMMARY FOR ALL VESSEL CLASSES*
($ THOUSANDS)

REGULATION: Improved Emergency Steering

Year	Total Annual Cost Class 1 (1)	Total Annual Cost Class 2 (2)	Total Annual Cost Class 3 (3)	Total Annual Cost Class 4 (4)	Total Annual Cost Class 5 (5)	Total Annual Cost Class ___ (6)	Total Annual Cost Class ___ (7)	Total Annual Cost Class ___ (8)	Total Annual Cost Class ___ (9)	Total Annual Cost All Classes (10) (1)+(2)+...(9)	Discount Factor 10 % (11)	Other Discount Factor ___ % (12)	Discounted Annual Cost (13) (10) (11)
1981	459	300	200	100	400					1459	1.000		1459
1	384	300	200	100	400					1384	954		1320
2	195	300	200	100	400					1195	867		1036
3	135	300	200	100	400					1135	788		894
4	285	300	200	100	400					1285	717		921
5	165	300	200	100	400					1165	652		760
6	165	300	200	100	400					1165	592		689
7	165	300	200	100	400					1165	538		627
8	240	300	200	100	400					1240	489		606
9	180	300	200	100	400					1185	456		525
10	620	300	200	100	400					1620	405		656
11	444	300	200	100	400					1444	368		531
12	268	300	200	100	400					1268	334		423
13	180	300	200	100	400					1180	304		358
14	356	300	200	100	400					1356	276		375
15	180	300	200	100	400					1180	251		296
16	240	300	200	100	400					1240	228		283
17	240	300	200	100	400					1240	208		258
18	328	300	200	100	400					1328	189		251
19	240	300	200	100	400					1240	172		213
20	300	300	200	100	400					1300	158		203
21	180	300	200	100	400					1180	142		168
22	180	300	200	100	400					1180	129		152
23	180	300	200	100	400					1180	117		138
24	180	300	200	100	400					1180	107		126
Totals											Cumulative Discount Factor 9.477		13,268 Total Discounted Industry Reg. Cost

*Uniform Annual Industry Regulation Cost (from Column 6, Format 1) × Total Discounted Industry Regulation Cost ÷ 9.477 = 1,407,450 Enter this in Column 5, Format 7

FORMAT 5

IN-HOUSE COST CATEGORIES

Regulation: *Improved Emergency Steering*

I.	R & D COSTS		_____
II.	INVESTMENT COSTS		
	A. Non-recurring		_____
	B. Recurring		_____
	(Time Period _____)		
III.	OPERATING COSTS		
	A. Personnel		
	1. Civilian Personnel Services	_____	
	2. Military Personnel Services	_____	
	3. Other Personnel Costs	_____	
	B. Materials, Supplies and Utilities	_____	
	C. Contractual Services	200,000	
	D. Government Furnished Services	_____	
	E. Maintenance and Repair	_____	
	F. Other	_____	
	TOTAL OPERATING COSTS		200,000

Explanatory Notes:

FORMAT 6

SUMMARY OF IN-HOUSE COST CATEGORIES*
($ THOUSANDS)

REGULATION: Improved Emergency Steering

Year	Annual R&D Costs (1)	Annual Investment Costs (Non-Recurring) (2)	Annual Investment Costs (Recurring) (3)	Annual Operating Costs (4)	Total Annual In-House Costs of the Regulation (5) (1) + (2) + (3) + (4)	Discount Factor 10 % (6)	Other Discount Factor ___ % (7)	Discounted Annual In-House Cost (8) (5) × (6)
0 1981				200	200	1.000		200
1				200	200	.954		191
2				200	200	.867		173
3				200	200	.788		158
4				200	200	.717		143
5				200	200	.652		130
6				200	200	.592		118
7				200	200	.538		108
8				200	200	.489		98
9				200	200	.445		89
10				200	200	.405		81
11				200	200	.368		74
12				200	200	.334		67
13				200	200	.304		61
14				200	200	.276		55
15				200	200	.251		50
16				200	200	.228		46
17				200	200	.208		42
18				200	200	.189		38
19				200	200	.172		34
20				200	200	.156		31
21				200	200	.142		28
22				200	200	.129		26
23				200	200	.117		23
24				200	200	.107		21
TOTALS						Cumulative Discount Factor 9.427		2,085 Total Discounted In-House Regulation Cost

Uniform Annual In-House Regulation Cost Total Discounted In-House Regulation Cost ÷ 9.427 221 Enter this in Column 5, Format 7.

* From Format 6.

FORMAT 7

COMPARISON OF ALTERNATIVES
($ THOUSANDS)

Description of Alternative Regulations (1)	Impacted Resources (2)	Compliance Dates (3)	Description of Benefits (4)	Uniform Annual Costs (5)
1. Improved Emergency Steering	≥ 10,000 G.T. NEW + EXISTING OIL TANKERS, GAS + CHEMICAL CARRIERS	6/81	REDUCE PROBABILITY OF COLLISIONS + GROUNDINGS	Industry* 4407 In-House** 221 Total 4,628
2.				Industry* ____ In-House** ____ Total ____
3.				Industry* ____ In-House** ____ Total ____
4.				Industry* ____ In-House** ____ Total ____
5.				Industry* ____ In-House** ____ Total ____
6.				Industry* ____ In-House** ____ Total ____
7.				Industry* ____ In-House** ____ Total ____
8.				Industry* ____ In-House** ____ Total ____
9.				Industry* ____ In-House** ____ Total ____
10.				Industry* ____ In-House** ____ Total ____

* From Format 4.

** From Format 6.

BLANK FORMATS

FORMAT 1

INDUSTRY COST CATEGORIES

Regulation:
Vessel Type:
Vessel Size:
Vessel Class:

I.	R & D COSTS			_____
II.	INVESTMENT COSTS (New Construction)			
	A. Non-recurring			_____
	B. Recurring			_____
	(Time Period _____)			
III.	INVESTMENT COSTS (Retrofit or Modification)			
	A. Non-recurring			_____
	B. Recurring			_____
	(Time Period _____)			
IV.	OPERATING COSTS (New Construction)			
	A. Total Delay Costs			_____
	B. Itemized Operating Costs			
	1. Personnel		_____	
	2. Maintenance and Repair		_____	
	3. Insurance		_____	
	4. Fuel, Lubricants and Water		_____	
	5. Stores and Supplies		_____	
	6. Material and Indirect Support		_____	
	7. Cargo Handling		_____	
	8. Port and Canal Fees		_____	
	9. Overhead		_____	
	10. Training		_____	
	Total Itemized Operating Costs			_____
V.	OPERATING COSTS (Retrofit or Modification)			
	A. Total Delay Costs			_____
	B. Itemized Operating Costs			
	1. Personnel		_____	
	2. Maintenance and Repair		_____	
	3. Insurance		_____	
	4. Fuel, Lubricants and Water		_____	
	5. Stores and Supplies		_____	
	6. Material and Indirect Support		_____	
	7. Cargo Handling		_____	
	8. Port and Canal Fees		_____	
	9. Overhead		_____	
	10. Training		_____	
	Total Itemized Operating Costs			_____

Explanatory Notes:

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REGULATION
VESSEL TYPE
VESSEL SIZE
VESSEL CLASS

FORMAT 2-A

INDUSTRY COST CATEGORY: R & D COSTS*

($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Annual R & D Costs of Regulation Per year (5) (3) x (4)
0 ___					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

* I from Format 1.

REGULATION
VESSEL TYPE
VESSEL SIZE
VESSEL CLASS

FORMAT 2-B

INDUSTRY COST CATEGORY: INVESTMENT (NEW CONSTRUCTION) ($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Investment (New Cons) Costs of Regulation Per year (5) = (3) x (4)
0 ___					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

* If From Format 1.

REGULATION
VESSEL TYPE
VESSEL SIZE
VESSEL CLASS

FORMAT 2-C

INDUSTRY COST CATEGORY: INVESTMENT COSTS (RETROFIT OR MODIFICATION) *
($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Investment (Retrofit) Costs of Regulation Per year (5) (3) x (4)
0 ___					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

* III from Format 1.

REGULATION
VESSEL TYPE
VESSEL SIZE
VESSEL CLASS

FORMAT 2-D

INDUSTRY COST CATEGORY: OPERATING COSTS (NEW CONSTRUCTION) *

($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Operating (New Cons) Costs of Regulation Per year (5) (3) x (4)
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

* IV from Format 1

REGULATION
VESSEL TYPE
VESSEL SIZE
VESSEL CLASS

FORMAT 2-E

INDUSTRY COST CATEGORY: OPERATING COSTS (RETROFIT OR MODIFICATION) *
($ THOUSANDS)

Year	Per Vessel Cost Before Regulation (1)	Per Vessel Cost After Regulation (2)	Cost due to Regulation (3) (2) - (1)	Number of Vessels Incurring Costs (4)	Total Operating (Retrofit) Costs of Regulation Per year (5) (3) x (4)
0 ___					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

* V from Format 1

REGULATION
VESSEL TYPE
VESSEL SIZE
VESSEL CLASS

FORMAT 3
SUMMARY OF INDUSTRY COST CATEGORIES *
($ THOUSANDS)

Year	Total Annual R & D Costs (1)	Total Annual Investment Costs (New Construction) (2)	Total Annual Operating Costs (New Construction) (3)	Total Annual Investment Costs (Retrofit) (4)	Total Annual Operating Costs (Retrofit) (5)	Total Annual Cost of the Regulation (6) (1)+(2)+(3)+(4)+(5)
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

* From Column 5, Format 2-A, 2-B, 2-C, 2-D and 2-E.

FORMAT 4
INDUSTRY REGULATION COSTS—SUMMARY FOR ALL VESSEL CLASSES*
($ THOUSANDS)

REGULATION:

Year	Total Annual Cost Class (1)	Total Annual Cost Class (2)	Total Annual Cost Class (3)	Total Annual Cost Class (4)	Total Annual Cost Class (5)	Total Annual Cost Class (6)	Total Annual Cost Class (7)	Total Annual Cost Class (8)	Total Annual Cost Class (9)	Total Annual Cost All Classes (10) (1)+(2)+ +(9)	Discount Factor ___ % (11)	Other Discount Factor ___ % (12)	Discounted Annual Cost (13) (10) (11)
0											1 000		
1											954		
2											867		
3											788		
4											717		
5											652		
6											592		
7											538		
8											489		
9											455		
10											405		
11											368		
12											334		
13											304		
14											276		
15											251		
16											228		
17											208		
18											189		
19											172		
20											158		
21											142		
22											129		
23											117		
24											107		
Totals											Cumulative Discount Factor 9 427		Total Discounted Industry Reg Cost

Uniform Annual Industry Regulation Cost Total Discounted Industry Regulation Cost — 9 427 ———— Enter this in Column 5, Format 7

* From Column 6, Format 3

FORMAT 5

IN-HOUSE COST CATEGORIES

Regulation:

I. R & D COSTS _____

II. INVESTMENT COSTS

A. Non-recurring _____

B. Recurring _____

(Time Period _____)

III. OPERATING COSTS

A. Personnel

1. Civilian Personnel Services _____

2. Military Personnel Services _____

3. Other Personnel Costs _____

B. Materials, Supplies and Utilities _____

C. Contractual Services _____

D. Government Furnished Services _____

E. Maintenance and Repair _____

F. Other _____

TOTAL OPERATING COSTS _____

_____

Explanatory Notes:

FORMAT 6

SUMMARY OF IN-HOUSE COST CATEGORIES*
($ THOUSANDS)

REGULATION.

Year	Annual R&D Costs (1)	Annual Investment Costs (Non-Recurring) (2)	Annual Investment Costs (Recurring) (3)	Annual Operating Costs (4)	Total Annual In-House Costs of the Regulation (5) (1) + (2) + (3) + (4)	Discount Factor ___ % (6)	Other Discount Factor ___ % (7)	Discounted Annual In-House Cost (8) (5) × (6)
0						1.000		
1						.954		
2						.867		
3						.788		
4						.717		
5						.652		
6						.592		
7						.538		
8						.489		
9						.445		
10						.405		
11						.368		
12						.334		
13						.304		
14						.276		
15						.251		
16						.228		
17						.208		
18						.189		
19						.172		
20						.156		
21						.142		
22						.129		
23						.117		
24						.107		
TOTALS						Cumulative Discount Factor 9 427		Total Discounted In-House Regulation Cost

Uniform Annual In-House Regulation Cost Total Discounted In-House Regulation Cost ÷ 9 427 _____ Enter this in Column 5, Format 7.

* From Format 5

FORMAT 7

COMPARISON OF ALTERNATIVES
($ THOUSANDS)

Description of Alternative Regulations (1)	Impacted Resources (2)	Compliance Dates (3)	Description of Benefits (4)	Uniform Annual Costs (5)
1.				Industry* ____ In-House** ____ Total ____
2.				Industry* ____ In-House** ____ Total ____
3.				Industry* ____ In-House** ____ Total ____
4.				Industry* ____ In-House** ____ Total ____
5.				Industry* ____ In-House** ____ Total ____
6.				Industry* ____ In-House** ____ Total ____
7.				Industry* ____ In-House** ____ Total ____
8.				Industry* ____ In-House** ____ Total ____
9.				Industry* ____ In-House** ____ Total ____
10.				Industry* ____ In-House** ____ Total ____

* From Format 4.

** From Format 6.

SECTION VI
COST PROCEDURES AND FACTOR DEVELOPMENT

This section is divided into six parts which address cost procedures for vessel design, vessel equipment, vessel staffing, vessel licensing, vessel inspection, and vessel operation changes.

A. Vessel Design Cost Procedures

The task of assessing industry costs of regulations affecting vessel design criteria is complicated by three factors:

- Classifying the vessels which must comply with a regulation according to the different ways the design requirement will be achieved on different sizes or types of vessels.
- Determining when in the life of the vessels the design change will be made.
- Identifying all the cost categories impacted by the regulation.

With these problems in mind, the necessary steps involved in measuring total industry costs of a regulation mandating a vessel design change are as follows:

1. Describe the regulation in detail. Include a discussion of the impacted vessels, by size and type (e.g., seagoing tank vessels of 20,000 DWT or more), and the time frame of the regulation (e.g., existing tank vessels must comply by January 1, 1982, and all new tank vessels constructed under contracts awarded after December 31, 1979 must comply). This step is necessary in estimating the impacted fleet population.

2. Classify impacted vessels according to the alternative methods of meeting the requirements of the regulation. Many design regulations are written in general terms which allow the requirements of the regulation to be met in a number of alternative ways. Ship owners comply with regulations in ways that will minimize the costs to them. For example, depending on vessel specifications, a double bottom may be used for segregated ballast on one ship and not on another. The result may be the methods and, consequently, the costs of complying with a regulation will vary from vessel to vessel.

The regulatory staff must be aware of this possibility. When different methods of complying with a regulation exist, the regulatory staff must make every effort to identify the costs of these alternative methods and separate the impacted vessel population into classes according to the likely method to be used for compliance.

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In addition, even when only one method of compliance exists, the costs of the design change will often differ by size of ship, type of propulsion, age of ship, commodity carried, etc. To illustrate, the cost of building a double hull on a 35,000 DWT tanker will be less than the cost for a 150,000 DWT tanker if only because of differences in the quantity of steel needed.

Because of these differences in costs among vessels, it is crucial to group vessels and perform the cost estimation by groups or classes of vessels when possible. In classifying, the regulatory staff must weigh the gain in precision of a very specific classification against the quality of the cost estimates. If there is a large margin of error and lack of knowledge associated with the costs of compliance, the value of a very specific breakdown of ships is correspondingly decreased. Similarly, the classification of vessels is constrained by the vessel population data. If vessel population is only forecast for 5 DWT sizes, then it makes little sense to estimate costs for 10 DWT sizes.

3. Determine the cost categories which will be impacted by the regulation.

Research and Development

This category includes all R&D costs expected to be incurred by the shipowner as a result of the design regulation. Sunk costs must not be included. If the regulation was researched by the shipping industry in an effort completed before the present cost analysis was begun, the costs of that research are considered sunk.

Most of the research and development costs associated with a given regulation will be incurred by the U.S. Coast Guard. However, the possible R&D costs incurred by industry must not be ignored. It is important to point out R&D efforts performed by the shipyard for the shipowner will not fall under R&D costs but will be passed into investment costs under shipyard costs.

Investment Costs

These are the capital costs associated with the retrofit of existing vessels to meet regulation requirements or the incorporation of the design change into vessels under construction. The capital or investment costs incurred by the owner can be broken down into two categories: the shipyard bill for construction or retrofit and other shipowner's costs in addition to the shipyard bill (see Figure 3).

Shipyard Bill

The shipyard bill for construction or retrofit is the most significant element in the costs of design change regulations. Preparing a good quality estimate of the

Figure 3

VESSEL INVESTMENT COSTS

1. Shipyard costs.
   - a. Material costs
     - (1) Hull
     - (2) Outfit
     - (3) Machinery
   - b. Labor costs
     - (1) Hull
     - (2) Outfit
     - (3) Machinery
   - c. Overhead
   - d. Profit
2. Other shipowner costs including overhead, training, attorney's fees, etc.

shipyard bill for a type or class of vessel is a difficult task complicated by a number of factors.

The costs for the same design change will differ according to whether the construction or alteration will be performed in a U.S. or a foreign shipyard. Hence, any cost estimate must be predicated on an assumption concerning the country the work will be done in.

The costs of the same design change will differ according to the shipyard chosen. A recent report to Congress on the relative cost of shipbuilding in the U.S. points out:

1. The cost of shipbuilding on the West Coast exceeds that on the East Coast by approximately 3½ percent.

2. The cost of shipbuiding on the East Coast exceeds that on the Gulf Coast by approximately 2½ percent.[1]

As a result, the analyst must be aware of the drawbacks associated with using an average cost for a certain design change over all U.S. shipyards.

Another problem inherent in estimating the cost of construction or retrofit arises from the nature of shipbuilding and repair cost estimating procedures currently employed. Ship cost estimation is often characterized as a "black box" science. Within the U.S. there are almost as many ways of estimating ship construction costs as there are shipyards.

In general, the shipyard bill is broken down into material costs, labor costs, overhead costs and profit. Material costs are normally estimated on an item-by-item basis by ship component. This leads to problems in analyzing costs of design change regulations because no consistent ship component breakdown exists between shipyards. The Maritime Administration (MarAd) uses steel, outfit and machinery to classify ship's components.[2] Some shipyards use MarAd's system, others use systems of up to 25 specific categories without more general groupings. This presents a particular problem in estimating average costs of a design change or retrofit. If the regulatory staff is interested in getting behind the estimates of the shipyard bill, care must be taken when appealing to industry or MarAd experts, and especially when comparing different cost estimates, to recognize that a cost

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1. Maritime Administration. Relative Cost of Shipbuilding: A Report to Congress. Washington, D.C.: Maritime Administration, 1977.
2. See Office of Ship Construction, Division of Estimates. "Classification of Ship Construction and Reconstruction Costs." Washington, D.C.: Maritime Administration, 1965.

element placed under outfit by one expert may be placed under machinery by another.

Similar problems arise regarding labor costs. Often labor costs are expressed in person-hours per ship component. These person-hour costs can then be multiplied by an average wage in the U.S. for shipyard labor.

Overhead costs are shipyard costs which cannot be charged to any one contract (e.g., taxes, officer's salaries, utilties, watchmen). One common way to estimate overhead costs is as a percentage of labor costs.

Profit is another element of the shipyard bill relevant to estimating the costs of a regulation. It is generally calculated as a percent of the total labor plus material costs.

Other Shipowner Costs

After the shipyard bill has been estimated, the regulatory staff must turn attention to any additional shipowner investment costs incidental to the shipyard bill. Along with any one-time crew training expenses, these may include, for example, architects fees for contract plans, specifications, working plan approval and inspection, fees for interior design, and attorney's fees. It has been suggested these costs for nonsubsidized owners are lower than for subsidized owners because of the fewer complications in reporting requirements.

Another siginificant cost is the cost of financing the capital investment. Methods for including this element are varied. Two alternatives are to capitalize these costs or to include this cost as a nonoperating expense. The former method is recommended since it simplifies the procedures without adversely affecting the analysis. Although the regulatory staff may have difficulty estimating this element, an attempt should be made to include this element since it will significantly impact the relative costs of alternatives when one alternative is more capital intensive than another. For comparison of capital intensive regulations its impact will be felt in measuring the level of total costs of each alternative.

The suggested method for including the interest portion of investment is as follows. The regulatory staff must first decide upon an appropriate interest. It is suggested that in most cases the staff use the same rate for interest as is used for discounting. Next determine an applicable payback period. This will be dependent upon the type and size of investment. Based upon the interest rate and payback period develop an applicable multiplier factor. To obtain total investment costs multiply the cost of capital times the appropriate factor.

Examples of several factors are:

Annual Interest Rate	Payback Period	Factor
10%	5 years	1.32
10%	10 years	1.63
12%	10 years	1.77

If $10,000 is borrowed at a 10% annual interest rate to be paid back in ten equal annual installments multiply $10,000 times 1.63. The total investment cost is then $16,300.

One investment cost of vessel design change to the shipowner frequently overlooked is the delay cost. When a regulation requires that a vessel retrofit, this often necessitates a trip to the shipyard. For some regulations, the design change can be accomplished while the vessel is already in the yard for its routine maintenance, repair and inspections. In these cases, there are no delay costs attributable to the design change. More often, however, the retrofit is accomplished during the regularly scheduled drydocking by extending the vessel's time in the yard or the retrofit requires a special trip to the yard. With vessels under construction, a requirement for a design change can significantly lengthen the construction period.

Delay costs of these types are true costs of the regulation in terms of lost vessel productivity. The problem is how to measure them. The recommended procedure is to estimate the delay time in days and multiply it by the vessel delay cost factor associated with the type and size of vessel under analysis found in Section VII.

Another point to consider regarding vessel design change is the loss (or gain) of cargo carrying capacity which may result from such a change. A decrease in cargo carrying capacity following a design change is a real cost of the regulation in terms of lost productivity and efficiency of the vessel. Measuring this lost productivity is a complicated process. One might suggest using the present or forecasted freight rate for the commodities transported in the impacted vessels. The problems with this method are:

1. It includes a profit percentage to the shipowners. The loss of this profit undoubtedly hurts the shipowners; however, it cannot be considered a cost to society because no real resources are used up.

2. It may involve double counting. The freight rate is based on costs. If the regulatory staff measures the R&D, investment and operating costs of the regulation and then measures the changes in freight rates, some costs of the regulation will have been counted twice.

3. The freight rate is highly variable in most trades.

The recommended approach in this manual is to measure the lost cargo carrying capacity in terms of lost deadweight tonnage and leave it at that, without attempting to put a dollar measure to this lost productivity.

Before leaving the subject of investment costs, several points must be stressed. Most importantly, when measuring the costs of a regulation mandating a vessel design change, the regulatory staff must estimate only the increase (or decrease) in investment costs attributable to the regulation. Often this may take the form of estimating the costs of constructing a "base ship" without the design change; estimating the cost of the same vessel with the design change; and comparing the two estimates to arrive at the change in costs resulting from the regulation. Sometimes, especially in the case of retrofit requirements, the regulatory staff can arrive at the regulation costs without estimating the base ship's cost.

Another important point regards the timing of the regulation in the life of the ship. It is generally recognized that a design change on a new ship is considerably less expensive than retrofit of an existing ship. In fact, one expert proffers that retrofitting is, on average, 75 percent more expensive. But costs also vary for a new vessel. It is cheaper to incorporate a vessel design change into a vessel on order versus one that is already under construction. A realistic assumption regarding older vessels (20 years plus) is that they will be retired before undergoing expensive retrofitting. In summary, the earlier in the life of the ship the design change is made, the less expensive the changes will be.

The most reliable source of shipbuilding and retrofit cost data are the shipyards which will be doing the work. The shipbuilding industry is very competitive, however, and there is a paucity of published cost data. The Maritime Administration, especially the Office of Ship Construction, has access to a large quantity of commercial vessel shipbuilding costs necessitated by its administration of the Construction Differential Subsidy. Again, most of their data are proprietary. Nevertheless, they have a large staff of experienced naval cost estimators who can be quite valuable in estimating the investment costs of a regulation. Point of Contact: Office of Ship Construction, Maritime Administration. Telephone: (202) 377-4373, Room 4868, Department of Commerce Building, Washington, D.C.

Operating Costs

The operating cost changes associated with a vessel design change or retrofit can be easily overlooked by the regulatory staff. This oversight can be partially justified when the investment costs of a regulation are very large relative to operating costs or when the operating cost changes are unmeasurable given the state-of-the-art and the resources available to the regulatory staff. In either case, it is important for the regulatory staff to describe the expected changes in operating costs in qualitative terms when quantitative estimates are unavailable. Each of the operating cost categories and the possible effects of a vessel design regulation on them will be discussed in turn.

Personnel

In general, a vessel design change itself would not be expected to impact crew wages or subsistence. Exceptions can occur, for example, if the vessel design regulation necessitates an additional crew member.

Determining the marginal cost of an extra crew member begins with an estimate of the number of extra crew members required, multiplied by an average wage factor and by the number of vessels expected to be impacted. A vessel design change could also theoretically lead to an increase in crew overtime or, perhaps, an increase in wages. For example, some experts contend that a double bottom on vessels increases the risk of explosion and, hence, danger to the crew. Given this circumstance, the maritime unions may bargain for an increase in wages for crew members on double-bottom vessels. It is useful to mention possibilities of this sort even though they may be unmeasurable.

Maintenance and Repair

Vessel design changes can have a myriad of both positive and negative impacts on maintenance and repair costs. For example, on the one hand, double bottoms may reduce tank cleaning requirements and decrease normal maintenance and repair costs. On the other hand, the increased structural complexity may make overall repair costs more costly.

Appendix B provides an example of a proposed regulation that could affect Maintenance and Repair costs. Test Case II, Double Hull Retrofits For Existing Tank Barges, demonstrates how the regulatory staff accounts for such cost changes.

Insurance

Experts differ on the expected effects a design change will have on insurance premiums. Some contend that if a regulation reduces, say, the probability

of a collision, the insurance industry will respond by decreasing hull and machinery (H&M) premiums. Others note the insurance industry bases its rates on past experience and history and, consequently, the impact on premiums of a regulation decreasing collision risk may not be experienced for 3-5 years.

In addition, effects on insurance premiums can be offsetting. For example, because double hulls are expected to decrease collision damage and resulting oil spills, H&M (hull and machinery) and TOVALOP[1/] (Tanker Owners Voluntary Agreement Concerning Liability For Oil Pollution) insurance premiums might be expected to fall. But double hulls also may increase probability of vessel explosions and crew danger, thereby leading to an increase in protection and indemnity premiums. Due to these conflicting arguments, any measure of the effect of a regulation on insurance premiums must be carefully justified by the regulatory staff.

Fuel, Lubricants and (Fresh) Water

A vessel design change is most likely to impact this category via fuel costs. For example, a vessel design change may result in decreased fuel costs.

Stores and Supplies

A vessel design change may necessitate more or less paint, cleaning materials and other stores, often through its effects on maintenance and repair.

Cargo Handling Costs

A vessel design change could impact these costs, both positively or negatively, if it changes cargo handling procedures or risks. This possibility should be investigated. Again, there is the possibility a vessel design change will decrease or increase the cargo carrying capacity of the vessel. When this occurs, cargo handling costs may change because of the change in cargo volume.

Port and Canal Fees

Vessel design changes can impact these categories mainly in pilotage or tug service expenses. For example, a regulation requiring stern and bow thrusters has the potential to reduce the need for tugs and tug charges.

[1/] An agreement administered by the International Tanker Owners Pollution Federation whereby tanker owners accept responsibility for cleaning-up oil spills caused by his vessel.

Material and Indirect Support

A vessel design regulation could impact this category by requiring additional spare or repair parts.

Overhead

Overhead is unlikely to be impacted by a vessel design change, although examples can be found. One possible administrative cost is the increase in paperwork resulting from the regulation.

Training

A vessel design regulation could impact this category if, for example, it necessitates crew drills or crew attendance at certain training institutions. Appendix B, Example I, provides an extensive example of a regulation that has an impact upon this category

Delay Costs

These are costs associated with any delays attributable to the regulation. The procedures for measuring the costs of vessel delays are found on page 75. Appendix B demonstrates in Example III, Vessel Delays at the Hackensack River Portal Bridge, the treatment of delay costs. While the delays analyzed are not attributable to new CVS regulations, the approach utilized is similar to one the regulatory staff would employ to assess regulatory costs.

B. Vessel Equipment Cost Procedures

The procedures associated with assessing the costs of a regulation requiring the installation of certain equipment are quite similar to those associated with a vessel design change regulation. Basically, the steps involved fall under two broad classifications: (1) determining the number of vessels over the pertinent time horizon which will comply with the regulation and when they will do so, and (2) determining how the vessels will comply with the regulation and the cost categories impacted. The actual steps involved in performing the cost estimation are discussed in detail below.

1. Describe the regulation under analysis. The description must include a discussion of the sizes and types of vessels required to comply with the regulation and when they must comply. This description will aid in determining the time horizon of the analysis and forecasting the impacted vessels.

2. Group the impacted vessel population and perform the cost estimation by groups or classes of vessels. The vessel population should be grouped according to the expected differences in the costs of the equipment and installation by vessel type and size. The necessity for this classification can be shown by

example: the costs of installing a doppler speed device on a VLCC may be greater than for a handy-weight tanker (35,000 DWTs) simply because of the length of cable required for hookup.

Any vessel classification is constrained first, by the vessel population breakdown available in the fleet forecast and second, by the regulatory staff's ability to obtain different estimates of the equipment cost for different sizes and types of vessels. In the past, cost estimates for equipment usually have not been broken out by the manufacturers for different sizes of vessels.

3. Determine the cost elements which will be impacted by the equipment regulation.

Research and Development

The discussion of R&D costs contained in the section on vessel design criteria is also applicable to equipment criteria. Most of the R&D costs expended by the shipping industry to investigate new equipment will not be attributable to the regulation. The regulation cost analysis is only concerned with costs which are a direct result of the regulation. R&D funds already spent by the industry are considered sunk costs and are not appropriate for inclusion in the analysis. Furthermore, R&D costs which the industry spends of its own volition, not as a direct result of the equipment regulation, should not be included in the analysis.

Investment Costs

These are the capital costs associated with retrofitting existing vessels with the required equipment and installing the equipment on vessels under construction. The investment costs incurred by the vessel owner include the unit cost of the equipment, any other costs associated with installation and making the equipment operational, plus the cost of financing the investment.

The manufacturers and distributors of the indicated equipment constitute the best source of information on the unit or per vessel investment cost of the equipment. There are two prime considerations to be made regarding manufacturer price estimates.

First, the regulatory staff must decide the number of manufacturers to survey. There may be several manufacturers of the indicated equipment and their equipment may differ in quality and/or price. The regulatory staff must find an average quality and an average price. To obtain the averages necessitates questioning more than one manufacturer. In one recent study, a survey of 9 out of 20 manufacturers was considered representative.

Note, the appropriate number to survey depends on the number of possible manufacturers and the disparity in their prices or quality. For example, when the number of manufacturers is considerably larger than 20, 9 may be an inadequate size sample. Likewise, if the quoted prices vary widely, it may be worthwhile to canvass more manufacturers than would be necessary when prices are relatively similar. When the quality or design of the equipment gives rise to doubts about its acceptability in meeting the requirements of the regulation, the companies manufacturing unacceptable equipment should be excluded from the survey.

The second problem confronting the regulatory staff involves determining what is included in the unit or per vessel price quoted by the manufacturers of the equipment. The investment cost to the ship owner of the regulation is made up of the cost of the equipment, costs to transport the equipment to the vessel, installation charges by the manufacturer or shipyard, cost of initial spares and stocks to keep the equipment operational, and any initial training in the proper use and maintenance of the equipment. The price quoted by the manufacturer may include all or just some fraction of these various costs. When the manufacturer quotes the price without transportation, installation, initial spares and stocks or initial training included, it falls on the regulatory staff to estimate these costs separately.

Another possible cost is the delay cost associated with installing the equipment. As was noted in the discussion on vessel design criteria, when a vessel makes a special trip to a shipyard or extends its stay at a shipyard for equipment installation, this time lost to productive uses represents a real cost to the owner in addition to the shipyard or manufacturer cost of installation.

The recommended procedure in these cases is to estimate the delay time in days and multiply it by the vessel delay cost factor associated with the type and size of vessels under analysis found in Section VII. This procedure gives a measure of the cost of the delay due to the equipment regulation.

Another cost is the possible loss of space aboard the vessel because of the new equipment. This loss of space represents a real cost of the regulation if it restricts movement of personnel, decreases cargo carrying capacity, or if the space had been used in the past for a productive use. While this space loss is a real cost, it is extremely difficult to place a dollar value on the costs. The recommended approach is to describe the amount of lost space and its effects without trying to measure the costs in dollars.

It is important to estimate the cost of retrofit separately from estimating the cost of equipment installation on future vessels yet to be built. This is because the costs of installation can vary widely according to when in the life of the vessel the installation is accomplished. For example, one expert noted installation charges for a fathometer varied from $2,500 for installation on a vessel under construction to $5,000 for installation on a vessel during its routine drydocking to $40,000 for installation during a special drydocking.

One vexing problem confronting the regulatory staff is determining which vessels have already installed the equipment voluntarily. The cost of the equipment to these owners is not a cost of the regulation unless the equipment was installed in expectation of the adoption of the regulation. Lloyd's of London Register of Shipping and the Army Corps of Engineers' Waterborne Commerce of the United States give some information on the equipment already installed on existing vessels. Realistically, however, for the great majority of potential equipment regulations, equipment statistics do not exist. In this case, there are several options. The shipping companies or equipment manufacturers can be surveyed or the COTPs at several locations can be asked to conduct ad hoc surveys of vessels entering the ports. As an additional option which may be justifiable because of time or other resource constraints, the regulatory staff can assume existing vessels with the equipment already installed are negligible and perform the cost analysis as if they did not exist.

Unlike most vessel design changes which last the life of the vessel, new equipment may not. In fact, the average lifetime may be on the order of 7 to 10 years. As a result, an equipment regulation does not represent a one-time only investment by the ship owner. Instead, the vessel must have replacement equipment installed periodically. The regulatory staff must be sure to capture these recurring investment costs. First, the equipment manufacturers should be asked what the expected life of the equipment is. Second, the regulatory staff must calculate how many times a given vessel will go into the shipyard for reinstallation before it retires. This, of course, necessitates an assumption about average retirement age. The recommended age to use is 25 years. Furthermore, vessels over 20 years old will not, by assumption, retrofit. A vessel which has the equipment installed during its construction is considered a retrofit when it goes in for reinstallation. In other words, suppose it costs $5,000 to install the equipment on a vessel under construction and $10,000 for the retrofit of an existing vessel and the equipment lasts 10 years. The cost of the regulation is $5,000 if the vessel is being built and $10,000 10 years later if the equipment must be retrofitted.

The old equipment is likely to have a scrap value. Theoretically, this scrap value should be subtracted from the cost of the equipment to obtain the true cost of the regulation. In practice, it is recommended the scrap value of the used equipment be ignored in the analysis.

The data sources for obtaining the costs of equipment include the equipment manufacturers and distributors. Another point of contact is Office of Ship Operations, telephone (202) 377-4847; and the Office of Ship Construction, telephone (202) 377-4373, Maritime Administration, Department of Commerce Building, Washington, D.C.

Operating Costs

Equipment regulations can affect annual operating costs in many of the same ways vessel design regulations can. Each of the operating cost categories and the possible effects of an equipment regulation on them will be discussed in turn.

Personnel

It is possible the new equipment would require an additional crewmember to operate the equipment. In this case, the annual personnel costs of the regulation would be the annual wage and subsistence costs of the additional crewmembers times the number of vessels hiring the additional crewmembers. Estimating the cost of an additional crewmember is discussed in detail on page 66.

A more likely case is the regulation will not require an additional crew member. Rather, it will increase the workload of existing crewmembers and thereby increase overtime hours. If this is expected, the regulatory staff must estimate the number of additional overtime hours per vessel per year and multiply it by the pertinent overtime wage rate and the number of vessels impacted.

Maintenance and Repair

New equipment can have both positive and negative effects on annual maintenance and repair costs. For example, inert gas systems are expected to reduce tank corrosion and therefore decrease maintenance and repair costs. Alternatively, the installation of certain emergency steering equipment is expected to increase maintenance costs because of certain tests which must be performed on the equipment periodically.

Insurance

The expected impact of equipment on vessel insurance premiums has been the subject of much discussion among the experts (see page 59 on vessel design change). A case can be made that the premiums for hull and machinery protection and indemnity, and pollution insurance might decrease because of the installation

of safety or pollution abatement equipment which reduces the probability of groundings, collisions, oil spills, etc. On the other hand, insurance premiums are based on historical experience. Using past experience as a basis implies insurance premiums will decrease only when enough time has elapsed after the adoption of the regulation for the expected decreases in accidents to show up in the data. Because of uncertainty surrounding the effects of equipment on insurance premiums, any measure of expected premium changes due to the regulation must be carefully justified by the regulatory staff.

Fuel, Lubricants and Water

An equipment regulation is most likely to impact this cost category through impacts on fuel costs. If the equipment either decreases or increases vessel speed, fuel costs per voyage can be expected to increase.

Stores and Supplies

Initial stocks necessary for placing the required equipment into operation are considered a non-recurring investment cost of the equipment. Stocks, stores or supplies used continually or periodically to keep the equipment in working order are considered an operating cost of the investment. The regulatory staff must estimate the stores and supplies used annually per vessel to keep the required equipment operational.

Training

Annual training costs can be a significant cost attributable to an equipment regulation. Any initial one-time training costs associated with the equipment installation (e.g., instruction manuals, special courses) are considered an investment cost of the regulation. If, however, the equipment necessitates continual or periodic training in order to instruct the crew in the use of the equipment and keep the equipment operational, these training costs fall under annual operating costs of the regulation. For example, the cost of crew drills performed quarterly on emergency steering gear are annual training costs directly attributable to the regulation. Similarly, any increase of annual shipping industry contributions to union training funds to provide instructional courses on the equipment is an increase in costs due to the regulation.

Other Operating Costs

Personnel, maintenance and repair, insurance, fuel, lubricants and water, stores and supplies, and training are the most likely operating cost categories to be affected by a vessel equipment regulation. The other categories, including material and indirect support, cargo handling, port and canal fees, and overhead, may also

be impacted but often not significantly. If the regulatory staff is constrained to limit the regulation analysis, the actual measurement of the cost changes in these categories can be ignored without severely damaging the analysis. However, the expected impacts must, in any case, be described in as much detail as possible.

C. Vessel Staffing Cost Procedures

Unlike vessel design or equipment criteria which can impact all three major cost categories, changes in staffing criteria will, for the majority of cases, impact only vessel operating costs. In order to assess the costs of a proposed staffing regulation, the impact on per vessel operating costs must be measured and multiplied by the number of vessels impacted for each of the 25 years of the regulation analysis. The steps involved are described below:

1. Describe the regulation, include a discussion of impacted vessels by size and type and the time frame of the regulation, i.e., the dates of expected compliance.

2. Group the impacted vessel population according to expected differences in the costs to different types and sizes of vessels of the staffing regulation. The cost estimation should be performed separately for each of the vessel groups or classifications. It is necessary to do this because the cost of an additional crewmember will often differ between sizes and types of vessels. For example, under certain conditions, crewmembers on automated ships receive higher wages than crewmembers on non-automated ships. Similarly, container ship crews typically receive higher fringe benefits than crews on other vessels.

3. Determine the components of operating costs that will be impacted by the staffing regulation. The most significant component impacted will be personnel costs.

Personnel Costs

There are two possible ways Coast Guard regulations can impact personnel costs: (1) by requiring the addition of one or more persons to the crew complement, and/or (2) by increasing or decreasing the duties or workloads of existing crewmembers. Regulations requiring additional crewmembers will impact both vessel wage costs and subsistence costs, whereas regulations changing work loads will impact only wage costs.

Crew wage costs can be broken down into 13 subcomponents. On a monthly basis, the wage costs per crewmember consist of:

1. Base Wage - Monthly amount paid to each crewmember. It differs by rating, for example, masters are paid a different base wage than able seamen, etc.

2. Non-watch Pay - Pay to non-watchstanding officers in lieu of overtime. It is justified by the extra supervisory work they are often involved in.

3. Vacation Fund - Employer contribution into a union vacation fund. These vacation funds are released to the crew by their union. The amount paid into the vacation fund is a set percentage of base and non-watch pay for each crewmembers. On certain fast turnaround container vessels, a special vacation fund is used.

4. Pension Fund - Employer contribution to union pension funds.

5. Welfare/Medical Fund - Employer contribution to union medical insurance fund.

6. Feinberg Contribution - Employer contribution of 4 to 6 percent of base wage and non-watch pay into pension fund for each day employee is on vacation. For container vessels, there is an extra Feinberg contribution per crewmember.

7. Training Contribution - Employer contribution to union training funds.

8. Automation Bonus - On automated vessels, certain crewmembers receive a 10 percent bonus of base and non-watch pay.

9. Employee Committee - Employee contribution to union hiring hall.

10. Special Account - Employer contribution into escrow account for use and distribution according to union needs.

11. Safety and Education Fund - Employer contribution to union fund for retraining and upgrading programs. This fund is only applicable to some unions.

12. Supplementary Pension Fund - Employer Contribution to pension fund. Employees receive these deferred benefits when they retire. This fund is only applicable to West Coast unions.

13. Hourly Overtime Rates - Wage per hour for overtime differs by crew rating.

As can be seen in the above breakdown, the crew wage costs will differ from vessel to vessel depending on the type of vessel, the number and ratings of crewmembers onboard, the unions the crews belong to and their bargaining arrangements. In order to measure the costs of an additional crewmember the regulatory staff must determine the rating of the required additional crewmember (e.g., radio operator, third mate, ordinary seaman, able seaman, etc.), the types of vessels impacted, and the average wage costs and subsistence costs for that rating on that type vessel.

If the regulatory staff has the time and resources to go straight to the primary sources, the shipping companies and unions can be surveyed for wage and subsistence costs. Another excellent source of information is the Maritime Manpower Impact System administered by the Office of Maritime Manpower, telephone (202) 377-3018, Maritime Administration, Room 3069A, Department of Commerce Building, Washington, D.C. This computer system is updated annually and is capable of listing by rating and union, wage costs per person/day, month or year broken out for 12 of the 13 subcomponents listed above for any ocean-going U.S. vessel greater than 1,000 gross tons. The system does not contain information on overtime wage rates. The system can also give average total wage costs or subcomponent costs for specific vessel types which include chemical, oil and gas tankers and conventional cargo, container, roll-on-roll-off, ore-bulk-oil, car carrier, and LASH vessels.

The shipping companies and unions remain the best source of information on overtime rates and subsistence costs for all vessels and wage costs for vessels operating in coastwise, Great Lakes, rivers, or inland waterway trades. One alternative source of information on domestic shipping wage costs is the Bureau of Accounts, and the Office of Publications, telephone (202) 275-7356, U.S. Interstate Commerce Commission. The Commission collects employment data for domestic water carriers. Average number of employees per year, total hours worked per year, and total compensation per year by region and by individual carrier is published annually by the Commission in "Table 4 -- Selected Financial and Operating Data by Individual Maritime Carrier" of Transport Statistics in the United States, Part V, Carriers by Water. Also, MarAd's Office of Domestic Shipping, telephone (202) 377-5478, Room 6606, collects some Great Lakes wage data.

For regulations which change the workload of existing crewmembers, the regulatory staff must determine which of the 13 subcomponents will be impacted

by the regulation. If the regulation adds duties to a particular rating, total overtime pay may be impacted in the short run and base wages may be impacted in the long run as unions bargain for increased base wages because of the extra duties. Again, the best sources of information regarding such possibilities are the shipping companies and unions. The Maritime Manpower Impact System may be used to provide historical data on union and industry reactions in the past to similar situations.

Other Operating Costs

While the possibility exists that other operating costs besides personnel costs will be impacted by a staffing regulation, these impacts will most often be insignificant, especially in relation to the personnel costs, and extremely difficult to measure. The recommended approach is to describe them in detail without attempting to place a dollar value on them.

Once the annual wage costs of the required additional crewmember or the change in wage costs of the crewmembers experiencing workload changes have been determined, the regulatory staff must estimate the number of crewmembers impacted per vessel. Because of the vacation plans for merchant mariners, shipping companies hire more than one person per year to fill any vacant position. The person per billet ratios differ by types of vessels. One recent study[1] estimated the person-per-billet ratios to be:

- 1.8 for breakbulk, dry cargo and passenger vessels.
- 1.9 for container and fast turnaround vessels.
- 2.0 for tankers.
- 1.25 for Great Lakes traffic.

The significance of these person-per-billet ratios for regulation analysis can be shown by example. If it costs $18,000 to hire an additional radio operator in compliance with a staffing regulation, the total cost of the regulation to a dry cargo vessel is not $18,000 but $32,400 ($18,000 x 1.8). In order to measure the

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1. Office of Maritime Manpower. "Deck and Engine Officers of the U.S. Merchant Marine: Supply and Demand, 1976-1985." Washington, D.C.: Maritime Administration, 1977.

annual per vessel costs of a staffing regulation, the regulatory staff must multiply the annual wage costs of the required additional crewmember or the change in wage costs of the crewmembers experiencing workload increases by the appropriate person-per-billet ratio.

D. Vessel Licensing Cost Procedures

In the great majority of cases, the most signficant costs to the industry of Coast Guard licensing requirements and qualification standards for merchant vessel personnel are the costs of training programs developed to meet those requirements and standards. In fact, such training programs are often implied by the licensing regulation. For example, recent proposed regulatory measures concerning licensing requirements have included requirements:

- For deck officers to demonstrate skills such as radar operation and interpretation instead of relying on written examinations.
- For issuance and renewal of licenses to ship masters, mates and pilots to include certain experience or training on ship simulators.
- For applicants for original certificates of service to be required to demonstrate basic knowledge and skills via training and examination.

These licensing regulations state or imply a level of training either through experience or training programs to meet the licensing requirements. In order to measure significant resource costs of a licensing regulation, it is recommended the regulatory staff concentrate on measuring the concrete effects of the regulation on training programs. Examples of possible effects are building a training school, adding a course to an existing curriculum or purchasing training equipment. The steps involved in performing the regulatory analyses are described below:

1. Describe the regulation under analysis. Include a discussion of the type of crew impacted by rating and vessel type. For example, does the regulation apply to all masters or just masters of oil tankers? It is also important to include the earliest compliance date for the regulation in order to determine the basline year of analysis.

2. Classify the impacted vessel population by type and size according to any expected differences in the costs of the regulation to different sizes or types of vessels.

3. Determine the vessel cost categories which will be affected by the licensing regulation.

Research and Development

It is unlikely this category would be impacted by a licensing regulation.

Investment Costs

Investment costs can be impacted in several ways by a licensing requirement. This occurs if the requirement necessitates building another school, enlarging a curriculum, buying training equipment, etc. The problem with measuring the costs of such investments in the regulatory analysis is determining whether industry, unions or government will administer and pay the costs of the training invstments.

U.S. maritime training institutions fall into two broad classes: those administered by federal or state governments, and those administered by labor unions. For the federal and state academies, tuition is generally free to the student and the cost of investments in new courses or equipment is paid entirely by the government. Licensing requirements which necessitate an investment by one of these government supported, tuition-free institutions do not measurably impact industry investment costs.

On the other hand, if tuition charging, government-run programs make the investment, e.g., MarAd's Radar Observer Training Schools, industry may bear at least some of the investment costs in terms of higher tuition fees. If, in response to the licensing requirement, the school invested in new equipment or in an additional course the investment cost to the industry for vessel personnel who would already be attending the school is calculated by multiplying the number of crew per vessel attending the institution by the added tuition and the wage costs of the crewmembers for any extra time they must spend at the school.

Alternatively, the licensing regulation could require vessel personnel, who previously did not attend a certain training program, to do so. In this case, the industry investment cost of the regulation is calculated by multiplying the number of vessel personnel affected per vessel by the tuition of the training program, if any, the wage costs for personnel off-time, any transportation costs to and from the institution, and lodging and meal costs while attending the school.

Because a large portion of merchant marine training costs are paid by the government, the government investment costs should not be overlooked. Cost estimates to the government of buying equipment or expanding the curriculum at

the various merchant marine academies can be obtained directly from the respective academies. In addition, information regarding existing investment and operating costs of the U.S. Merchant Marine Academy is also published by the Budget Office, MarAd.

When a licensing requirement means a union training institution will invest in a new course or equipment, the cost to the industry becomes very complicated to measure. The unions will directly make the necessary investments. However, the costs of these investments will be paid indirectly by the shipping companies in increases in certain wage costs. Annual wages of vessel personnel contain employer training contributions to training funds of unions. The effects of union investment in new courses or equipment will be felt eventually by the industry in increased training contributions. These increased training contributions made by industry do not represent an investment cost to the industry but an operating cost. In other words, when unions invest in new courses or equipment in response to licensing requirements, these union investment costs are passed into industry operating costs in the form of increased wages or benefits. The regulatory staff must try to estimate these increases as an increase in vessel operating costs. Do not also estimate the union investment costs because to do so results in double counting. Sources of data regarding potential increases in employer training contributions include the union training institutions and the Maritime Manpower Impact System.

Thus far, industry investment costs in training due to a licensing regulation, have been discussed. It is very easy to mix up industry investment costs with industry operating costs of training. The difference is this. Investment costs in training include any one-time increased expenditures for new schools, courses, tuition, equipment, handbooks, etc. These investment costs may be recurring, e.g., handbooks may have to be replaced every 5 years. But they are not recurring on an annual basis. Any training costs paid annually are considered part of a vessel's annual operating costs. For example, if the regulation requires shipmasters to demonstrate proficiency on certain equipment every 6 months, the costs of the regulation are considered part of vessel operating costs. Alternatively, stiffer requirments for obtaining original certificates of service impact investment costs.

Operating Costs

There are two main categories of vessel operating costs likely to be impacted by a licensing requirement: personnel and training.

Personnel

As mentioned previously, the employer contribution to union training funds per employee may increase as the result of the licensing requirement. In this case,

per vessel personnel costs of the regulation are calculated by multiplying the increase in training contribution per employee by the number of vessel personnel impacted. In addition, if a licensing regulation leads to an increase in skill level for certain ratings, unions may bargain for an increase in wages. Possibilities of this sort should be investigated by the regulatory staff.

Training

A regulation may require vessel personnel to periodically demonstrate proficiency or perform regular drills. To calculate the costs of such training exercises requires an estimate of the number of crewmembers involved, the number of hours expended in the exercise, and the appropriate wage rate, either straight time or overtime.

Other Operating Costs

It is unlikely any other operating costs will be impacted significantly by a licensing regulation. They can be safely ignored.

E. Vessel Inspection Cost Procedures

Standard planning factors for person-hours required to conduct various types of vessel inspections are contained in the Operating Program Plan for Commercial Vessel Safety,* 11 July 1977. This section of the manual is not devoted to cost procedures for routine vessel inspections currently required by existing Coast Guard regulations. This section is designed to discuss procedures for new types of vessel inspection currently being considered by IMCO for implementation throughout the world. Singular emphasis is focused upon vessel boardings to conduct unscheduled inspections.

There are three potential areas which may be impacted as the result of increased inspection requirements:

- Inspecting officer compensation.
- Transit to and from the inspected vessel.
- Vessel delay costs associated with interference with normal operations.

Therefore, only operating costs will be addressed.

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*This plan is published by the Planning and Special Projects staff, Office of Merchant Marine Safety.

Inspecting Officer Compensation

While it is true in-house personnel compensation for the current staff is relatively "fixed" over, say, a year's period, if personnel are required to perform different duties (e.g., increased inspections), their normal routine is neglected and an opportunity cost will be experienced. In this case, the opportunity cost is what is foregone, e.g., previous duties, as a result of undertaking different duties. This method is used in this particular case since project costs relate to courses of action. Financial accounting, on the other hand, values concrete things.

Since the grade levels of inspecting officers vary, the regulatory staff should use the pay grade contained in Section VII of this manual of $23,400 per annum for commissioned officers when grade distribution is unknown. All recurring costs should be calculated and added to pay to obtain total compensation. OG 20.00 Permanent Change of Station (PCS) should be calculated using the inside U.S. recurring factor of $1,420. Total compensation would thus tally as follows:

Pay and Allowances	-	$ 23,400
PCS	-	1,420
Operating and Maintenance	-	1,040
Training and Procurement	-	198
Total	-	$ 26,058

Using a standard availability rate of 2,080 hours per year, this yields an approximate (rounded) averge compensation rate of $12.50 per hour.

For every vessel inspected, one inspecting officer's rate should be multiplied by the estimated number of hours to conduct[1] the unscheduled inspection. This factor should, in turn, be multiplied by the estimated number of vessels to be inspected every year. Enter the results of these computations under military personnel annual costs on line III.A.2, Format 5. If additional inspecting officers are required to perform this function then their annual compensation rate should be used instead of the oportunity cost approach just described. Carry forward totals to Format 6. This is a realized cost approach, since personnel are added to handle the increased level of work rather than diverting existing personnel from other duties.

Transit To and From Inspected Vessels

Although it is unknown whether unscheduled inspections will take place other than at dockside, in the event this type of inspection involves transit by Coast Guard boats, a cost will be incurred. Standard rates for small boats are

1. If other than a dockside inspection, include one additional hour for transit time if transportation is required.

contained in COMDTINST 16465.2a Series. For calculation purposes, it is reasonable to select a single boat type. It is further recommended, for the sake of consistency, factors for the 40-foot utility boat (UTB) be employed, less the costs of depreciation. Capital costs of the boat are considered sunk and not applicable to a decision to increase vessel inspection frequency. For example, the following rates are applicable for the 40-foot UTB:

		1978 Dollars
Personnel	-	$10.43/hour
Fuel	-	3.35/hour
Other*	-	31.72/hour
Total:		$45.50/hour

* "Other" consists of primarily of maintenance.

Updated factors were obtained from the point of contact cited (Economic Analysis Branch).

The total fee for transportation should be calculated per visit as follows using ½ hour enroute[1] travel to the vessel and ½ hour return leg per vessel:

A. Intransit= 1 hour @$45.50.

B. Moored alongside= X hours for vessel inspection @$42.15 (the intransit factor less fuel).

Add the total of A. and B., multiply the number of vessels to be impacted very year, enter on line III.D., Format 5. Carry forward to Format 6.

Point of Contact: Office of the Comptroller, Economic Review Division, Economic Analysis Branch, U.S. Coast Guard Headquarters, Washington, D.C.

Vessel Delay Costs

In the event the vessel to be inspected is delayed, factors contained in Section VII should be multiplied by the number of vessels impacted by type and size and entered into line IV.A. on Format 1 for the total delay costs. Note daily vessel operating costs may be further broken down into hourly cost factors by dividing by 24.

Since there will be a difference in the inspection delay cost between newly constructed vessels and retrofits, the regulatory staff should carry the totals forward to Format 2C, Operating Costs (New Construction), followed by calculations for Formats 3 and 4 eventually to be coupled with U.S. Government costs on Format 7. A full discussion of completing Formats 2-4 is contained in Section V.

1. To be used only in the absence of more definitive estimating criteria.

F. Vessel Operating Cost Procedures

This section is devoted to discussion of daily operating cost factors and procedures for tankers, cargo vessels and vessels which ply inland U.S. waterways. The reason for developing such factors is to identify the loss in productivity (or cost) if a vessel is taken off line or delayed as the result of regulatory action (e.g., inspection or required to clear the channel for an LNG docking).

The factors were developed with two principal criteria:

- Base data must be updated on an annual basis.
- Factors employed should be easy to revise and use.

It is noted no costs of capital are included within the base factor data. Capital costs may be considered sunk and not a contributing factor to the majority of decisions pertinent to regulation implementation.

At the conclusion of the portion of this section dealing with tanker cost factors a list of demurrage factors (Table 4, Page 86.) are provided to give the regulatory staff an alternative reference point. No demurrage factors are contained in this section for other types of vessel since these rates vary widely depending upon the cargo carried and the port of call.

An implicit assumption is that U.S. operating costs are roughly equivalent to foreign flag operating costs. The foreign vessel cost data used by MarAd as the basis for determining U.S. subsidies must often be estimated. It is recognized that while subsidies do not cover all operating cost differentials,[1] there is no sound basis to make adjustments to account for potentially cheaper foreign vessel operating costs.

Cargo Vessel Operating Procedures

The following daily operating cost factors for ocean-going cargo vessels may be used when calculating the cost of delays in operation or drydocking as the result of implementation of a regulation. Vessel costs are classified by deadweight tonnage (DWT) for purposes of data compatibility with other types of Coast Guard analysis (e.g., risk assessment):

---

1. All operating cost elements are not eligible for subsidy under MarAd's subsidy program.

DWT	1978 Daily Operating Cost Factor[a]
9,000	$17,393
10,000 - 12,000	16,304
13,000 - 14,000	21,056
15,000	36,356

[a] Per Page 81.

There are no "ready-made" operating cost factors published by industry which pertain to either ocean-going or in-land waterway vessel movements. Adhering to the rule that cost procedures and factors should be amenable to relatively easy update every year, current Maritime Administration and U.S. Army Corps of Engineer reports offer the best basis for deriving commercial vessel operating costs.

The Office of Ship Operating Costs (MarAd) develops and makes available summary sheets of daily operating costs of subsidized vessels. Data reflected in these summary sheets are available from 1965 to 1975 (the latest year available). Table 1 is a duplicate of the 1975 summary sheet. The summary sheets are based upon annual input of several hundred shippers and are developed every year as the data are tabulated. Data for 1976 are now in the process of being tabulated. These data are an ingredient in determining operating differential subsidies and can therefore be considered roughly representative of world fleet costs as well.

The lines of interest in development of cargo vessel operating costs on this report format are lines 9 through 28 of Table 1 dealing with vessel expenses. These add to a total vessel operating expense per voyage day on line 6. The regulatory staff is discouraged from using line 5, Vessel Operating Revenue Per Voyage Day to calculate operating costs. The reason for this is that in 1975 3 out of 11 vessel types, per line 8 of Table 1, were operating at a loss. In addition, the regulatory staff is interested in calculating real costs incurred as the result of consumed resources as contrasted to profit considerations.

There are several data compatibility problems in molding these data into useable cost factors. The following steps are applicable:

Step 1

The initial data conversion necessary involves resolving a classification problem. MarAd classifies vessels by type; e.g., C-3, C-4, etc. These classifications must be converted to a vessel size (deadweight tons) in order to be compatible with risk assessment generated data. It is noted there is no direct

Table 1. RECAPITULATION OF LINE/SERVICE AVERAGE DAILY OPERATING COST OF SUBSIDIZED VESSELS VOYAGES TERMINATED DURING THE PERIOD JANUARY 1 TO DECEMBER 31, 1975

SHEET 1 OF 2

	ITEMS	C-3(OLD) SCH 1 NON-AUTO	C-3(NEW) SCH 2 NON-AUTO	C-3(NEW) SCH 2 AUTOMATED	C-4(OLD) SCH 3 NON-AUTO	C-4(NEW) SCH 4 NON AUTO	C-4(NEW) SCH 5 AUTOMATED
1.	NUMBER OF VOYAGES	11	131	23	67	103	180
2.	NUMBER OF VOYAGE DAYS	336	12,493	1,773	7,103	5,129	11,359
3.	NUMBER OF VOYAGE DAYS AT SEA	151	6,311	802	3,503	2,288	5,909
4.	% OF SEA DAYS TO TOTAL VOYAGE DAYS	45%	51%	45%	49%	45%	52%
5.	TOTAL VESSEL OPERATING REVENUE PER VOYAGE DAY	14,822	13,603	13,350	16,292	15,773	20,198
6.	TOTAL VESSEL OPERATING EXPENSE PER VOYAGE DAY	13,807	12,943	15,357	14,774	18,899	16,715
7.	DIRECT PROFIT (LOSS) FROM VESSEL OPERATIONS	1,015	659	(2,007)	1,519	(3,126)	3,483
8.	% OF DIRECT PROFIT (OR LOSS)	6.75%	2.82%	(14.41%)	5.73%	(63.44%)	16.36%
9.	VESSEL OPERATING EXPENSES PER VOYAGE DAY-						
10.	WAGES- STRAIGHT TIME	1,234	1,176	1,264	1,224	1,712	1,380
11.	OVERTIME	978	837	1,043	983	1,169	995
12.	OTHER	2,116	1,786	1,665	1,852	2,396	2,088
13.	TOTAL WAGES	4,327	3,799	3,972	4,059	5,276	4,463
14.	SUBSISTENCE	165	225	160	162	271	167
15.	STORES, SUPPLIES AND EQUIPMENT	215	238	215	308	263	267
16.	REPAIRS AND OTHER MAINTAINANCE EXPENSES	890	815	576	1,101	959	814
17.	FUEL	1,891	2,362	2,018	2,634	2,948	2,821
18.	INSURANCE- HULL	149	206	156	222	301	241
19.	P & I	892	686	439	512	817	611
20.	OTHER	35	21	0	40	591	11
21.	TOTAL INSURANCE	1,076	913	595	774	1,708	863
22.	CHARTER HIRE	0	0	0	405	0	0
23.	OTHER VESSEL EXPENSE	90	54	140	71	117	56
24.	TOTAL VESSEL EXPENSES PER VOYAGE DAY	8,652	8,406	7,674	9,514	11,540	9,451
25.	PORT EXPENSES PER VOYAGE DAY (INCLUDES CARGO HANDLING)	4,607	4,195	5,870	4,741	5,526	5,907
26.	BROKERAGE EXPENSES PER VOYAGE DAY (INCLUDES AGENCY FEES AND COMMISSIONS) 1/	0	0	0	0	0	0
27.	OTHER VOYAGE EXPENSES PER VOYAGE DAY	548	343	1,813	519	1,834	1,357
28.	TOTAL VESSEL OPERATING EXPENSES	13,807	12,943	15,357	14,774	18,899	16,715
	OTHER DATA						
29.	% OF OVERTIME TO STRAIGHT TIME WAGES	79.18%	71.25%	82.47%	80.46%	69.16%	72.32%
30.	AMOUNT OF WAGES PAID IN EXCESS OF BARGAINING AGREEMENTS AND EXCLUDABLE ITEMS	6	50	5	57	87	57
31.	AVERAGE CREW COMPLEMENT- DECK	18	18	19	17	19	18
32.	ENGINE	15	16	13	16	19	14
33.	STEWARD	10	10	8	8	12	8
34.	CADETS AND OTHERS	0	0	0	0	0	0
35.	TOTAL COMPLEMENT	42	44	40	42	50	40
36.	AVERAGE NUMBER OF PASSENGERS CARRIED	0	0	0	0	0	0

1/ Information was not available for Item 26.

Table 1. (Continued
RECAPITULATION OF LINE/SERVICE AVERAGE DAILY OPERATING COST OF SUBSIDIZED VESSELS VOYAGES TERMINATED DURING THE PERIOD JANUARY 1 TO DECEMBER 31, 1975

	ITEMS	C-5 SCH 6 NON-AUTO	C-5 SCH 6 AUTOMATED	C-6 SCH 7 NON-AUTO	C-6 SCH 7 AUTOMATED	C-8&C-9 SCH 8 AUTOMATED
1.	NUMBER OF VOYAGES	40	69	43	99	136
2.	NUMBER OF VOYAGE DAYS	4.893	3.612	1.295	5.873	6.630
3.	NUMBER OF VOYAGE DAYS AT SEA	2.404	2.252	1.051	4.113	4.506
4.	% OF SEA DAYS TO TOTAL VOYAGE DAYS	49%	62%	81%	70%	68%
5.	TOTAL VESSEL OPERATING REVENUE PER VOYAGE DAY	14.195	28.321	24.309	32.081	38.725
6.	TOTAL VESSEL OPERATING EXPENSE PER VOYAGE DAY	11.495	25.556	26.710	29.376	34.956
7.	DIRECT PROFIT (LOSS) FROM VESSEL OPERATIONS	2.700	2.765	(2.401)	2.705	3.769
8.	% OF DIRECT PROFIT (OR LOSS)	18.81%	9.36%	(11.80%)	6.67%	8.99%
9.	VESSEL OPERATING EXPENSES PER VOYAGE DAY-					
10.	WAGES- STRAIGHT TIME	1.131	1.494	1.860	1.714	1.391
1.	OVERTIME	835	1.046	855	940	1.184
2.	OTHER	1.613	1.897	2.488	2.241	2.265
3.	TOTAL WAGES	3.579	4.438	5.204	4.894	4.840
4.	SUBSISTENCE	128	169	261	370	161
5.	STORES, SUPPLIES AND EQUIPMENT	216	222	211	226	297
6.	REPAIRS AND OTHER MAINTAINANCE EXPENSES	811	815	1.504	2.292	1.444
7.	FUEL	1.685	4.451	5.143	4.932	7.315
8.	INSURANCE- HULL	237	419	412	497	583
9.	P & I	401	711	632	593	871
0.	OTHER	9	364	702	915	121
1.	TOTAL INSURANCE	647	1.494	1.746	2.005	1.575
2.	CHARTER HIRE	0	0	0	575	889
3.	OTHER VESSEL EXPENSE	19	71	124	125	270
4.	TOTAL VESSEL EXPENSES PER VOYAGE DAY	7.085	11.659	14.192	15.041	16.792
5.	PORT EXPENSES PER VOYAGE DAY (INCLUDES CARGO HANDLING)	4.072	10.325	7.600	9.144	12.187
6.	BROKERAGE EXPENSES PER VOYAGE DAY (INCLUDES AGENCY FEES AND COMMISSIONS) 1/	0	0	0	0	0
7.	OTHER VOYAGE EXPENSES PER VOYAGE DAY	338	3.571	4.918	5.190	5.977
8.	TOTAL VESSEL OPERATING EXPENSES	11.495	25.556	26.710	29.376	34.956
	OTHER DATA					
1.	% OF OVERTIME TO STRAIGHT TIME WAGES	73.72%	71.36%	45.96%	55.25%	53.12%
1.	AMOUNT OF WAGES PAID IN EXCESS OF BARGAINING AGREEMENTS AND EXCLUDABLE ITEMS	84	24	23	30	18
.	AVERAGE CREW COMPLEMENT- DECK	17	18	18	18	16
.	ENGINE	16	13	14	13	13
.	STEWARD	9	8	9	9	7
.	CADETS AND OTHERS	0	2	5	3	2
.	TOTAL COMPLEMENT	42	41	46	43	38
.	AVERAGE NUMBER OF PASSENGERS CARRIED	0	0	0	0	0

/ Information was not available for Item 26.

relationship between vessel type (C-3) and size (DWT) classifications. Within one vessel type you will find several different sizes. Therefore, the Vessel Inventory Report (as of June 30, 1977) published by MarAd must be turned to in order to match type and size classifications of cargo vessels. This may be achieved by comparing types and sizes and selecting the mode, or the most frequent observation of a given weight for a vessel type. Vessel size and weight relationships using this method yield:

Type	DWT (X 1,000)
C-1	Less than 10
C-2	10
C-3	11-12
C-5	15
C-6	20
C-8/9	38

Step 2

Selected data sources to be employed in risk analysis of vessels subject to regulatory changes do not identify any vessel weight over 15,000 DWTs. This is true of the Vessel Casualty Reporting System (VCRS). Therefore, any operating cost for a vessel over this threshold will be the average (C-5, C-6 and C-8/9).

Step 3

Nothing in the U.S. subsidized fleet is reportedly smaller than C-3 and would therefore not show up in the MarAd summary sheets of "Daily Operating Costs of Subsidized Vessels." The MarAd publication "A Statistical Analysis of the World's Merchant Fleet," 31 December 1976, notes that of the world's (then) inventory of 12,923 merchant type freighters, roughly 59 percent or 7,614 vessels, falls below 9,000 DWT (or below the C-3 threshold).

	World Fleet			
DWT (000)	Under 2	2-3.9	4-6.9	7-8.9
# Vessels	941	2,616	2,826	1,231

In the absence of a reasonable methodology to estimate cost factors below the C-3 level, the following factors should be used:

DWT (X 1,000)	Less Than 9	9-12.9	13-14.9	15 +
	Old C-3	New C-3	New C-4	Ave. C-5, C-6 and C-8/C-9

The distinction between old and new vessel types is contained in the column leader information on the summary sheets.

Step 4

The cost factors contained in the MarAd summary sheets for cargo vessels are in 1975 dollars. These must be adjusted to current (1978) dollars using an inflation factor. MarAd has no cost element-specific inflation index applicable to wages, fuel, etc. However, a marine industry-wide inflation rate of 8 percent per annum was recommended for use in updating 1975 dollars. While later refinement may be in order, using a gross average of, for example, 8 percent is considered appropriate in the context of the gross averaging technique used to compile the base data. The following figure reflects calculation of this last step to arrive at cargo vessel daily operating costs:

Vessel Type	DWT	1975 Factor	@1.08%/Annum (1978 Factor)	
C-3 Old	9,000	13,807	17,393	
C-3 New (1)	10-12,000	12,943	16,304	
C-4 New	13-14,000	16,715	21,056	
C-5 New	15,000	25,556	32,193	$36,356
C-6 & 8/9	More than 15,000	32,166	40,520	

(1) All new figures are expressed in terms of automated versions.

(2) An average of $29,376 and $34,956. The C-5 and C-6 and 8/9 total should be averaged to obtain a factor of $36,356 for 15,000 DWT and higher.

Automated versions were selected for cost factoring since they will be more representative of the world fleet over the next 30 years than non-automated versions.

Tanker Operating Cost Procedures

The following daily operating cost factors may be used when calculating the costs of delays experienced as the result of implementation of a regulation. Vessel costs are classified by deadweight tonnage (DWT) to be compatible with other forms of Coast Guard vessel analysis (e.g., risk management).

DWT	1978 Daily Operating Cost Factor
25,000	$10,400
35,000	12,178
35,000*	9,562
45,000	12,987
55,000	14,494
65,000	14,412
80,000	16,180
120,000	16,950
225,000	27,053
390,000	28,800

* Diesel

The Office of Ship Operating Costs, Maritime Administration began collecting tanker operating cost data in 1966. Currently, about 30 shipping firms provide input for several vessels in each deadweight ton class listed. The steps used in formulation of daily operating costs of tankers are as shown.

Step 1

Factors provided by MarAd for tankers are listed at Tables 2 and 3. Note cost factors are provided for a yearly period. Annual data should be divided by a 350-day operational year.

Step 2

Note no costs are listed for fuel. It is necessary to build a series of scenarios on average fuel use. First, however, it is appropriate to select an "average" cost factor for fuel. MarAd regulatory staffs recommend use of a current factor of $78 a ton. The price of fuel varies widely by geographic point of sale. The 1978 dollar factor is slanted to U.S. waters and is low by comparison with most regions of the world. More refined factors are available in industry publications, one of which is a weekly document by EXXON titled "International Contract Price List (EXXON) for Marine Fuel Delivered as Ships' Bunkers."

Step 3

Calculation of fuel costs requires developing scenarios of probable consumption based on representative trade routes. For factoring purposes, the following representative routes were selected and matched with vessels sizes likely to ply these routes.

Short -- 25,000; 35,000; 35,000 (Diesel); 45,000 DWT vessels. Curacao -Port Arthur, Texas - 1,785 nautical miles.

Intermediate -- 55,000; 65,000; 80,000 DWT vessels. Nigeria - Texas -6,100 nautical miles.

Long -- 120,000; 225,000; 390,000 DWT vessels. Kharg Island (Persian Gulf) - Curacao - 10,850 nautical miles.

Step 4

Select a steaming speed, time in port for each leg of the voyage and length of each operation year. The purpose is to arrive at a weighted average of a representative fuel consumption per day:

- 15 knots
- 4 days in port
- 350-day operational year

Table 2

1976/77 TANKER OPERATING COSTS
($ Per Year)

	25,000 DWT	35,000 DWT	(DIESEL) 35,000 DWT
WAGES	1,543,300	1,608,200	1,363,300
SUBSISTENCE	61,500	60,500	59,500
MAINTENANCE & REPAIR	385,500	303,000	276,200
INSURANCE	231,300	287,200	197,900
STORES & SUPPLIES	102,500	147,600	182,200
MISCELLANEOUS	140,400	124,400	122,000
FUEL CONSUMPTION			
@ SEA (L. TONS/DAY)	54	87	55 (HVFO)
IN PORT (L. TONS/DAY)	13	17	11 (HVFO)

	45,000 DWT	55,000 DWT	65,000 DWT
WAGES	1,620,800	1,636,900	1,724,500
SUBSISTENCE	77,500	59,000	58,100
MAINTENANCE & REPAIR	315,900	429,100	298,900
INSURANCE	367,800	161,900	252,800
STORES & SUPPLIES	113,400	94,000	110,100
MISCELLANEOUS	135,100	141,600	141,500
FUEL CONSUMPTION			
@ SEA (L. TONS/DAY)	93	100	96
IN PORT (L. TONS/DAY)	24	27	25

	80,000 DWT	120,000 DWT
WAGES	1,496,200	1,582,500
SUBSISTENCE	44,900	56,200
MAINTENANCE & REPAIR	346,300	589,500
INSURANCE	343,300	296,400
STORES & SUPPLIES	134,600	95,700
MISCELLANEOUS	156,600	82,300
FUEL CONSUMPTION		
@ SEA (L. TONS/DAY)	127	122
IN PORT (L. TONS/DAY)	26	23

Point of Contact: Office of Ship Operating Costs, Maritime Administration, Department of Commerce, Washington, D.C.

Table 3

1978 TANKER OPERATING COSTS
($ Per Year)

	225,000 DWT	390,000 DWT
Wages	1,587,000	1,780,000
Subsistence	73,800	60,000
Maintenance & Repair	684,000	590,000
Insurance	1,515,000	1,920,000
Stores & Supplies	172,500	280,000
Miscellaneous	162,150	130,000
Fuel Consumption:		
At Sea (L. Tons/Day)	220	220
In Port (L. Tons/Day)	80	90

Note: Costs shown are averages of several vessels in each class submitted by 30 U.S. firms.

Point of Contact: Office of Ship Operating Costs, Maritime Administration
Department of Commerce.

Step 5

Perform calculations. Example: 25,000 DWT, vessel, short haul: Curacao - Port Arthur (1,785 nautical miles one way).

15 knots @24 hours = average 360 miles per day
1,785 miles 360 miles/day = 5 days enroute
+4 days in port
9 days/leg
350 operational days 9 days/leg = 38.8 legs
38.8 legs @4 port days = 155 days in port
38.8 legs @5 voyage days = 195 days at sea

25,000 DWT Factors (From Table 2)

At Sea - 54 long tons/day @195 days at sea per year @$78/long ton = $821,340

In Port - 13 long tons/day @155 days in port per year @78/long ton = $157,170

$821,340 + $157,170 = $978,510/year

$978,510/year 350 operating days = $2,795/day

Note: Had one used only at-sea fuel consumption (54 long tons/day), the factor would be $4,212/day for fuel consumption.

Step 6

Inflate 1977 daily operating expense by 8 percent and add the fuel cost. See rationale of using an 8 percent inflation factor to arrive at 1978 constant dollars in the section dealing with cargo vessel operating costs.

Size	Total Expenses	@108%	350	$ Fuel	Oper $/Day
25,000 DWT	$2,464,500	2,661,660	7,605	2,795	$10,400

Using this method the following costs are obtained by vessel weight. Short, intermediate and long haul are indicated by initial after each weight:

DWT	Haul	Oper $/Day
35,000	S	$12,178
35,000 *	S	9,562
45,000	S	12,987
55,000	I	14,494
65,000	I	14,412
80,000	I	16,180
120,000	L	16,950
225,000	L	27,053 **
390,000	L	28,800 **

* Diesel
** Provided in 1978 $ from Marad.

Table 4

1978 TANKER OPERATING COST COMPARISON
($)

DWT	Operating Cost/Day	Demurrage/Day World Scale 100
25,000	$2,795	$3,000
35,000 (Diesel)	9,562	4,750
45,000	12,987	6,750
55,000	14,494	8,875
65,000	14,412	11,075
80,000	16,180	14,400
120,000	16,950	24,700
225,000	27,053	48,300
390,000	28,800	85,500

Point of Contact: Office of Ship Operating Costs Mantime Administration. Department of Commerce, Washington, D.C.

River Vessel Operating Cost Procedures

The following daily operating cost factors and procedures may be used when calculating costs attributable to vessel delay or out of service periods for inland waterway vessels as the result of implementation of a regulation.

Tow Boat Length (Feet)	1978 Average Unit Operating Cost/Day
46	$ 627
57	714
78	1,393
110	1.709
131	2,193
146	2,893
150	3,415
160	3,723
175	4,232
180	4,835
182	5,053
190	5,440

Table 5 was extracted from input data for the Inland Waterways Cost Model administered by the U.S. Army Corps of Enginers. The data consist of total variable costs for "operating" and "manuevering." Operating time is associated with line haul, manuevering represents time in harbour and docking manuevers. Since different types of tow operation have varying degrees of manuevering, it should be assumed operations and maneuvering share the towboats' times and the two factors should be averaged. For example, in the case of the 300 HP 46' towboat, the regulatory staff should average $23.45 (operation) and $21.39 (maneuver) to arrive at an hourly average of $22.42. Since line haul towboats are normally kept underway, continually picking up and dropping barges, it should be assumed they are available 24 hours per day. Therefore, in the example, the 46' towboat would incur average daily operating costs (less the costs of capital) of approximately $538 ($22.42 x 24 hours). The data shown on table 5 are in 1976 dollars. Therefore, they must be escalated to current year (1978) dollars at a consistent 8 percent inflation factor. The variable operating costs for barges are negligible and should be excluded from calculations. The towboat data are derived from periodic field surveys conducted by the U.S. Army Corps of Engineers. Typically, these surveys take place every 2 years and involve surveying 20 to 30 towboat companies and 2 to 3 builders of towboats. The appropriate contact for Corps of Engineers operating cost data is located in Room 4E050, the Forrestal Building in Washington, D.C.:

Table 5. TOWBOAT CHARACTERISTICS

	TOWBOAT CLASS	HORSE-POWER	MAX TOW SIZE	LENGTH (FT)	BEAM (FT)	DRAFT (FT)	BLOCK COEFF	FUEL CONSUMP. (GAL/HR) OPER.	FUEL CONSUMP. (GAL/HR) MNVR.	LABOR COST ($/HR)	OTHER COST ($/HR)	TOTAL VARIABLE COST ($/HR) OPER.	TOTAL VARIABLE COST ($/HR) MNVR.	ANNUAL FIXED COST($)	AVAILA-BILITY FACTOR
1	300 HP TOWBOAT	300	2	46	15	4.2	.75	12.5	6.3	15.70	3.63	23.45	21.39	54600	1.00
2	600 HP TOWBOAT	600	4	57	18	5.1	.75	25.0	12.5	15.70	3.63	27.58	23.45	54600	1.00
3	1200 HP TOWBOAT	1200	8	78	23	6.9	.75	50.0	25.0	26.30	11.10	53.90	45.65	117000	1.00
4	1800 HP TOWBOAT	1800	12	110	29	8.6	.75	75.0	37.5	28.80	13.70	67.25	54.87	152000	1.00
5	2500 HP TOWBOAT	2500	14	131	33	9.5	.75	104.0	52.1	34.30	18.30	86.92	69.79	222000	1.00
6	3300 HP TOWBOAT	3300	17	146	34	8.8	.75	138.0	68.8	39.30	22.60	107.44	84.60	293000	1.00
7	4300 HP TOWBOAT	4300	23	146	37	9.5	.75	179.0	89.6	39.50	26.90	125.47	95.97	358000	1.00
8	5000 HP TOWBOAT	5000	26	150	40	9.4	.75	208.0	104.0	41.10	29.40	139.14	104.82	396000	1.00
9	5700 HP TOWBOAT	5700	28	160	45	9.4	.75	238.0	119.0	42.30	31.80	152.64	113.37	437000	1.00
10	7000 HP TOWBOAT	7000	33	175	50	9.0	.75	292.0	146.0	42.90	36.00	175.26	127.08	524000	1.00
11	8400 HP TOWBOAT	8400	36	180	52	9.2	.75	350.0	175.0	45.30	40.80	201.60	143.85	611000	1.00
12	9000 HP TOWBOAT	9000	38	182	58	8.6	.75	375.0	188.0	45.30	42.30	211.35	149.64	646000	1.00
13	10100 HP TOWBOAT	10100	40	190	54	9.0	.75	421.0	210.0	45.30	44.90	229.13	159.50	706000	1.00

Source: D.O.T. Transportation Systems Center, Cambridge, Massachusetts, Inland Waterways Cost Model

Planning Division
Civil Works
U.S. Army Corps of Engineers
Telephone: (202) 693-1590

Great Lakes Vessel Operating Cost Procedures

The following factors and procedures may be used when calculating the costs attributable to vessel delay or out of service periods:

DWT	1978 Average Unit Operating Cost/Day	
9,000 - 10,999	$ 6,563	
11,000 - 13,999	7,480	
14,000 - 15,999	9,668	
20,000 - 22,999	10,266	
23,000 - 25,999	10,972	
26,000 - 31,999	11,277	
32,000 - 43,999	10,975	
44,000 - 58,999	14,321	
59,000 - 71,999	15,019	$17,293* Average
72,000 - 89,999	16,375	
90,000 - 107,999	21,574	
108,000 - 129,999	23,890	
130,000 - 154,999	26,293	
155,000	19,267	

* The VCRS does not identify bulk carriers over 15,000 DWT. In this case, an average of $17,293 should be employed.

The Maritime Administration's Office of Domestic Shipping develops daily operating cost factors of vessels plying the Great Lakes. Various and diverse internal information systems are employed to arrive at these data within MarAd.

Stripping away "budget costs" for construction, the basis of estimated costs is as follows:

Wages: Includes base, overtime, and other expenses such as taxes, contribution to vacation and welfare plans, etc. Based on a 32-man crew, automated to a 2-man engine watch at wage rates effective June 16, 1977.

Subsistence: Includes the cost of all edibles, sales taxes, delivery charges, and loading costs.

Stores, Supplies, and Equipment: The cost of all consumable stores, supplies, and expendable equipment other than edibles, fuel, and water.

Insurance: Annual cost for H&M, P&I, and port risk for the operating period between April 1 and December 31, 1977. Cost rates for operation during extended season not included.

Maintenance and Repair: Repair work not recoverable from insurance including a reserve for special surveys, dry docking, inspection, and lay up.

Fuel Cost: Based on spot prices in Cleveland of $12.80/bbl for bunker "C" and $17.20/bbl for marine diesel.

The data are calculated using a 250-day operating year. Data obtained from MarAd are expressed in detail and are available (but not included in this manual) in 1977 dollars and have been updated to 1978 dollars using an 8 percent inflation factor.

The point of contact for updates of basic Great Lake vessel operating cost data is:

Office of Domestic Shipping
Maritime Administration
(202) 377-5478

G. In-House Training Costs Procedures

The Marine Safety School, USCG Reserve Training Center in Yorktown conducts a large portion of safety related courses for Coast Guard personnel. A current variable cost factor used for quick calculations is $4.85 per student day for all courses. This includes: (1) publications, (2) travel costs for instructors, (3) equipment, and (4) reusable training materials. Note the factor does not include instructor costs (i.e., pay and benefits). If increased schooling is required as the result of regulation implementation, instructor costs should be included. Furthermore, if new construction is required to handle a new or expanded class, such costs should also be included.

The Marine Safety School is hesitant to provide general cost factors for training since there is a wide variation in calculated results depending upon what questions the regulatory staff is attempting to answer. The school staff normally prepares a cost worksheet on request that often runs 20 pages in length. Inquiries concerning training costs should be directed to:

The Marine Safety School
USCG Reserve Training Center
Yorktown, Virginia 23690
or call (804) 898-3500

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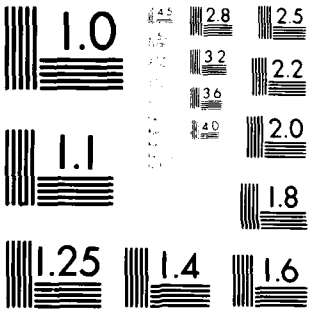

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Another knowledgable point of contact within Coast Guard headquarters concerning budget costs of training is the Office of Personnel, Training and Education, Washington, D.C. Each school within the Coast Guard has a cost center by object code (e.g., transportation). This office is in the process of collecting cost data for each center but has not yet compiled a complete year's data.

Ideally, the following elements of costs should contribute to developed training cost factors if the data are available:

- Student transportation costs to and from school, except when a permanent change of station follows the training period, in which case the second leg of the trip should not be charged to training.
- Consumables (publications, etc.)
- Instructor time - using standard military or civilian pay cost factors.
- Facility operation and maintenance costs to include utilities. Do not include fixed costs or attempt to amortize investment costs of existing facilities since these are "sunk" and not applicable to the decision process.
- Training ammunition.
- Facility overhead (administrative costs not included under operation and maintenance).

SECTION VII
COST FACTORS

A. General

Selected individual cost factors to be used in cost-benefit estimating exercises are contained in this section. In some cases, in-house cost factors contained in planning manuals and other sources have been extracted and quoted herein to provide the regulatory staff with a convenient single-source document for common cost factors.

It is noted single daily operating cost factors are listed for vessels; costs are not broken out in terms of wages, fuel, etc. This is done strictly for the convenience of the analyst. Details of how these single numbers were derived are contained in Section VI. When using single daily operating cost factors for vessels, such factors should be entered under the cost element "Total Delay Costs" on Format 1.

B. Vessel Delay Cost Factors

The following daily operating cost factors may be used in calculating vessel delays incurred as the result of implementing a regulation. These factors are derived from 1977 operating cost data supplied by various MarAd offices, updated by an escalation factor recommended by MarAd. It should be noted that daily operating costs include wages, subsistence, stores, repairs, maintenance, fuel and insurance expenses. The rationale behind the development of these factors is contained in Section VI. The majority of these factors are expressed in terms of deadweight tonnage (DWT) classifications. Tow boats are classified by length.

Ocean-Going Cargo Vessels

DWT (X 1,000)	(1978) Daily Operating Cost Factor
9	$17,393
10-12	16,304
13-14	21,056
15	36,353

Point of Contact: Office of Ship Operating Costs, Maritime Administration; Telephone: (202) 377-4321; Room 3085, Department of Commerce Building, Washington, D.C.

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Tankers

DWT	(1978) Daily Operating Cost Factor
25,000	$10,400
35,000	12,178
35,000	9,562
45,000	12,978
55,000	14,494
65,000	14,412
80,000	16,180
120,000	16,950
225,000	27,053
390,000	28,800

Point of Contact: Office of Ship Operating Costs, Maritime Administration. Telephone: (202) 377-3954, Room 3078, Department of Commerce Building, Washington, D.C.

Inland Waterway Vessels (TOWBOATS)

Length (Feet)	(1978) Daily Operating Cost Factor
46	$ 627
57	714
78	1,393
110	1,709
131	2,193
146	2,893
150	3,415
160	3,723
175	4,232
180	4,835
182	5,053
190	5,440

Point of Contact: Planning Division, Civil Works, U.S. Army Corps. of Engineers. Telephone: (202) 693-1590, Room 4E050, Forrestal Building, Washington, D.C.

Great Lakes Vessels

DWT	(1978) Daily Operating Cost Factor
9,000-10,000	$ 6,563
11,000-13,000	7,480
14,000-15,000	9,668
15,000	17,293

Point of Contact: Office of Domestic Shipping, Maritime Administration. Telephone: (202) 377-5478, Room 6606, Department of Commerce Building, Washington, D.C.

C. Annual Standard Personnel Cost Factors

These factors were extracted from COMDTNOTE 7100, dated 31 January 1978, and are listed here strictly as a convenience to the regulatory staff. Factors are in 1978 dollars.

1. Pay, Allowances and Salaries.

Civilian	Annual Salary BudgetAverage
GS-18	$ 51,400
GS-17	51,400
GS-16	45,900
GS-15	39,200
GS-14	33,400
GS-13	28,300
GS-12	23,900
GS-11	20,000
GS-10	18,200
GS-9	16,600
GS-8	15,500
GS-7	13,600
GS-6	12,300
GS-5	11,000
GS-4	9,900
GS-3	8,900
GS-2	7,900
GS-1	7,000
Wageboard	18,700

1 General Schedule Pay Scales limit the basic compensation rate for employees at these levels to the rate for level V of the executive schedule at $47,500. The additional amount of approximately $3,900 is for the governments' contribution for Civil Service Retirement, FEHGA and FEGLIA. These factors do not include overseas station allowances.

Point of Contact: Civil Service Commission, Washington, D.C.

Military

When Grade Distribution Not Known:	
Commissioned Officers	$23,400
Warrant Officers	20,700
Enlisted Men	11,600
0-6 (CAPT)	37,300
0-5 (CDR)	31,000
0-4 (LCDR)	26,200
0-3 (LT)	22,200
0-2 (LTJG)	18,000
0-1 (ENS)	13,100
W-4	25,000
W-3	21,100
W-2	18,300
E-9 (MCPO)	21,100
E-8 (SMPO)	18,300
E-7 (CPO)	16,200
E-6 (PO1)	13,800
E-5 (PO2)	11,600
E-4 (PO3)	10,000
E-3 (SN)	8,900
E-2 (SA)	7,700
E-1 (SR)	7,100
Flight Pay:	
Commissioned Officers	2,500
Warrant Officers	1,800
Enlisted Men	1,050
Sea or Foreign Duty Pay:	
Enlisted Men	170

Note: The above military pay and allowances cost estimates do not include overseas station allowances. Such costs are to be calculated separately based on current rates, and where applicable, added to the above costs estimates.

Source: Office of Comptroller, U.S. Coast Guard Headquarters, Washington, D.C.

2. Support Costs

See the following page for standard factors used in calculating Coast Guard personnel support costs.

ANNUAL STANDARD PERSONNEL SUPPORT COSTS
(1978)

	PERMANENT CHANGE OF STATION PROGRAM			OPERATING AND MAINTENANCE COSTS		PERSONNEL TRAINING AND PROCUREMENT	
	OG 20.00			OG 30.00[2]		OG 56.00	
	INSIDE UNITED STATES[1]		OUTSIDE UNITED STATES				
	RECURRING	NON RECURRING	RECURRING	RECURRING[3]	NON RECURRING[4]	RECURRING	NON RECURRING
Commissioned Officer	1,420	1,420	6,300	1,040	600	513	744
Warrant Officer	1,420	1,420	6,300	1,040	600	198	470
Enlisted Men	680	680	1,684	1,040	600	150	225
Civilians	250	NA	NA	1,040	600	171	80
Avia Training (Off)							
Fixed Wing	...	...	...			3,780	10,915[5]
Rotary Wing	...	...	...			2,055	15,900

[1] Where recurring and nonrecurring costs are shown, the amount in the budget year will be the sum of the two figures.

[2] Because standard level user charges (SLUC) will be shown as a separate line item in budgets, it is inappropriate to include the cost in OG 30 SPC. However, when these figures are to be used for economic analysis, an imputed cost of $1,784 recurring should be added for each billet newly created at SLUC-type units.

[3] $410 Headquarters retained funds.

[4] $180 Headquarters retained funds.

[5] Two-year program; first year costs are applicable for two years.

Point of Contact: Budget Division, Office of the Comptroller, Room 8430, Nassif Building, Washington, D. C. (202) 426-2421.

SECTION VIII
FLEET FORECAST

A. Introduction

The preceding sections of this manual present procedures and factors with which the regulatory staff can measure industry and government costs of CVS regulations. This section contains forecasts of U.S. and world commercial fleets necessary to complete many of the formats for cost measurement. In addition, recommendations are presented for those occasions when these forecasts are not adequate as presented.

B. Forecast Background

The U.S. and world fleet forecasts presented herein summarize the findings published in Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade, a report prepared by Temple, Barker and Sloan, Inc. (TBS), under contract to the Office of Commercial Development, Maritime Administration, U. S. Department of Commerce. The TBS study, which was released in May, 1978, is one of several analyses of merchant fleets frequently prepared under the aegis of the Maritime Administration.

Several such forecasts were examined. The TBS study was chosen as the source of the enclosed forecasts because it was the most current and detailed analysis available. The TBS forecasts were prepared using Maritime Administration cargo forecasts by trade routes; commercial, operating, and national maritime policy as well as general commercial factors. The resultant fleet forecast prepared by TBS contained the number, size, and design characteristics of nine types of commercial vessels. In addition, U. S. and worldwide projections of new construction by vessel type were prepared for the forecast period. Such projections can be of particular use to the regulatory staff when analyzing regulations which specifically address newly constructed vessels. The forecasts provided in this section also summarize those TBS findings. If detail greater than that provided herein is needed, the regulatory staff can turn to the original report.

It has been noted that the TBS study is just one of many analyses of U.S. and worldwide merchant vessel fleets sponsored by the Maritime Administration. As time passes or needs and requirements change, it will become necessary for the regulatory staff to seek other, perhaps more timely fleet forecasts. It is likely the Maritime Administration will continue to be the best source of such information and it is, therefore, recommended that future searches for fleet forecasts begin

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within that organization. Among the Maritime Administration offices frequently sponsoring such fleet analyses are: the Office of Trade Studies and Statistics; the Office of Maritime Manpower; and, the Office of Commercial Development.

C. Using Forecasts

As indicated in Section V, for Cost Measurement, one of the first things the regulatory staff must do in measuring costs is to separate the impacted vessel population into classes by size and by type. This is, of course, because the costs of a regulation often will vary with different sizes and different types of vessels. Having done so, the regulatory staff then provides the identifying information required at the top of Formats 1 - 3 as appropriate. The regulatory staff identifies the vessel type (e.g., general cargo ships), describes the vessel size (e.g., 5 - 10 DWT), and indicates the vessel class according to the system decided upon. Only those formats pertinent to the analysis need be completed. For example, if a regulation requiring the installation of certain safety equipment has no impact upon research and development or operating costs, the regulatory staff would complete Formats 1, 2-B, 2-C, 3, 4, 5, 6, and 7. Formats 2-A, 2-D, and 2-E should be ignored.

The regulatory staff may encounter certain difficulties in utilizing these fleet forecasts. The first area of difficulty could be the TBS classification system which assigns 51 vessel types to 9 groups. Table 6 presents the composition of the 9 vessel groupings. A regulation which addresses a vessel type within a vessel group (e.g., tanker) could pose problems to the regulatory staff. In such cases, one of two courses is recommended. First, the regulatory staff could examine alternate sources of information. For example, the Coast Guard regularly publishes lists of inspected tankships including information about cargo carried, size, age, etc. This data is current and rather detailed, and provides the means by which the regulatory staff can determine the ratio of a particular ship type to the larger vessel grouping. The second option would be to use expert estimates of the ratio of ship type to vessel group. Such ratios can then be used to multiply the total values for a vessel group to come up with an estimated count of a particular type within the group.

Another source of difficulty could be the forecast's use of 5-year increments extending only to year 2000. In the event the regulatory staff needs annual forecasts or forecasts beyond the study's horizon, a simple linear extrapolation should be adequate. If, for example, the regulatory staff needed annual forecasts for 1980 - 1990, a simple method would be to: (1) calculate TBS forecast changes

Table 6

ASSIGNMENT OF SHIP TYPES

TO VESSEL GROUPS

Conventional General Cargo

- Freighter
- Freighter/Nuclear
- Freighter/Refrig.
- Combo. Pass. & Cargo
- Combo/Refrig.
- Combo/Nuclear

Partial Container

- Pallet Carrier
- Partial Container

Full Containership

- Containership
- Container/Car Carrier
- Container/Rail Carrier
- Container/Ro-Ro
- Roll-on/Roll-off

Barge Carrier

- Barge Carrier
- Container/Barge Carrier

Neobulk

- Bulk/Car Carrier
- Bulk/Containership
- Bulk/Timber Carrier
- Car Carrier
- Timber Carrier
- Cattle Carrier

Dry Bulk

- Bauxite Carrier
- Bulk Carrier
- Cement Carrier
- Colliers
- Limestone Carrier
- Nickel Carrier
- Ore Carrier
- Pellett Carrier
- Phosphate Carrier
- Salt Carrier
- Sand Carrier
- Urea Carrier
- Woodchip Carrier

Combination Carriers

- Bulk/Oil
- Ore/Bulk/Oil
- Ore/Oil Carrier

Liquefied Gas

- LPG Tanker
- LNG Tanker

Liquid Bulk Carrier

- Asphalt Tanker
- Asphalt/Bitumen
- Bitumen
- Chemical Tanker
- Molasses Tanker
- Nuclear Tanker
- Phosphorus Tanker
- Solvents Tanker
- Sulphur Tanker
- Tanker
- Whaling Tanker
- Wine Tanker

Source: Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade, Temple, Barker & Sloane, Inc., Table V - 10

in fleet size from 1980 - 1985; (2) divide TBS forecast changes in fleet size over that period by 5 to estimate annual rate, adjust 1980 values to estimate 1981, then use 1981 values to estimate 1982 and continue through to 1985; (4) repeat the procedure for the period 1985 - 1990. In the event the regulatory staff needs a forecast beyond 2000, analysis of the trend forecast between 1980 - 2000 should be done to estimate a rate of change in the fleet size. The calculated rate of change can then be used to project forward as far as needed. It should be noted again that the regulatory staff might also consider seeking additional forecasts from other sources.

Another shortcoming of the TBS fleet forecast is its focus upon the world fleet rather than U. S. flag fleet. This focus is, however, somewhat predictable because it is far easier to estimate worldwide vessel numbers than it is to distribute that world fleet among particular flags. The former requires estimates of worldwide cargo movements while the latter requires numerous presumptions about matters political in nature. The regulatory staff should understand this situation exists even though little can be done about it. The regulatory staff must assume that the factors that determine which flag of registry a vessel uses will balance themselves and that present circumstances will continue into the future.

The regulatory staff should recognize that both the fleet forecasts and the projections of new construction exclude vessels under 1,000 DWT. As a result, certain vessels such as inland waterway barges are ignored by the forecasts. If the regulatory staff has a need for data on such vessels, other sources will have to be explored. One recommended avenue would be Coast Guard records of inspected or certificated vessels.

Table 7

MERCHANT FLEET FORECAST: GENERAL CARGO SHIPS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
Deadweight	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-5	428	3	365	3	249	3	179	3	114	3
5-10	472	2	411	2	340	0	257	0	198	0
10-15	700	69	587	65	479	28	388	15	294	10
15-20	245	0	258	0	249	0	189	0	153	0
20-25	20	6	23	6	27	6	28	0	28	5
25-30	0	0	1	0	2	0	5	0	6	0
30+	0	0	0	0	0	0	0	0	0	0
TOTAL	1865	80	1645	76	1446	37	1046	18	793	18

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-1, -10, -19, -28, -37.

Table 8

MERCHANT FLEET FORECAST: PARTIAL CONTAINERSHIPS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
Deadweight	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	80	0	88	0	91	0	61	0	50	0
10-15	118	19	185	26	288	38	416	54	575	69
15-20	27	1	56	1	99	2	155	2	233	2
20-25	23	0	41	0	68	0	105	0	149	0
25-30	0	0	3	0	7	0	15	0	27	0
30+	0	0	0	0	3	0	4	0	8	0
TOTAL	248	20	373	27	556	40	756	56	1042	71

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-2, -11, -20, -29, -38.

Table 9

MERCHANT FLEET FORECAST: FULL CONTAINERSHIPS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
Deadweight	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	63	5	64	3	69	3	53	4	37	4
10-15	45	3	55	4	69	6	85	9	105	11
15-20	65	27	79	29	97	39	112	45	140	58
20-25	39	19	47	22	60	28	79	37	103	48
25-30	31	15	39	18	47	21	62	28	69	31
30-40	16	0	18	0	23	0	34	1	44	2
40+	0	0	1	0	2	0	3	0	11	0
TOTAL	259	69	303	76	367	97	428	124	509	154

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-3, -12, -21, -30, -39.

Table 10

MERCHANT FLEET FORECAST: BARGE CARRIERS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
Deadweight	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-20	0	0	0	0	0	0	0	0	0	0
20-30	7	7	7	6	7	6	6	5	0	0
30-40	3	3	3	3	3	3	4	4	7	7
40-50	13	9	19	13	23	15	27	17	33	20
50+	0	0	0	0	0	0	0	0	0	0
TOTAL	23	19	29	22	33	24	37	26	40	27

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-4, -13, -22, -31, -40.

Table 11

MERCHANT FLEET FORECAST: NEOBULK CARRIERS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
Deadweight	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-15	24	0	26	1	30	1	26	1	25	1
15-20	25	0	33	0	40	1	43	1	51	2
20-25	13	0	20	0	27	0	35	1	45	1
25-35	33	0	36	0	43	0	50	2	44	2
35-60	7	0	8	0	11	0	17	0	26	0
60+	0	0	0	0	2	0	5	0	11	0
TOTAL	102	0	123	1	153	2	176	5	202	6

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-5, -14, -23, -32, -41.

Table 12

MERCHANT FLEET FORECAST: DRY BULK CARRIERS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
Deadweight	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	32	0	36	0	37	1	40	1	34	1
10-20	177	0	156	2	143	4	118	4	109	5
20-30	328	1	342	6	334	9	328	12	283	14
30-50	239	5	264	9	275	11	302	17	324	20
50-70	109	0	128	2	149	3	164	5	195	9
70-125	19	0	28	0	43	0	67	2	98	5
125-175	1	0	3	0	6	0	14	0	27	1
175+	0	0	0	0	0	0	3	0	10	0
TOTAL	905	6	957	19	987	28	1036	41	1080	55

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-6, -15, -24, -33, -42.

Table 13

MERCHANT FLEET FORECAST: COMBINATION CARRIERS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
Deadweight	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	0	0	0	0	0	0	0	0	0	0
10-20	0	0	0	0	0	0	0	0	0	0
20-30	3	0	1	0	1	0	1	0	1	0
30-50	13	0	15	0	13	0	12	0	10	0
50-70	27	0	24	0	18	0	15	0	17	0
70-125	49	2	57	2	63	3	56	3	56	3
125-175	4	0	8	0	13	0	21	0	26	0
175-225	0	0	1	0	2	0	7	0	11	0
225+	0	0	0	0	0	0	2	0	3	0
TOTAL	96	2	106	2	110	3	114	3	124	3

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-7, -16, -25, -34, -43.

Table 14

MERCHANT FLEET FORECAST: LIQUEFIED GAS CARRIERS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
Deadweight	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	0	0	0	0	0	0	0	0	0	0
10-20	0	0	0	0	0	0	0	0	0	0
20-30	0	0	0	0	0	0	0	0	0	0
30-50	1	0	1	0	1	0	0	0	0	0
50-70	10	6	41	23	57	31	58	32	58	32
70+	0	0	0	0	0	0	14	7	24	12
TOTAL	11	6	42	23	58	31	72	39	82	44

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-8, -17, -26, -35, -44.

Table 15

MERCHANT FLEET FORECAST: LIQUID BULK CARRIERS

(deadweight in thousands)

Forecast Year	1980		1985		1990		1995		2000	
Deadweight	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.	Worldwide	U.S.
1-10	62	0	62	0	55	0	40	0	17	0
10-20	27	0	29	0	24	0	24	0	22	0
20-30	151	2	156	3	147	4	120	4	99	4
30-50	200	25	183	24	191	26	178	26	133	25
50-70	152	6	95	4	92	3	99	4	65	4
70-125	175	8	166	9	129	7	119	8	64	6
125-175	14	0	28	1	38	1	43	1	52	2
175-225	6	0	13	0	19	0	21	0	26	0
225-300	11	4	23	2	33	2	38	3	42	3
300+	7	3	15	6	21	7	26	9	28	9
TOTAL	805	48	770	49	749	50	708	55	548	53

Source: Merchant Fleet Forecast of Vessel in U.S.-Foreign Trade, Temple, Barker & Sloane, Inc., Tables XIII-9, -18, -27, -36, -45.

Table 16

MERCHANT FLEET FORECAST SUMMARY

World Fleet New Constructions[1]

(deadweight in thousands)

1976-2000

	1976-1980		1981-1985		1986-1990		1991-1995		1996-2000	
	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight
General Cargo Ships	230	2,471	139	1,615	111	1,322	243	3,094	72	884
Partial Containerships	116	1,626	141	2,146	199	3,080	249	3,969	338	5,544
Full Containerships	96	1,664	60	1,090	68	1,293	110	2,271	189	4,021
Barge Carriers	0	0	6	264	4	176	5	214	25	1,066
Neobulk Carriers	21	464	27	612	32	769	50	1,263	75	2,319
Dry Bulk Carriers	102	3,209	134	5,095	172	7,027	313	13,682	359	17,539
Combination Carriers	19	1,535	19	1,794	20	2,075	36	3,956	31	3,729
LNG Carriers	10	576	31	1,786	16	922	15	1,717	10	1,185
Liquid Bulk Carriers	430	26,532	114	13,843	76	8,741	93	7,745	266	20,557
Total	1,022	38,077	670	28,246	698	25,404	1,114	37,911	1,365	56,845

Source: Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade,

Temple, Barker & Sloane, Inc., Table II - 6

Table 17

MERCHANT FLEET FORECAST SUMMARY

U.S.-Flag Fleet New Constructions

(deadweight in thousands)

1975-2000

	1976-1980		1981-1985		1986-1990		1991-1995		1996-2000	
	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight	Vessels	Deadweight
General Cargo Ships	3	12	0	0	8	104	7	124	1	27
Partial Containerships	0	0	19	268	21	292	15	211	16	228
Full Containerships	25	434	22	384	25	458	43	892	60	1,277
Barge Carriers	0	0	4	176	2	88	3	126	18	758
Neobulk Carriers	0	0	1	28	2	45	2	60	3	92
Dry Bulk Carriers	5	178	11	364	12	438	13	552	15	797
Combination Carriers	0	0	1	51	1	58	0	36	2	204
LNG Carriers	6	346	17	979	8	461	8	887	5	593
Liquid Bulk Carriers	15	2,715	21	1,776	13	1,250	9	1,073	13	2,506
Total	54	3,685	96	4,029	91	3,194	100	3,962	133	6,482

Source: Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade, Temple, Barker & Sloane, Inc., Table II - 10

Table 18

MERCHANT FLEET FORECAST
PERCENT DISTRIBUTION OF NEW CONSTRUCTIONS

	1976-1980		1981-1985		1986-1990		1991-1995		1996-2000		1976-2000	
	World	U.S.-Flag	World	U.S.-Flag	World	U.S.-Flag	World	U.S.-Flag	World	U.S.-Flag	World	U.S.-flag
General Cargo Ships	6.5	.3	6	0	5	3	8	3	2	0	5	1
Partial Containerships	43	0	8	7	12	9	10	5	10	4	9	5
Full Containerships	4.4	11.8	4	10	5	14	6	23	7	20	6	16
Barge Carriers	0	0	1	4	1	3	1	3	2	12	1	5
Neobulk Carriers	1.2	0	2	1	3	1	3	2	4	1	3	1
Dry Bulk Carriers	8.4	4.8	18	9	28	14	36	14	31	12	25	11
Combination Carriers	4.0	0	6	1	8	2	10	1	7	3	7	2
LNG Carriers	1.5	9.4	6	24	4	14	4	22	2	9	3	15
Liquid Bulk Carriers	69.2	73.2	49	44	34	40	20	27	35	39	41	44
Total Percent	100.0	100.0	100	100	100	100	100	100	100	100	100	100
Total Deadweight*	38,077	3,685	28,246	4,629	25,404	3,194	37,911	3,962	56,845	6,482	186,483	21,351

Source: Merchant Fleet Forecast of Vessels in U. S. - Foreign Trade, Temple, Barker & Sloane, Inc., Table II - 19

SECTION IX
COST IMPACT PROCEDURES

A. Introduction

Sections III through VII of this manual detail procedures which can be used to measure the industry costs of CVS regulations. The purpose of this Section is to describe procedures to trace the interindustry impacts of these regulatory costs and determine their measurable impacts on GNP, inflation and other economy-wide indicators. The Interindustry Forecasting Model of the U.S. Economy, at the University of Maryland, INFORUM, is the major tool which will be used for accomplishing these two goals.

B. INFORUM Background

The U.S. economy is a complex web of interindustry and consumer relationships. Each industry absorbs part of its output itself, sells some to other industries as inputs into their production, and delivers the remainder to final consumers. Input-output analysis describes the technical interrelationships of the economy and traces the flow of outputs among industries to the level of final demand. Input-output analysis also provides information on the cost/price structure of each industry and can be used to measure the direct and indirect repercussions of changes in prices or changes in demand.

INFORUM uses the input-output relationships prepared by the U.S. Department of Commerce and updated by INFORUM to obtain a detailed year-by-year forecast of the U.S. economy for 10 to 15 years into the future. The two types of forecasts are the final demand forecasts and the interindustry forecasts. The final demand forecasts consist of the size and annual growth rates of:

- Gross National Product (GNP).
- Personal consumption expenditures for durable goods, non-durable goods and services.
- Gross private domestic investment in residential structures, producers' durable equipment and inventory change.
- Exports and imports of goods and services.
- Federal government purchases for public construction, national defense, and other federal programs and state and local government expenditures including education.

- Productivity and employment in private industry, civilian government, and the military.
- Wholesale price index.

INFORUM breaks the economy into 200 industrial sectors (shown in Figure 4) and forecasts the sales of each of these sectors to:

- Each other, as material or service inputs.
- Each of 90 investment sectors (aggregates of the 200) as capital inputs.
- Thirty types of construction, as construction materials.
- Nine categories of government expenditures.
- Household consumption, inventory change, and exports with import appearing as an offsetting entry.

With INFORUM, an increase in the costs of production (due to a regulation) in one of the 200 sectors translates, assuming 100 percent cost pass-through, into an increase in the price of the product of that sector. The effects of the price increase in one sector on the 199 other sectors as well as on GNP, consumption, investment, exports and imports, government purchases, employment, and the wholesale price index can then be determined. INFORUM is designed to forecast, for example, how an increase in the price of steel will impact the output of the motor vehicles industry and other industrial buyers of steel. In turn, INFORUM can forecast how the change in the output of the motor vehicle industry, impacts the auto repair, trucking, and wholesale and retail trade industries, as well as households and other buyers of motor vehicles. After the changes in sector outputs due to the increase in the price of steel have been determined, the model can also supply the final changes in GNP and its components caused by the price and subsequent output changes relative to the forecasts made without the steel price increase factored in. For each individual industry, it can also forecast the final change, after all the effects have filtered through the economy, in its output or product shipments, its prices, its sales to final consumer demand, and exports and imports, its investment and productivity, and changes in its inventories. All these changes are relative to base forecasts made without taking the steel price increases into account.

The basic steps to enter regulation cost estimates into the INFORUM industry and macroeconomic models are listed below. Detailed discussion of these steps within the context of CVS regulations are discussed in subsection C.

Figure 4. Definitions for the 200 Sectors in the INFORM Model

The INFORM model divides the economy into 200 sectors. The sector number and title are listed in columns 1 and 2. Column 3 groups the 200 sector listing into 90 aggregated categories for investment and employment.
Columns 4–10 list by number the Standard Industrial Classification (S.I.C.) sectors included in each of the 200 INFORM sectors of the economy. The S.I.C. classification system is the one used in compiling data on domestic output. The 4-digit S.I.C. codes are those used for the 1967 census of manufacturers. A code ending with a '0' designates an entire 3-digit group; a code ending with '00' designates an entire 2-digit group. A minus sign indicates that this S.I.C. is excluded from the section.

	SECTOR TITLES	90–ORDER	1967 STANDARD INDUSTRIAL CLASSIFICATION					
1	Diary Farm Products	(1)	132					
2	Poultry and Eggs	(1)	133					
3	Meat Animals, Other Livestock	(1)	135	136	139	193		
4	Cotton	(1)	112					
5	Grains	(1)	113					
6	Tobacco	(1)	114					
7	Fruit, Vegetables, Other Crops	(1)	119	120	192			
8	Forestry	(1)	810	820	840	860	910	
9	Fishery Products	(1)	074					
10	Agriculture, Forestry & Fishery Services	(1)	710	720	730	850	980	
11	Iron Ores	(2)	1010	1060				
12	Copper Ore	(2)	1020					
13	Other Non-Ferrous Ores	(2)	1030	1050	1090			
14	Coal Mining	(2)	1110	1210				
15	Crude Petroleum, Natural Gas	(3)	1310	1320				
16	Empty							
17	Stone and Clay Mining	(2)	1410	1420	1440	1450	1490	
18	Chemical Fertilizer Mining	(2)	1470					
19	New Construction	(4)	1600					
20	Maintenance Construction	(0)	1500					
21	Complete Guided Missiles	(5)	1925					
22	Ammunition	(5)	1929	1960				
23	Other Ordnance	(5)	1910	1930	1940	1950	1990	
24	Meat Products	(6)	2010					
25	Dairy Products	(7)	2020					
26	Canned and Frozen Foods	(8)	2030					
27	Grain Mill Products	(9)	2040					
28	Bakery Products	(10)	2050					
29	Sugar	(11)	2060					
30	Confectionary Products	(12)	2070					
31	Alcoholic Beverages	(13)	2082	2083	2084	2085		
32	Soft Drinks and Flavorings	(13)	2086	2087				
33	Fats and Oils	(14)	2091	2092	2093	2094	2096	
34	Miscellaneous Food Products	(14)	2095	2097	2098	2099		
35	Tobacco Products	(15)	2110	2120	2130	2140		
36	Broad and Narrow Fabrics	(16)	2210	2220	2230	2240	2261	2261
37	Yarn, Thread, Finishing	(16)	2269	2280				
38	Floor Coverings	(17)	2270					
39	Miscellaneous Textiles	(18)	2290					

40	Knitting	(19)	2250						
41	Apparel	(20)	2310	2320	2330	2340	2350	2360	2370
42	Household Textiles	(21)	2390						
43	Logging Camps	(22)	2410						
44	Saw and Planing Mills	(22)	2420						
45	Veneer and Plywood	(23)	2432						
46	Millwork and Wood Products	(23)	2431	2433	2490				
47	Wooden Containers	(24)	2440						
48	Household Furniture	(25)	2510						
49	Other Furniture	(25)	2520	2530	2540	2590			
50	Pulp Mills	(25)	2610						
51	Paper and Paperboard Mills	(27)	2620	2630					
52	Paper Products, Nec	(27)	2641	2642	2643	2645	2646	2647	2649
53	Wall and Building Paper	(27)	2644	2660					
54	Paperboard Containers	(28)	2650						
55	Newspapers	(29)	2710						
56	Periodicals	(30)	2720						
57	Books	(30)	2730						
58	Business Forms, Blank Books	(30)	2760	2782					
59	Commercial Printing	(30)	2751	2752					
60	Other Printing, Publishing	(30)	2740	2753	2770	2789	2790		
61	Empty								
62	Empty								
63	Empty								
64	Industrial Chemicals	(31)	2810						
65	Fertilizers	(32)	2871	2872					
66	Pesticides and Agricultural Chemicals	(32)	2879						
67	Miscellaneous Chemical Products	(33)	2860	2890					
68	Plastic Materials and Resins	(34)	2821						
69	Synthetic Rubber	(34)	2822						
70	Cellulosic Fibers	(34)	2823						
71	Non-Cellulosic Fibers	(34)	2824						
72	Drugs	(35)	2830						
73	Cleaning and Toilet Products	(36)	2840						
74	Paints	(37)	2850						
75	Empty								
76	Petroleum Refining [1]	(38)	2911	2990					
77	Fuel Oil [1]	(38)	2911						
78	Paving and Asphalt	(38)	2950						
79	Empty								
80	Tires and Inner Tubes	(39)	3010						
81	Rubber Products	(40)	3020	3030	3060				
82	Miscellaneous Platsic Products	(41)	3070						
83	Leather and Industrial Leather Products	(42)	3110	3120					
84	Footwear (Excluding Rubber)	(43)	3130	3140					
85	Other LEather Products	(43)	3150	3160	3170	3190			
86	Glass	(44)	3210	3220	3230				
87	Structural Clay Products	(45)	3250						
88	Pottery	(45)	3260						
89	Cement, Concrete, Gypsum	(45)	3240	3270					
90	Other Stone and Clay Products	(45)	3280	3290					
91	Steel	(46)	3310	3320	3391	3399			

92	Copper	(47)	3331	3340	3351	3362		
93	Lead	(47)	3332					
94	Zinc	(47)	3333					
95	Aluminum	(47)	3334	3352	3361			
96	Other Primary Non-Ferrous Metals	(47)	3339					
97	Other Non-Ferrous Roll and Draw	(47)	3356					
98	Non-Ferrous Wire Drawing	(47)	3357					
99	Non-Ferrous Casting and Forging	(47)	3369	3392				
100	Metal Cans	(48)	3410					
101	Metal Barrels and Drums	(48)	3491					
102	Plumbing and Heating Equipment	(49)	3430					
103	Boiler Shops	(50)	3443					
104	Other Structural Metal Products	(50)	3441	3442	3444	3446	3449	
105	Screw Machine Products	(51)	3450					
106	Metal Stampings	(51)	3460					
107	Cutlery, Hand Tools, Hardware	(52)	3420					
108	Miscellaneous Fabricated Wire Products	(52)	3480					
109	Pipes, Valves, Fittings	(52)	3494	3498				
110	Other Fabricated Metal Products	(52)	3470	3492	3493	3496	3497	3499
111	Engines and Turbines	(53)	3510					
112	Farm Machinery	(54)	3520					
113	Construction, Mine, Oilfield Machinery	(55)	3531	3532	3533			
114	Materials Handling Machinery	(55)	3534	3535	3536	3537		
115	Machine Tools, Metal Cutting	(56)	3541					
116	Machine Tools, Metal Forming	(56)	3542					
117	Other Metal Working Machinery	(56)	3544	3545	3548			
118	Special Industrial Machinery	(57)	3550					
119	Pumps, Compressors, Blowers	(58)	3561	3564				
120	Ball and Roller Bearings	(58)	3562					
121	Power Transmission Equipment	(58)	3566					
122	Industrial Patterns	(58)	3565	3567	3569			
123	Computers and Related Machinery	(60)	3571	3573	3574			
124	Other Office Machinery	(60)	3572	3576	3579			
125	Service Industry Machinery	(61)	3580					
126	Machine Shop Products	(59)	3590					
127	Empty							
128	Empty							
129	Electrical Measuring Instrumententation	(62)	3611					
130	Transformers and Switchgear	(62)	3612	3613				
131	Motors and Generators	(63)	3621					
132	Industrial Controls	(63)	3622					
133	Welding App. Graphite Products	(63)	3623	3624	3629			
134	Household Appliances	(64)	3630					
135	Electric Lighting and Wiring Fq.	(65)	3640					
136	Radio and T.V. Receiving	(66)	3651					
137	Phonograph Records	(66)	3652					
138	Communication Equpment	(67)	3660					
139	Electronic Components	(68)	3670					
140	Batteries	(69)	3691	3692				
141	Engine Electrical Equipment	(69)	3694					
142	X-Ray, Electrical Equipment, Nec.	(69)	3693	3699				
143	Empty							
144	Truck, Bus, Trailer Bodies	(70)	3713	3715				
145	Motor Vehicles	(70)	3711	3714	3717			
146	Empty							

147	Aircraft	(71)	3721						
148	Aircraft Engines	(71)	3722						
149	Aircraft Equipment, Nec.	(71)	3723	3729					
150	Ship and Boat Building	(72)	3730						
151	Railroad Equipment	(73)	3740						
152	Cycles, Transportation Equipment, Nec.	(74)	3750	3799					
153	Trailer Coaches	(74)	3791						
154	Empty								
155	Empty								
156	Engineering and Scientific Instruments	(75)	3810						
157	Mechanical Measuring Devices	(76)	3820						
158	Optical and Ophthalmic Goods	(78)	3830	3850					
159	Medical and Surgical Instruments	(77)	3840						
160	Photographic Equipment	(78)	3860						
161	Empty								
162	Watches and Clocks	(78)	3870						
163	Jewelry and Silverware	(79)	3910	3961					
164	Toys, Sport, Musical Instruments	(79)	3930						
165	Office Supplies	(79)	3950						
166	Miscellaneous Manufacturing, Nec.	(79)	3962	3963	3964	3980	3991	3993	3994
			3995	3996	3999				
167	Railroads	(80)	4000	4740					
168	Busses and Local Transit	(82)	4100						
169	Trucking	(81)	4200	4730					
170	Water Transportation	(82)	4400						
171	Airlines	(83)	4500						
172	Pipelines	(82)	4600						
173	Freight Forwarding	(82)	4700	-4730	-4740				
174	Telephone and Telegraph	(85)	4800	-4830					
175	Radio and T.V. Broadcasting	(85)	4830						
176	Electric Utilities	(87)	4910	4930					
177	Empty								
178	Natural Gas	(88)	4920	4930					
179	Water and Sewer Services	(88)	4930	4940	4950	4960	4970		
180	Wholesale Trade	(84)	5000						
181	Retail Trade	(84)	5200	5300	5400	5500	5600	5700	5800
			5960	7390					
182	Banks, Credit Agencies, Brokers	(86)	6000	6100	6200	6700			
183	Insurance	(86)	6300						
184	Owner-Occupied Dwellings	(0)	6400						
185	Real Estate	(86)	6500	6600	-6561				
186	Hotel and Lodging Places	(86)	7000						
187	Personal and Repair Services	(86)	7200	7600	-7692	-7694	-7699		
188	Business Services	(86)	7300	7692	8100	8900	7310	-7396	-8921
189	Advertising	(86)	7310						
190	Automobile Repair	(86)	7500						
191	Movies and Amusements	(86)	7800	7900					
192	Medical Services	(86)	0722	8010	8020	8030	8040	8060	8070
			8090						
193	Private Schools and NPO	(86)	8200	8400	8600	8921			
194	Post Office								
195	Federal and S&L Government Enterprises								
196	Non-Competitive Imports								
197	Business Travel (Dummy)								
198	Office Supplies (Dummy)								
199	Unimportant Business (Dummy)								
200	Computer Rental (Dummy)								

[1] Sector 76 shows shipments of all petroleum refining. However all fuel oil is sold to Sector 77; therefore, the sales to other sectors show purchases of gasoline, aviation fuel, and petrochemical feedstocks. The Distribution of sales for sector 77 shows purchases of residual and distillate fuel oil, diesel fuel, and kerosene.

Basic steps:

1. Obtain a base forecast of the economy for the period under analysis.

2. Calculate the undiscounted, direct, industry costs of the regulation for each year of impact analysis.

3. Deflate the costs to 1976 dollars to be compatible with data in the INFORUM model.

4. Determine the appropriate industrial sector(s) expected to bear the direct costs.

5. Translate the cost increases into annual percentage price increases.

6. Run the INFORUM price model to calculate the effect these price increases will have on all industries.

7. Determine the changes in investment, employment, government spending, exports and imports and other structural changes expected to result from regulatory expenditures and adjust the appropriate structural functions in the model accordingly.

8. Given the scenario developed in steps 2 through 7, run the INFORUM macroeconomic model. Compare macroeconomic indicators and industry variables emerging from the base forecast with the scenario forecasts to determine the impacts of the regulation on both the economy as a whole and on industries of interest.

C. INFORUM and CVS Regulations

The purpose of this section is to describe how to follow the basic steps listed above when performing a cost impact anlaysis of CVS regulations.

1. Obtain a base forecast for the period under analysis.

For the cost measurement portion of CVS regulatory analysis, a 25-year time horizon for the analysis was recommended. Because of the inherent inadequacies of forecasting models in general, and based on suggestions of the INFORUM staff, it is recommended the time horizon of the cost impact analysis be limited to 1985. INFORUM has the capability to forecast out to 1990 by linear extrapolation of the results of 1980-85. This method involves extra computer time, however, without adding much substantive information to the analysis.

2. Calculate the undiscounted, direct industry costs of the regulation for each year of impact analysis.

Procedures for calculating the direct industry costs of CVS regulations are described in Sections V, VI and VII. The industry costs resulting from a cost measurement analysis and placed on the various formats described in Section V must be collected by the regulatory staff for input into the INFORUM model. Format 4, "Industry Summary -- All Vessels," contains the necessary direct, industry costs in column 10. Note for the impact analysis, undiscounted costs are appropriate. Furthermore, because the impact analysis is limited to 1985, the regulatory staff is only concerned with costs from the base year to 1985.

3. Deflate the costs to 1976 dollars.

To deflate the costs found in column 10, Format 4 to 1976 dollars, multiply the costs in each year from the base year or year zero to 1985 by the ratio of the 1976 wholesale price index (WPI) to the wholesale price index for the base year.

$$\text{Deflated costs} = \text{undeflated costs} \times \left(\frac{\text{WPI 1976}}{\text{WPI base year}}\right)$$

Actual WPIs for 1976 and 1977 and forecasted WPIs for 1978 to 1990 are published in the June 1978 INFORUM forecasts and are reproduced in Table 20, page 130.

Format 8 is designed to aid the analyst in following steps 2 and 3 above. It provides space for computing deflated industry costs over a 10-year time horizon.

4. Determine the appropriate industrial sector(s) expected to bear the direct costs.

For all types of CVS regulations, with one exception, the costs of CVS regulations will enter the INFORUM model through INFORUM Sector 170, entitled "Water Transportation."

Section 170, Water Transportation, includes all industries contained in Major Group 44 of the 1967 Standard Industrial Classification Manual. By definition, this includes U.S. establishments engaged in deep sea foreign transportation, deep sea domestic transportation, Great Lakes - St. Lawrence Seaway transportation, transportation on rivers and canals, local water transportation, marine cargo handling, canal operation, and furnishing miscellaneous services incidental to water transportation (e.g., cargo salvaging, marine surveyors, and marine wrecking). Figure 5 from the 1967 SIC Manual contains a more detailed description of water transportation.

Figure 5

Major Group 44.—WATER TRANSPORTATION *

The Major Group as a Whole

This major group includes companies engaged in freight and passenger transportation on the open seas or inland waters, and companies furnishing such incidental services as lighterage, towing, and canal operation. This major group also includes excursion boats, sight-seeing boats, and water taxis. Cargo handling operations when carried on by transportation companies and separately reported are classified in Industry 4463. When separate reports for cargo handling are not available, these operations are classified with the transportation company.

Group No. / Industry No.

441 DEEP SEA FOREIGN TRANSPORTATION

4411 Deep Sea Foreign Transportation

Companies primarily engaged in operating vessels for the transportation of freight or passengers on the deep seas between the United States and foreign ports. Companies operating to foreign ports and also to noncontiguous territories are classified in this industry.

Deep sea foreign transportation

442 DEEP SEA DOMESTIC TRANSPORTATION

4421 Transportation to and Between Noncontiguous Territories

Companies primarily engaged in operating vessels for the transportation of freight or passengers on the deep seas between the United States mainland and Alaska, *the Panama Canal Zone, the Hawaiian* Islands, Puerto Rico and island possessions or protectorates and between such territories.

Domestic transportation, deep sea
Water transportation to noncontiguous territories

4422 Coastwise Transportation

Companies primarily engaged in operating vessels for the transportation of freight or passengers on the deep seas between mainland United States ports, between those located solely on the Atlantic coast and Gulf coast, or between those located solely on the Pacific coast, or along the coasts of Alaska, Hawaii or Puerto Rico. This industry does not include intracoastal transportation performed in inland waterway service on the intracoastal waterways paralleling the Atlantic and Gulf Coasts, classified in Industry 4441.

Coastwise transportation

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* **Supplementary code for Major Group 44.—Type of operation:**

1 **Common carriers**
Companies primarily engaged in operating vessels to serve the general public. Frequently these companies operate over fixed routes and on fixed schedules.

2 **Contract carriers—ocean shipping**
Companies primarily engaged in operating vessels under special contracts or agreements for the transportation of goods of others or of passengers.

3 **Contract carriers—inland and Great Lakes shipping**
Companies primarily engaged in operating vessels and or towing services principally under special contracts or agreements.

4 **Private carriers**
Separate corporations carrying only the goods of corporations to which they are subsidiary.

Group No. / Industry No.

442 DEEP SEA DOMESTIC TRANSPORTATION—Continued

4423 Intercoastal Transportation

Companies primarily engaged in operating vessels for the transportation of freight or passengers on the deep seas between ports on the United States Atlantic and Gulf coasts on the one hand, and United States Pacific coast ports on the other, via the Panama Canal.

Intercoastal transportation

443 GREAT LAKES-ST. LAWRENCE SEAWAY TRANSPORTATION

4431 Great Lakes-St. Lawrence Seaway Transportation

Companies primarily engaged in the transportation of freight or passengers on the Great Lakes and St. Lawrence Seaway, either between United States ports or between United States and Canadian ports.

Ferries operating on the Great Lakes and St. Lawrence Seaway
Great Lakes and St. Lawrence Seaway transportation

444 TRANSPORTATION ON RIVERS AND CANALS

4441 Transportation on Rivers and Canals

Companies primarily engaged in transporting freight or passengers on all inland waterways, including the intracoastal waterway on the Atlantic and Gulf coasts. Transportation on the Great Lakes-St. Lawrence Seaway is classified in Industry 4431; local water transportation including intraport transportation in Group 445; and the maintenance and operation of canals primarily for use by the vessels of others in Industry 4464.

Canal barge operation
Canal transportation
Intracoastal transportation
Lake transportation, other than on the Great Lakes
Log rafting and towing
River transportation, other than on *the St. Lawrence Seaway*
Transportation on bays and sounds of the ocean

445 LOCAL WATER TRANSPORTATION

4452 Ferries

Companies primarily engaged in operating ferries across rivers or within harbors. Companies operating ferries across the Great Lakes are classified in Industry 4431.

Car lighters (ferries), separately incorporated or organized
Ferries operating across rivers or within harbors
Intraport transportation
Railroad ferries, separately incorporated or organized

4453 Lighterage

Companies primarily engaged in operating lighters and other harbor vessels for transferring goods and passengers between ship and shore or from one ship to another.

Lighterage

4454 Towing and Tugboat Service

Companies primarily engaged in furnishing marine towing and tugboat services in the performance of auxiliary or terminal services in harbor areas. The vessels used in performing these services do not carry cargo or passengers.

Docking of ocean vessels
Shifting of floating equipment with in harbors
Towing, marine
Tugboat service
Undocking of ocean vessels

Figure 5 (continued)

Group No.	Industry No	
445		**LOCAL WATER TRANSPORTATION—*Continued***
	4459	**Local Water Transportation, Not Elsewhere Classified**

Companies primarily engaged in furnishing local water transportation, not elsewhere classified, such as excursion boats, sight-seeing boats, and water taxis.

Airboats (swamp buggy rides)
Excursion boats
Sight seeing boats
Water taxis

446 SERVICES INCIDENTAL TO WATER TRANSPORTATION

4463 Marine Cargo Handling

Establishments primarily engaged in activities directly related to marine cargo handling from the time cargo, for or from a vessel, arrives at shipside, dock, pier, terminal, staging area, or intransit area until cargo loading or unloading operations are completed. This industry includes the operation and maintenance of piers, docks, and associated buildings and facilities; but lessors of such facilities are classified in Industry 6512.

Loading vessels
Marine cargo handling
Operation and maintenance of piers and docks, including buildings and facilities
Ship hold cleaning
Stevedoring
Unloading vessels
Waterfront terminal operation

4464 Canal Operation

Companies primarily engaged in the maintenance and operation of canals.

Canal operation

4469 Water Transportation Services, Not Elsewhere Classified

Companies primarily engaged in furnishing miscellaneous services incidental to water transportation, not elsewhere classified, such as boat hiring, except for pleasure; chartering of vessels; ship cleaning, except hold cleaning (Industry 4463); and steamship leasing.

Boat hiring, except pleasure
Boat livery, except pleasure
Boat yards, storage and incidental repair
Boathouses
Dismantling ships
Ship registers: survey and classification of ships, engines, and marine equipment; and publication of a register
Marinas
Marine basins, renting and operating
Marine salvaging
Marine surveyors
Marine wrecking: salvaging from sunken craft, removal of underwater hazards by divers, wrecking ships for scrap
Piloting vessels in and out of harbors
Rental or charter of commercial boats
Salvaging of distressed vessels and their cargoes
Ship cleaning, except hold cleaning
Steamship leasing
Yacht basins

For those CVS regulations imposed largely on petroleum tankers, INFORUM Sector 15, entitled "Crude Petroleum, Natural Gas" can be used. Sector 15 contains 1967 SIC groups 1310 and 1320 which include establishments engaged in producing crude petroleum and natural gas. Figure 6 from the 1967 SIC Manual presents a detailed description of the Crude Petroleum, Natural Gas sector.

5. Translate the cost increases into annual percentage price increases.

Annual percentage price increases are calculated in the following way:

$$\frac{\text{Annual Percentage Price}}{\text{Increase in Year n}} = \frac{\text{Deflated Direct Costs in Year n}}{\text{Product Shipments in Industry i in Year n}} \times 100$$

where:

- o Industry i represents the industry bearing the direct costs. For CVS regulations the industry will either be Sector 170, Water Transportation or Sector 15, Crude Petroleum, Natural Gas.
- o Year n represents each year from the base year to 1985, i.e., n = year 0, year 1,....year 1985.
- o Direct costs must be in 1976 dollars and can be obtained as discussed in steps 2 and 3 above or found in column 3, Format 8.
- o INFORUM forecasts product shipments for 1978 to 1990. The forecasted product shipments for "Water Transportation" can be used without adjustment. The forecasted product shipments for "Crude Petroleum, Natural Gas" must be adjusted to include only the output of the domestic crude petroleum industry; the output of the natural gas industry must be subtracted out. Table 19 presents the product shipments of water transportation and the adjusted products shipments of crude petroleum.

Format 9A and 9B provide a means for the regulatory staff to compute annual percentage price increases as described above. Format 9A is to be used when water transportation has been selected as the industry bearing the initial costs. Format 9B is to be used when Sector 15, "Crude Petroleum" has been selected.

Figure 6

Major Group 13.—CRUDE PETROLEUM AND NATURAL GAS

The Major Group as a Whole

This major group includes establishments primarily engaged in: (1) producing crude petroleum and natural gas, (2) recovering oil from oil sands and oil shale, and (3) producing natural gasoline and cycle condensate. Types of activities included are exploration, drilling, oil and gas well operation and maintenance, the operation of natural gasoline and cycle plants, and the mining and extraction of oil from oil sands and oil shale. This major group also includes such basic activities as emulsion breaking and desilting of crude petroleum to render the oil marketable. Pipe line transportation of petroleum, gasoline and other petroleum products (except gathering lines) is classified in Major Group 46—Pipe Line Transportation, and of natural gas in Major Group 49—Electric, Gas, and Sanitary Services. Establishments primarily engaged in petroleum refining and in the production of lubricating oils and greases are classified in Major Group 29.

Group No.	Industry No.	
131		**CRUDE PETROLEUM AND NATURAL GAS**
	1311	**Crude Petroleum and Natural Gas**

Establishments primarily engaged in operating oil and gas field properties. Such activities include exploration for crude petroleum and natural gas; drilling, completing, and equipping wells; operation of separators, emulsion breakers, desilting equipment; and all other activities incident to making oil and gas marketable up to the point of shipment from the producing property. This industry also includes the production of oil through the mining and extraction of oil from oil shale and oil sands. Establishments primarily engaged in performing oil field services for operators on a contract, fee, or other basis are classified in Group 138.

Crude oil production
Crude petroleum production
Natural gas production
Oil sand mining
Oil shale mining
Sufur extraction from sour natural gas

132		**NATURAL GAS LIQUIDS**
	1321	**Natural Gas Liquids**

Establishments primarily engaged in producing liquid hydrocarbons from oil and gas field gases. Establishments recovering liquefied petroleum gases incident to petroleum refining or to the manufacturing of chemicals are classified in Major Groups 28 or 29.

Butane (natural) production
Casing head butane and propane production
Cycle condensate production
Isobutane production
Liquefied petroleum gases (natural) production
Natural gasoline production
Propane (natural) production

Table 19

PRODUCT SHIPMENTS IN PRODUCER PRICES

(Millions of 1976 $)

Year	Water Transportation	Crude Petroleum (Adjusted)
1978	10315	28646.
1979	10655	28329.
1980	11020	28011.
1981	11251	27942.
1982	11494	27873
1983	11774	27805.
1984	12045	27877.
1985	12329	27950.
1986	12604	28022.
1987	12886	28095.
1988	13180	28167.
1989	13481	28239.
1990	13791	28312.

Source: INFORUM, "Summary of National Accounts and Final Demand," June 1978.

6. Run the INFORUM price model to calculate the effect these price increases will have on all industries.

The annual price increases computed in step 5 above and found in column 4, Format 9 can be entered into the INFORUM price model by INFORUM staff and the impacts of the price increases on other industries can be traced by the computer. Through example runs of the price model it was learned that only when the price increase in at least 1 year is greater than 10 percent for water transportation or 2.5 percent for crude petroleum will there be measurable impacts in the INFORUM model. When price increases are less, the regulatory staff should not run the INFORUM model or continue with the remaining steps 7 and 8. Discussion of what to do about cost impacts when price increases are not large enough to measurably impact the INFORUM model are contained in Section X.

7. Determine any structural changes expected to result from the regulatory expenditures and adjust the appropriate structural functions in the model.

This step is included as an option for the regulatory staff. In most regulatory impact analyses, the price change will have the primary impact on the model. Structural changes are generally included in order to refine the output of the model. When time and other resources permit, the regulatory staff can increase the precision of the results by making adjustments to structural functions.

There will be two major structural changes expected to result from CVS regulations. These changes will occur in Investment and Government Spending. Other structural changes in employment, productivity, imports or exports,[1] are conceivable; however, it is difficult to predict the direction and amount of these changes.

The majority of CVS regulations lead to an increase in investment expenditures by the shipping industry; consequently, the constant term in the investment function should be raised accordingly. The INFORUM staff will perform the required adjustment if the regulatory staff provides the amount of increase in investment for each year of analysis in 1976 dollars.

Investment costs per vessel class are listed in columns 2 and 4 on Format 3. Add column 2, Investment Costs (New Construction) to column 4, Investment Costs (Retrofit and Modification) for year 0 to 1985 to obtain total

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1. When non-U.S. flag vessels do not have to comply with the regulation and subsidies to U.S. flag vessels are not expected to pick up the costs of the regulation, the regulatory staff may adjust, with the aid of INFORUM staff, exports of water transportation downward and imports upward.

annual investment costs for each vessel class. Add the total annual investment costs for each vessel class together to obtain total annual investment costs for the whole industry. Deflate the total annual investment costs for the whole industry to 1976 dollars using the following formula:

$$\text{Total Deflated Investment Costs in Year n} = \text{Total Undeflated Investment Costs in Year n} \times \frac{WPI_{1976}}{WPI_{\text{base year}}}$$

where:

- o n= year 0 (base year), year 1, year 2...year 1985.
- o WPIs are listed in Table 20.

The total deflated annual investment costs can now be added to the appropriate investment function by INFORUM staff.

CVS regulations can often lead to significant increases in government spending. When this occurs the government expenditure function should be adjusted. The INFORUM staff will make the required changes, but the regulatory staff must provide the total, annual, deflated government or in-house costs of the regulation.

Total annual in-house costs are listed in column 5, Format 6. The regulatory staff can deflate these costs to 1976 dollars using the following formula:

$$\text{Total Deflated In-House Costs in Year n} = \text{Total Undeflated In-House Costs in Year n} \times \frac{WPI_{1976}}{WPI_{\text{base year}}}$$

where:

- o n= year 0 (base year), year 1, year 2.....year 1985.
- o WPIs are listed in Table 20.

8. Given the scenario developed in steps 2-7, run the INFORUM macroeconomic model and compare results with the base forecasts to determine regulation impacts.

The regulatory staff should analyze both the impacts on economy-wide or macroeconomic indicators and impacts in selected industrial sectors. INFORUM's macroeconomic model is capable of forecasting size and annual growth rates of numerous economic indicators as listed on page 115. For

Table 20

WHOLESALE PRICE INDICES

Year	WPI (1967 = 100)
1976	183.00
1977	194.15
1978	203.96
1979	216.72
1980	230.23
1981	244.74
1982	260.12
1983	276.83
1984	295.21
1985	314.49
1986	331.35
1987	348.20
1988	365.05
1989	381.91
1990	398.76

Source: INFORUM, "Summary of National Accounts and Final Demand," June 1978.

purposes of regulatory cost impact analysis, the regulatory staff should concentrate on looking at the major macroeconomic indicators. The output of the INFORUM forecasts will present the base and regulation forecasts for all the indicators.[1] Format 10 allows the regulatory staff to cull the major indicators from the complete, detailed forecasts. It provides space to compare the base projections with the projections with regulation costs factored in and compute the percent difference for:

- Gross National Product (GNP)
- Wholesale Price Index
- Unemployment Rate
- Trade Balance (exports in current dollars minus imports in current dollars)

There are 200 industry sectors in the INFORUM model. An increase in the price of water transportation or crude petroleum can lead to changes in the remaining 199 sectors. Realistically, the regulatory staff must limit analysis of industry impacts to those industries which experience significant changes. This includes Sector 170 Water Transportation and Sector 15 Crude Petroleum. It can also be assumed that the major buyers of these two industries might be significantly impacted. In addition, Sector 150 Ship and Boatbuilding is likely to be an important sector due to the nature of CVS regulations and because the ship and boatbuilding industry is a major supplier to water transportation.

Formats 11A and 11B provide a way for the regulatory staff to easily compare the base and regulation forecasts of certain industrial indicators for Sector 170, Water Transportation and Sector 15, Crude Petroleum. The industry indicators presented on the formats include product shipments, industry wholesale prices, industry exports and imports, and industry employment.[2] Other industry variables can be looked at, for example, industry productivity or investment or industry sales to government. Formats 11A and B, however, are limited to the major industry indicators.

Formats 12A, 12B, and 12C allow the regulatory staff to quickly compare three major industry indicators, prices, product shipments and

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1. These will be found on the "Summary of National Accounts and Final Demand" printouts.
2. From the INFORUM printout "Summary of National Accounts and Final Demand."

employment,[1] in the industries most likely to be significantly impacted by CVS regulations. These include Water Transportation, Crude Petroleum, Ship and Boatbuilding and their major industrial buyers. Formats 12A, B and C also leave space at the bottom for the regulatory staff to compare the results for other industries of interest in any particular cost impact analysis.

9. Perform sensitivity analysis.

The regulatory staff may perform sensitivity tests to determine if changes in one or more inputs into the scenario developed in steps 2-7 will have an appreciable effect on the results. Two types of changes can be considered: changes in the assumptions built into the model regarding conditions in the economy and the assumption of 100 percent cost pass through, and changes in the level or timing of regulation costs.

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1. Ibid.

SECTION X
EXPECTED IMPACTS OF CVS REGULATIONS

A. Introduction

When costs are not large enough to cause a measurable impact in the INFORUM model, a valuable cost impact analysis can still be done by tracing the industries most likely to be impacted and by identifying, if not the magnitude, at least the direction of expected changes in economy-wide and industry indicators.

B. Impact Tracing

INFORUM publishes bi-annually the "Matrix Listing of Seller-Buyer Relationships" for a 12-year time horizon. This listing shows the major industrial buyers[1] of each of the 200 industry sectors and the amounts they buy in each forecasted year. It also shows the sales of each industry to final demand sectors including investment, government, exports and personal consumption[2]. This listing of sales can be extremely important in tracing the regulation's impacts. Knowing the buyers of an industry's output allows the regulatory staff to determine those sectors most likely to be directly and indirectly affected by a price change in the industry under study.

The buyers of the output of the water transportation industry are listed in Table 21. Analysis shows in 1978 much of the output of water transportation was sold as exports to other countries. After exports, the largest consumer of water transportation is the industry itself, with households directly buying $1067.5 million for personal consumption and the federal government buying $741.4 million for defense. The largest industrial buyers, after water transportation itself, are petroleum refining with steel and electric utilities following.

The first order impacts of a price increase in water transportation will be borne by the buyers listed in Table 21. The industrial buyers (petroleum refining, steel, electric utilities, etc.) will pass the price increases, in turn, to their buyers. Price increases borne by households and government will impact the level of GNP directly. In other words, price increases experienced at the industry level either directly impact GNP components (personal consumption, investment, government, exports or imports) or filter through many different industries to impact GNP components indirectly.

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1. A major industrial buyer is one which buys more than one-half percent of the output of the industry.
2. A complete breakdown of all buyers, not just major ones, is available upon request, from the University of Maryland.

Table 21

OUTPUT OF SECTOR 170, WATER TRANSPORTATION

Buyers	1978 (Millions $)		As percent of Total Output (Domestic)	
170 Water Transportation	1180.8		11.5	
5 Grains	63.5		.6	
34 Miscellaneous Food	75.9		.7	
64 Industrial Chemicals	66.8		.7	
76 Petroleum Refining	768.7		7.5	
91 Steel	254.9		2.5	
176 Electric Utilities	140.5		1.5	
Sales to Other Intermediate Users	927.8		8.8	
Sum of Sales to Intermediate Use		3478.9		33.7
Sum of Sales to Equipment Buyers		26.1		.3
Sum of Sales to Construction		82.2		.8
Personal Consumption	1067.5		10.4	
Defense	741.4		7.2	
Non-Defense Federal Government	134.9		1.3	
Exports	4946.2		48.0	
Imports	-276.5 *		-2.7 *	
Sales to Other Final Demand Categories	114.2		1.0	
Sum of Sales to Final Demand		6727.7		65.2
Total Output (Domestic)		10315.0		100.0

Source: "Matrix Listing of Seller-Buyer Relationships, June 1978.

* Imports are shown as negative number since they are not part of domestic production.

Using the "Matrix Listing of Seller-Buyer Relationships," Figure 7 illustrates the complex tracing of the impacts of a price increase in water transportation. Row 1 shows the percentage of the domestic production of water transportation sold to (1) industrial sectors for use in their production and (2) to components of GNP including investment, consumption, exports minus imports, and government.

Any across-the-board increase in the price of water transportation will impact these buyers. Impacts on investment, government spending, personal consumption and exports minus imports will directly effect GNP, the price level, the volume of trade and other economy-wide variables.[1] Impacts on industrial buyers of water transportation will be passed to other buyers. To illustrate, row 2 traces the buyers of petroleum refining. It shows that 33 percent of refined petroleum products are sold to consumers. This figure suggests that over one-third of any price increase in petroleum refining will be experienced directly at the level of GNP. Important industrial buyers are fuel oil (22 percent), petroleum refining itself (10 percent), industrial chemicals (10 percent), grain (3 percent), and wholesale trades (3 percent). Any increase in the price of refined petroleum products that these industries buy will be passed, in turn, to their customers.

Row 3 illustrates some of these third-order impacts by showing the buyers of fuel oil. Forty-one percent of domestically produced fuel oil is bought by households for personal consumption. The important industrial buyers of fuel oil are electric utilities, railroads, and retail trades.[2] Any increase in the price of fuel oil will be passed, in turn, to their buyers. Row 4 illustrates these fourth-order impacts and shows the buyers of electric utilities. Thirty-four percent of electricity is sold to households; the major industrial buyer is retail trades. To illustrate fifth-order impacts, row 5 traces the buyers of the products of retail trades. At this level, almost all the impacts will be felt by final consumers (85 percent). This illustrates how an industrial price increase will filter through other industries, finally to the level of final demand.

Table 22 shows how the output of the crude petroleum industry is distributed. Analysis shows that the majority of crude petroleum sold in this country goes to the petroleum refining industry. Thus, the majority of the first-order impacts of an increase in the price of crude petroleum will be borne by petroleum refining. The price increase will be passed, in turn, to the buyers of

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1. Any increase in the price of exports will be borne by foreign industries and consumers.
2. Note water transportation buys 3 percent of the output of fuel oil. This illustrates the interrelationships of the economy.

Figure 7. IMPACT TRACING BASED ON SELLER—BUYER RELATIONSHIPS

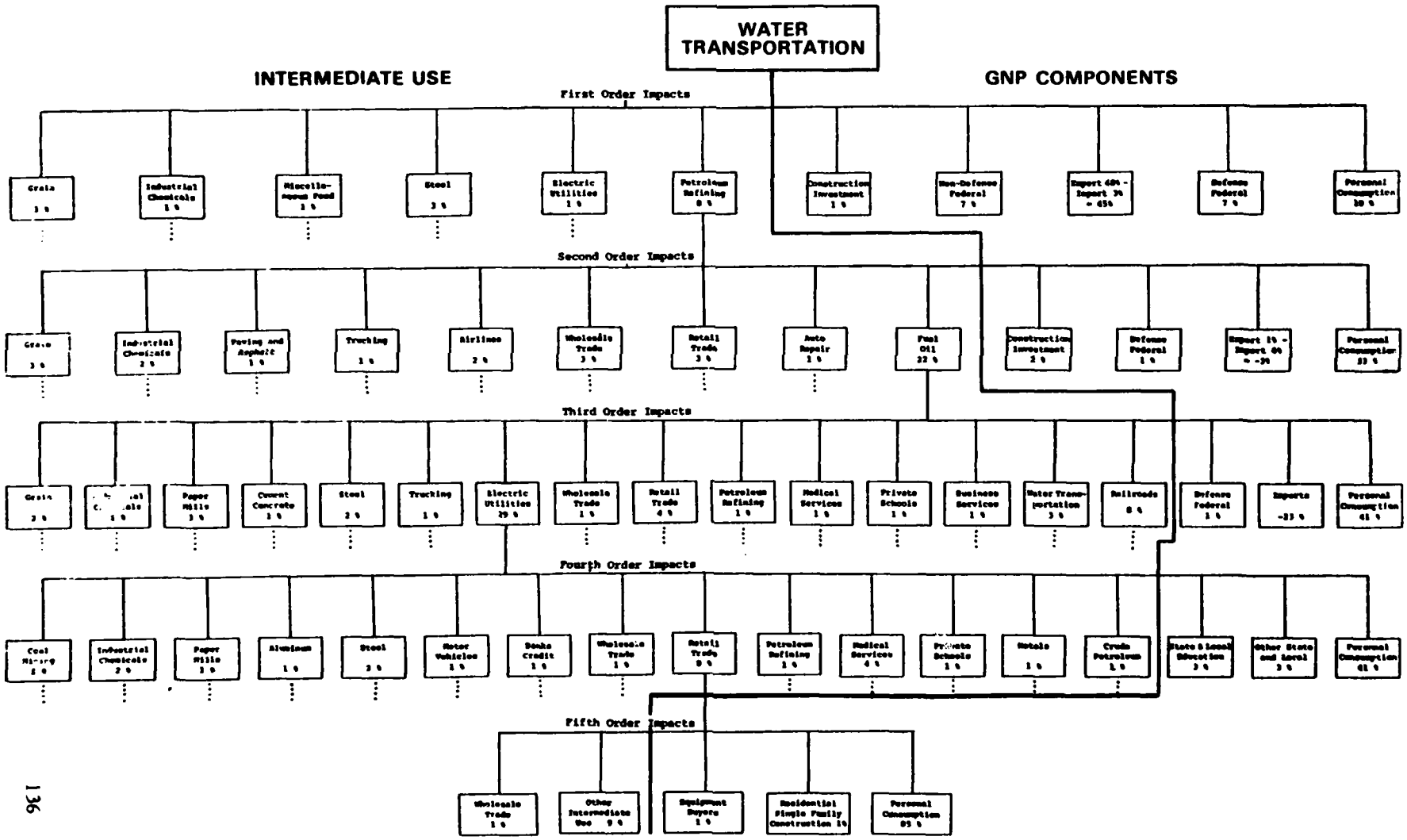

Table 22

OUTPUT OF SECTOR 15, CRUDE PETROLEUM, NATURAL GAS

Buyers	1978 (Millions $)		As percent of Total Output (Domestic)		As percent of Total United States Consumption **	
15 Crude Petroleum, Natural Gas	1603.4		4.01		2.27	
76 Petroleum Refining	57527.9		143.70*		81.30	
178 Natural Gas	10923.6		27.29		15.44	
Sales to Other Intermediate Users	214.0		.53		.30	
Sum of Sales to Intermediate Use		70268.9		175.53		99.31
210 Imports	-30725.7		-77.19		43.42	
Sales to Other Final Demand Categories	489.8		1.66			.69
Sum of Sales to Final Demand		-30235.9		-75.53	42.73	
Total Output (Domestic)		40033.0		100.00		100.00

Source: "Matrix Listing of Seller-Buyer Relationships," June 1978.

* Greater than 100 percent because Petroleum Refining buys more than the total domestic production of crude petroleum.

** Total United States Conumption of Crude Petroleum, Natural Gas equals Total Output (Domestic) + Imports = 70758.7.

refined petroleum products and on throughout the economy until it reaches the level of final demand. Note a large portion of crude petroleum bought in the U.S. is imported. Because petroleum refining buys a large quantity of imported petroleum, the impact of an increase in the price of domestically produced oil on refined petroleum products will be less if the price of foreign crude does not also increase as a result of the regulation.

Figure 7 can be used to illustrate the impacts of an increase in the price of crude petroleum as well as water transportation because row 2 traces the buyers of the petroleum refining industry, by far the largest buyer of crude petroleum.

C. Direction of Changes

The impacts of a price increase of less than 10 percent in the case of water transportation or 2.5 percent in the case of crude petroleum are not large enough to be measured using the INFORUM model. By analyzing the results of the lower limiting cases, though, the regulatory staff can trace the types and directions of expected changes in economy-wide and industry indicators resulting from smaller price increases. The purpose of this part of the manual is to describe the types of changes resulting from a 10 percent increase in the price of water transportation and a 2.5 percent increase in the price of crude petroleum. The direction of these changes will remain the same for smaller price increases.

Case 1: 10 percent increase in price of water transportation in 1978.

Format 10 presents the change from 1978 to 1985 in GNP, wholesale price index, unemployment rate and the trade balance. No structural functions have been adjusted, the changes are the result of the price increase only.

GNP. GNP or output decreases in every year due to the fact the prices of inputs have risen. The greatest decrease is in year 3 when GNP falls by $60 million. This amounts to only .0038 of a percent of base year GNP.

Wholesale Price Index (WPI). The WPI increases in every year reflecting the rise in the price of water transportation which is passd throughout the economy. The largest increase is in year 2 when the WPI rises by .028 percent.

Unemployment Rate. The unemployment rate shows virtually no change. This is because the water transportation industry is a relatively small segment of the economy. For larger price increases, the unemployment rate would be expected to rise as a result of input price increases which lower output and lead to employee layoffs.

Trade Balance. This indicator is composed of exports in current dollars minus imports in current dollars. A negative trade balance indicates the U.S. is

FORMAT 10

COMPARISON OF MAJOR MACOECONOMIC INDICATORS

FOR REGULATION VERSUS BASE

Regulation: PRICE WATER TRANSPORTATION INCREASES 10% IN 1978

YEAR

	0=1978	1	2	3	4	5	6	7	8	9	10
GNP (BILLIONS 1976 $)											
Base Projection	1398.26	1461.06	1523.58	1565.95	1609.29	1652.32	1696.06	1739.84			
With Regulation Costs	1398.25	1461.02	1523.53	1565.89	1609.23	1652.27	1696.01	1739.79			
Percent Difference *	-.0007%	-.0027%	-.0033%	-.0038%	-.0037%	-.003%	-.0029%	-.0029%			
WHOLESALE PRICE INDEX (1967 = 100)											
Base Projection	204.11	216.77	229.92	244.28	259.85	276.62	294.87	313.91			
With Regulation Costs	204.13	216.81	229.97	244.34	259.91	276.69	294.94	313.98			
Percent Difference *	.001%	.018%	.028%	.025%	.023%	.025%	.024%	.013%			
UNEMPLOYMENT RATE (PERCENT)											
Base Projection	5.67	5.80	5.76	5.25	5.09	5.03	5.02	5.05			
With Regulation Costs	5.67	5.80	5.76	5.26	5.09	5.03	5.02	5.05			
Difference	—	—	—	.01	—	—	—	—			
TRADE BALANCE—EXPORTS MINUS IMPORTS (BILLIONS 1976 $)											
Base Projection	-14.44	-18.69	-24.06	-21.72	-20.32	-21.08	-19.63	-17.37			
With Regulation Costs	-14.46	-18.71	-24.09	-21.76	-20.36	-21.13	-19.68	-17.42			
Percent Difference *	-.14%	-.16%	-.12%	-.18%	-.20%	-.24%	-.25%	-.29%			

$$* \text{ Percent Difference} = \frac{\text{(Projection with Regulation Costs - Base Projection)}}{\text{Base Projection}} \times 100.$$

importing more foreign goods and services than it is exporting U.S. goods and services. The price increase in water transportation worsens the U.S. trade balance in every year. This illustrates that as the price of U.S. water transportation increases, shippers switch from U.S. shipping companies to foreign shipping companies. In addition, as the increase in the price of water transportation filters through the economy leading to price increases in other U.S. goods and services, customers switch away from the relatively more expensive U.S. goods to foreign produced goods. The end result is an increase in imports and a decline in exports.

Format 11-A presents a detailed comparison of major industrial indicators for water transportation.

Product Shipments. The product shipments or output of the water transportation industry decline in every year. The average decrease is $34 million. Product shipments decline when the price of products of the water transportation industry increase and some customers switch to substitute products. In addition, as the price increase filters throughout the economy it causes contractions of other industries which, in turn, buy less water transportation.

Price Index. The wholesale price index for water transportation is approximately 10 percent higher in every year reflecting the constraints of the example.

Exports and Imports. The value of exports of U.S. water transportation decrease by $1 million in almost every year. The value of imports of water transportation increase an average of $27 million per year. This illustrates when the price of U.S. water transportation increases, consumers will switch from relatively more expensive U.S. water transportation to the relatively cheaper foreign water transportation.

Employment. INFORUM does not measure employment per individual industry but by aggregates of industries. Employment statistics for water transportation are found in Sector 82 entitled "Other Transportation." It includes the following industries: Water Transportation, Buses and Local Transit, Pipelines, and Freight Forwarding. The impact of a 10 percent price increase in water transportation on employment in these industries is to decrease employment an average of 1,125 jobs per year.

Format 11-B presents the impacts of a price increase in water transportation on the crude petroleum, natural gas industry. The price increase does not appreciably impact output, prices, and employment in the crude petroleum sector. It is interesting to note imports of crude petroleum decrease an average of $24 million per year. This is due to the fact transportation costs of imported oil have increased.

FORMAT 11-A

DETAILED COMPARISON OF INDUSTRIAL INDICATORS FOR REGULATION VERSUS BASE

SECTOR 170 — WATER TRANSPORTATION

Regulation: PRICE WATER TRANSPORTATION INCREASES 10% IN 1978

YEAR

	0=1978	1	2	3	4	5	6	7	8	9	10
PRODUCT SHIPMENTS (MILLIONS 1976 $)											
Base Projection	10348	10674	11055	11283	11526	11815	12091	12370			
With Regulation Costs	10312	10638	11020	11249	11493	11783	12059	12339			
PRICE INDEX (1967 = 100)											
Base Projection	225	240	255	272	290	309	330	351			
With Regulation Costs	246	263	279	298	318	339	362	385			
MERCHANDISE EXPORTS (MILLIONS 1976 $)											
Base Projection	4697	4878	5079	5199	5340	5516	5680	5845			
With Regulation Costs	4696	4877	5078	5199	5339	5515	5679	5844			
COMPETITIVE IMPORTS											
Base Projection	5239	5437	5657	5787	5939	6132	6310	6491			
With Regulation Costs	5269	5465	5684	5814	5965	6157	6335	6515			
* EMPLOYMENT IN INDUSTRY (THOUSANDS OF JOBS)											
Base Projection	668	668	669	665	659	653	647	641			
With Regulation Costs	668	667	667	663	658	652	646	640			

* From 90 Order Sector 82 "Other Transportation."

FORMAT 11-B

DETAILED COMPARISON OF INDUSTRIAL INDICATORS FOR REGULATION VERSUS BASE

SECTOR 15 — CRUDE PETROLEUM

Regulation: PRICE WATER TRANSPORTATION INCREASES 10% IN 1978

YEAR

	0=1978	1	2	3	4	5	6	7	8	9	10
PRODUCT SHIPMENTS (MILLIONS 1976 $)											
Base Projection	40033	39536	39381	39381	39753	38701	38650	38510			
With Regulation Costs		—	NO	CHANGE			—				
PRICE INDEX (1967 = 100)											
Base Projection	302	334	369	399	423	450	482	519			
With Regulation Costs		—	NO	CHANGE			—				
MERCHANDISE EXPORTS (MILLIONS 1976 $)											
Base Projection	148	159	166	174	181	189	197	205			
With Regulation Costs		—	NO	CHANGE			—				
COMPETITIVE IMPORTS											
Base Projection	31259	33731	35856	37432	38410	40835	42258	43698			
With Regulation Costs	31238	33708	35831	37407	38386	40810	42232	43672			
* EMPLOYMENT IN INDUSTRY (THOUSANDS OF JOBS)											
Base Projection	361	370	380	380	380	380	380	380			
With Regulation Costs		—	NO	CHANGE			—				

* From 90 Order Sector 3 "Petroleum and Gas."

Formats 12-A, 12-B, and 12-C present the impacts of the water transportation price increase on prices, product shipments and employment in other industries selected because of their close connection as buyers of or sellers to the water transportation or crude petroleum industry.

Price Comparisons. The impact of the price increase in water transportation on other industries is minimal. There are slight price increases in fishing products, miscellaneous food products, industrial chemicals, petroleum refining, fuel oil, paving and asphalt, steel, ship and boatbuilding, railroad equipment and airlines. The largest increase (average of 5 points from year 2 through 7) occurs in the wholesale trades industry.

Product Shipment Comparisons. The effects of the price increase on product shipments of other industries is more widespread. Almost all the industries show a decline in output.

Employment Comparisons. The impact of the price increase on employment in other industries is minimal. Iron and steel, trucking wholesale and retail trades, and finances and services experience scattered decreases of one to two thousand jobs a year.

FORMAT 12-A

PRICE COMPARISONS — SELECTED INDUSTRIES

Regulation: PRICE WATER TRANSPORTATION INCREASES 10% in 1978

SECTORS	PRICE INDICES (1967 = 100)	0-1978	1	2	3	4	5	6	7	8	9	10
		YEAR										
5 GRAINS	Base Projections	195	219	233	249	266	284	304	326			
	With Regulation Costs				NO	CHANGE						
9 FISHING PRODUCTS	Base Projections	293	315	337	361	338	417	449	483			
	With Regulation Costs	—	—	—	+1	—	+1	—	—			
15 CRUDE PETROLEUM	Base Projections	302	334	369	399	423	450	482	519			
	With Regulation Costs				NO	CHANGE						
34 MISCELLANEOUS FOOD PRODUCTS	Base Projections	232	245	260	276	294	314	335	358			
	With Regulation Costs	—	—	—	—	—	—	+1	—			
64 INDUSTRIAL CHEMICALS	Base Projections	219	228	239	252	265	280	296	314			
	With Regulation Costs	—	—	—	—	—	—	+1	—			
76 PETROLEUM REFINING	Base Projections	296	319	342	365	388	409	433	460			
	With Regulation Costs	—	—	—	+1	—	—	—	—			
77 FUEL OIL	Base Projections	449	485	519	555	590	622	658	699			
	With Regulation Costs	+1	—	—	—	—	—	—	—			
78 PAVING AND ASPHALT	Base Projections	292	311	331	352	375	399	426	453			
	With Regulation Costs	—	—	—	—	—	+1	—	+1			
91 STEEL	Base Projections	255	265	280	300	320	341	365	391			
	With Regulation Costs	—	—	—	—	—	+1	+1	—			
167 SHIP AND BOAT	Base Projections	224	240	254	268	284	303	322	342			
	With Regulation Costs	—	—	—	—	+1	—	—	+1			
168 RAILROAD EQUIPMENT	Base Projections	242	255	270	286	304	323	343	364			
	With Regulation Costs	—	—	—	+1	—	—	—	—			
169 TRUCKING	Base Projections	223	229	241	257	269	281	295	309			
	With Regulation Costs				NO	CHANGE						
170 WATER TRANSPORTATION	Base Projections	225	240	255	272	290	309	330	351			
	With Regulation Costs	+21	+23	+24	+26	+28	+30	+32	+34			
171 AIRLINES	Base Projections	194	207	219	233	248	263	281	299			
	With Regulation Costs	—	—	—	—	—	+1	—	—			
172 FREIGHT FORWARDING	Base Projections	227	239	252	266	281	297	315	333			
	With Regulation Costs				NO	CHANGE						
176 ELECTRIC UTILITIES	Base Projections	263	279	293	309	328	348	371	394			
	With Regulation Costs				NO	CHANGE						
180 WHOLESALE TRADES	Base Projections	185	195	202	214	226	239	254	269			
	With Regulation Costs	—	—	+2	+3	+4	+5	+7	+9			
181 RETAIL TRADES	Base Projections	187	195	204	217	230	245	261	278			
	With Regulation Costs				NO	CHANGE						
187 AUTO REPAIR	Base Projections	214	225	240	257	276	297	320	343			
	With Regulation Costs				NO	CHANGE						
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											

FORMAT 12-B

PRODUCT SHIPMENTS — SELECTED INDUSTRIES

Regulation: PRICE WATER TRANSPORTATION INCREASES 10% IN 1978

SECTORS	PRODUCT SHIPMENTS (MILLIONS 1976 $)	YEAR 0 1978	1	2	3	4	5	6	7	8	9	10
5 GRAINS	Base Projections	39966	40991	42221	43441	44601	45762	46953	48164			
	With Regulation Costs	+1	+1	+2	+1	+1	+1	+2	+1			
9 FISHING PRODUCTS	Base Projections	1002	1043	1086	1124	1158	1189	1219	1249			
	With Regulation Costs	—	—	—	-1	-1	0	-1	-3			
15 CRUDE PETROLEUM	Base Projections	40033	39536	39381	39381	39753	38701	38650	38510			
	With Regulation Costs				NO	CHANGE						
34 MISCELLANEOUS FOOD PRODUCTS	Base Projections	11772	12387	12955	13470	13824	14130	14452	14782			
	With Regulation Costs	-1	-2	-2	-2	-2	-1	-2	-1			
64 INDUSTRIAL CHEMICALS	Base Projections	47391	49630	52274	54203	56214	58322	60474	62659			
	With Regulation Costs	-3	-5	-6	-7	-7	-7	-7	-7			
76 PETROLEUM REFINING	Base Projections	96223	99026	102036	104804	107133	109606	112038	114375			
	With Regulation Costs	-36	-39	-40	-40	-41	-41	-43	-44			
77 FUEL OIL	Base Projections	21050	21358	21700	22054	22391	22742	23067	23355			
	With Regulation Costs	-7	-8	-8	-8	-8	-7	-7	-8			
78 PAVING AND ASPHALT	Base Projections	3401	3661	3916	4100	4277	4456	4634	4812			
	With Regulation Costs				NO	CHANGE						
91 STEEL	Base Projections	61856	64536	66814	67589	68546	69501	70386	71143			
	With Regulation Costs	-7	-15	-20	-22	-20	-19	-18	-17			
150 SHIP AND BOAT	Base Projections	7879	8493	9076	9319	9640	9983	10172	10180			
	With Regulation Costs	-3	-4	-4	-4	-4	-4	-4	-4			
151 RAILROAD EQUIPMENT	Base Projections	4381	4859	5035	4997	4993	5009	5010	5064			
	With Regulation Costs	-1	-1	-1	-1	-1	—	-1	—			
169 TRUCKING	Base Projections	48827	52134	55371	57849	60411	63031	65700	68404			
	With Regulation Costs	-3	-4	-5	-6	-6	-6	-6	-5			
170 WATER TRANSPORTATION	Base Projections	10348	10674	11055	11283	11526	11815	12091	12370			
	With Regulation Costs	-36	-36	-35	-34	-33	-32	-32	-31			
171 AIRLINES	Base Projections	23325	24573	25936	26992	28054	29140	30247	31372			
	With Regulation Costs	-2	-4	-5	-5	-5	-5	-5	-5			
173 FREIGHT FORWARDING	Base Projections	1754	1835	1921	1982	2043	2106	2171	2237			
	With Regulation Costs	-1	-1	-2	-2	-1	-1	-1	-1			
176 ELECTRIC UTILITIES	Base Projections	69464	72603	75944	78830	81299	83794	86313	88840			
	With Regulation Costs	-1	-2	-3	-3	-3	-3	-2	-2			
180 WHOLESALE TRADES	Base Projections	171059	180130	189411	196276	203165	210194	217320	224473			
	With Regulation Costs	-9	-14	-18	-20	-20	-19	-19	-17			
181 RETAIL TRADES	Base Projections	239953	250990	262464	269448	277114	284788	292610	300602			
	With Regulation Costs	-1	-4	-5	-4	-4	-3	-3	-2			
190 AUTO REPAIR	Base Projections	38107	40267	42291	44112	45589	47120	48690	50283			
	With Regulation Costs	—	-1	-1	-1	-1	-1	--	--			
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											

FORMAT 12-C

EMPLOYMENT COMPARISONS — SELECTED INDUSTRIES

PRICE WATER TRANSPORTATION INCREASES 10% IN 1978

SECTORS (90 ORDER)	EMPLOYMENT (THOUSANDS OF JOBS)	YEAR 0 1978	1	2	3	4	5	6	7	8	9	10
1 AGRICULTURE	Base Projections	3266	3160	3075	2991	2906	2821	2739	2659			
	With Regulation Costs	+1	+1	—	+1	—	—	—	—			
3 PETROLEUM AND GAS	Base Projections	361	370	380	380	380	380	380	380			
	With Regulation Costs				NO	CHANGE						
14 MISCELLANEOUS FOOD PRODUCTS	Base Projections	143	145	147	149	150	151	152	153			
	With Regulation Costs				NO	CHANGE						
31 INDUSTRIAL CHEMICALS	Base Projections	349	352	357	362	366	370	375	381			
	With Regulation Costs				NO	CHANGE						
38 PETROLEUM REFINING	Base Projections	205	207	209	212	214	215	217	219			
	With Regulation Costs				NO	CHANGE						
46 IRON AND STEEL	Base Projections	870	898	922	932	937	940	943	945			
	With Regulation Costs	—	—	—	—	-1	—	—	—			
72 SHIPS AND BOATS	Base Projections	208	215	221	220	219	219	215	207			
	With Regulation Costs				NO	CHANGE						
73 RAILROAD EQUIPMENT	Base Projections	47	50	51	50	48	47	46	45			
	With Regulation Costs				NO	CHANGE						
81 TRUCKING	Base Projections	1389	1440	1484	1509	1526	1540	1551	1561			
	With Regulation Costs	—	—	—	—	—	-1	—	—			
82 OTHER TRANSPORTATION	Base Projections	668	668	669	665	659	653	647	641			
	With Regulation Costs	—	-1	-2	-2	-1	-1	-1	-1			
83 AIRLINES	Base Projections	392	401	409	414	417	419	420	422			
	With Regulation Costs				NO	CHANGE						
87 ELECTRIC UTILIES	Base Projections	510	512	516	521	524	526	529	531			
	With Regulation Costs				NO	CHANGE						
84 WHOLESALE AND RETAIL TRADES	Base Projections	20240	20727	21235	21627	21909	22162	22388	22594			
	With Regulation Costs	—	-1	-1	-1	—	-1	-1	-1			
86 FINANCE AND SERVICES	Base Projections	22951	23894	24907	25897	26775	27625	28428	29228			
	With Regulation Costs	—	—	-1	-1	—	-1	-1	-1			
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											

Case 2: 2.5 percent increase in price of crude petroleum in 1978.

Format 10 presents the changes from 1978-1985 in GNP, wholesale price index, unemployment rate and the trade balance. No structural forecasts have been adjusted; the changes are the result of the 2.5 percent increase in crude petroleum only.

GNP. GNP decreases in every year. The greatest decrease is in year 4 when GNP falls by $440 million which is a .027 percent decrease in GNP.

Wholesale Price Index (WPI). The WPI increases in every year illustrating that the rise in the price of crude petroleum is passed throughout the economy. In years 4 through 7 the WPI with regulation costs represents a .32 percent increase over the base WPI projection.

Unemployment Rate. The rate of unemployment increases by approximately .02 in every year from year 1 through year 7. The crude petroleum industry is a relatively important industry in the economy. As its price increase leads to increased prices in other industries, output throughout the economy falls leading to layoffs.

Trade Balance. The price increase in crude petroleum leads to a more favorable balance of trade in the early years but worsens the trade balance after year 3 until the negative trade balance has increased 1 percent by year 7.

Format 11-A presents detailed impacts of the increase in the price of crude petroleum on water transportation.

Product Shipments. Product shipments fall in each year because water transportation buys refined petroleum products and fuel oil whose prices have risen due to the increase in the price of crude. The increase in the price of its inputs leads to a decrease in the output of water transportation.

Price Index. The wholesale price index for water transportation rises in every year after year 3. This, too, reflects the fact that the prices of its inputs have increased.

Exports and Imports. The increased price of crude petroleum causes both exports and imports of water transportation to decline.

Employment. Employment in "Other Transportation" declines by 1,000 jobs per year after year 2 as a result of the contraction of the water transportation industry.

FORMAT 10

COMPARISON OF MAJOR MACOECONOMIC INDICATORS

FOR REGULATION VERSUS BASE

Regulation: PRICE CRUDE OIL INCREASES 2.5% IN 1978

YEAR

	0=1978	1	2	3	4	5	6	7	8	9	10
GNP (BILLIONS 1976 $)											
Base Projection	1398.26	1461.06	1523.58	1565.95	1609.29	1652.32	1696.06	1739.84			
With Regulation Costs	1398.23	1460.85	1523.25	1565.54	1608.85	1651.89	1695.64	1739.43			
Percent Difference *	-.0021%	-.014%	-.022%	-.026%	-.027%	-.026%	-.025%	-.024%			
WHOLESALE PRICE INDEX (1967 = 100)											
Base Projection	204.11	216.77	229.92	244.28	259.85	276.62	294.87	313.91			
With Regulation Costs	204.38	217.29	230.58	245.03	260.68	277.51	295.82	314.92			
Percent Difference *	+.13%	+.24%	+.29%	+.31%	+.32%	+.32%	+.32%	+.32%			
UNEMPLOYMENT RATE (PERCENT)											
Base Projection	5.67	5.80	5.76	5.25	5.09	5.03	5.02	5.05			
With Regulation Costs	5.67	5.81	5.78	5.27	5.11	5.05	5.04	5.07			
Difference	–	+.01	+.02	+.02	+.02	+.02	+.02	+.02			
TRADE BALANCE—EXPORTS MINUS IMPORTS (BILLIONS 1976 $)											
Base Projection	-14.44	-18.69	-24.06	-21.72	-20.32	-21.08	-19.63	-17.37			
With Regulation Costs	-14.34	-18.62	-24.05	-21.76	-20.39	-21.20	-19.78	-17.54			
Percent Difference *	+.7%	+.4%	+.04%	-.2%	-.3%	-.6%	-.8%	-1.0%			

$$* \text{ Percent Difference} = \frac{\text{(Projection with Regulation Costs - Base Projection)}}{\text{Base Projection}} \times 100.$$

FORMAT 11-A

DETAILED COMPARISON OF INDUSTRIAL INDICATORS FOR REGULATION VERSUS BASE

SECTOR 170 — WATER TRANSPORTATION

Regulation: PRICE CRUDE OIL INCREASES 2.5% IN 1978

YEAR

	0=1978	1	2	3	4	5	6	7	8	9	10
PRODUCT SHIPMENTS (MILLIONS 1976 $)											
Base Projection	10348	10674	11055	11283	11526	11815	12091	12370			
With Regulation Costs	10342	10664	11043	11271	11513	11802	12078	12356			
PRICE INDEX (1967 = 100)											
Base Projection	225	240	255	272	290	309	330	351			
With Regulation Costs	225	240	255	273	291	310	331	352			
MERCHANDISE EXPORTS (MILLIONS 1976 $)											
Base Projection	4697	4878	5079	5199	5340	5516	5680	5845			
With Regulation Costs	4695	4874	5075	5195	5335	5511	5675	5840			
COMPETITIVE IMPORTS											
Base Projection	5239	5437	5657	5787	5939	6132	6310	6491			
With Regulation Costs	5237	5433	5653	5782	5934	6127	6305	6486			
* EMPLOYMENT IN INDUSTRY (THOUSANDS OF JOBS)											
Base Projection	668	668	669	665	659	653	647	641			
With Regulation Costs	668	668	668	664	658	652	646	640			

* From 90 Order Sector 82 "Other Transportation."

Format 11-B present the impact of the increase in the price of crude petroleum on the industry itself.

Product Shipments. Product shipments of the industry are constrained to show no change by assumption of the INFORUM model. The rationale is because of the unstable situation regarding oil imports, domestic production will not be effected by a price increase in domestic crude.

Price Index. The wholesale price index for crude petroleum is approximately 2.5 percent higher in each year reflecting the constraints of the example.

Exports and Imports. Exports of crude petroleum which are very small are not impacted by the price increase. Imports, on the other hand, fall by an average of $140 million per year.

Employment. Employment in the industry is unaffected because product shipments or output are constrained to their base level; no industry contraction can occur.

Formats 12-A, 12-B, and 12-C present the impacts of the crude petroleum price increase on prices, product shipments and employment in other industries.

Price Comparisons. The increased price of crude results in scattered price increases in the majority of industries selected. Consistent and significant price increases occur in industrial chemicals, petroleum refining, fuel oil, and paving and asphalt.

Product Shipment Comparisons. The crude price increase causes widespread contractions in the output of other industries. Industrial chemicals, petroleum refining, fuel oil, steel, trucking, electric utilities and wholesale trades are particularly impacted.

Employment Comparisons. The effect of the crude price increase on employment in other industries is scattered. The wholesale and retail trades sectors experience the largest decline in employment.

FORMAT 11-B

DETAILED COMPARISON OF INDUSTRIAL INDICATORS FOR REGULATION VERSUS BASE

SECTOR 15 — CRUDE PETROLEUM

Regulation: PRICE CRUDE OIL INCREASES 2.5% IN 1978

	YEAR										
	0= 1978	1	2	3	4	5	6	7	8	9	10
PRODUCT SHIPMENTS (MILLIONS 1976 $)											
Base Projection	40033	39536	39381	39381	39753	38701	38650	38510			
With Regulation Costs	SAME										
PRICE INDEX (1967 = 100)											
Base Projection	302	334	369	399	423	450	482	519			
With Regulation Costs	310	342	379	409	433	461	494	532			
MERCHANDISE EXPORTS (MILLIONS 1976 $)											
Base Projection	148	159	166	174	181	189	197	205			
With Regulation Costs	SAME										
COMPETITIVE IMPORTS											
Base Projection	31259	33731	35856	37432	38410	40835	42258	43698			
With Regulation Costs	31167	33598	35715	37287	38263	40685	42104	43540			
* EMPLOYMENT IN INDUSTRY (THOUSANDS OF JOBS)											
Base Projection	361	370	380	380	380	380	380	380			
With Regulation Costs	SAME										

* From 90 Order Sector 3 "Petroleum and Gas."

FORMAT 12-A

PRICE COMPARISONS — SELECTED INDUSTRIES

Regulation: PRICE CRUDE OIL INCREASES 2.5% IN 1978

SECTORS	PRICE INDICES (1967 = 100)	YEAR 0 1978	1	2	3	4	5	6	7	8	9	10
5 GRAINS	Base Projections	195	219	233	249	266	284	304	326			
	With Regulation Costs	—	—	—	—	—	+1	+1	—			
9 FISHING PRODUCTS	Base Projections	293	315	337	361	388	417	449	483			
	With Regulation Costs	—	—	+1	+2	+2	+2	+2	+2			
15 CRUDE PETROLEUM	Base Projections	302	334	369	399	423	450	482	519			
	With Regulation Costs	+8	+8	+10	+10	+10	+11	+12	+13			
34 MISCELLANEOUS FOOD PRODUCTS	Base Projections	232	245	260	276	294	314	335	358			
	With Regulation Costs	—	—	—	+1	+1	+1	+1	—			
64 INDUSTRIAL CHEMICALS	Base Projections	219	228	239	252	265	280	296	314			
	With Regulation Costs	+1	+2	+2	+2	+2	+2	+3	+3			
76 PETROLEUM REFINING	Base Projections	296	319	342	365	388	409	433	460			
	With Regulation Costs	+4	+5	+5	+6	+6	+7	+7	+8			
77 FUEL OIL	Base Projections	449	485	519	555	590	622	658	699			
	With Regulation Costs	+6	+7	+9	+9	+9	+10	+10	+11			
78 PAVING AND ASPHALT	Base Projections	292	311	331	352	375	399	426	453			
	With Regulation Costs	+1	+1	+2	+2	+2	+3	+2	+3			
91 STEEL	Base Projections	255	265	280	300	320	341	365	391			
	With Regulation Costs	—	+1	—	+1	+1	+1	+1	—			
150 SHIP AND BOAT	Base Projections	224	240	254	268	284	303	322	342			
	With Regulation Costs	—	+1	—	—	+1	—	+1	+1			
151 RAILROAD EQUIPMENT	Base Projections	242	255	270	286	304	323	343	364			
	With Regulation Costs	—	—	—	+1	—	—	—	+1			
169 TRUCKING	Base Projections	223	229	241	257	269	281	295	309			
	With Regulation Costs	—	—	—	+1	+1	+1	—	—			
170 WATER TRANSPORTATION	Base Projections	225	240	255	272	290	309	330	351			
	With Regulation Costs	—	—	—	+1	+1	+1	+1	+1			
171 AIRLINES	Base Projections	194	207	219	233	248	263	281	299			
	With Regulation Costs	—	—	+1	—	—	+1	+1	+1			
173 FREIGHT FORWARDING	Base Projections	227	239	252	266	281	297	315	333			
	With Regulation Costs	—	—	—	—	—	+1	+1	+1			
176 ELECTRIC UTILITIES	Base Projections	263	279	293	309	328	348	371	394			
	With Regulation Costs	+1	—	—	+1	+1	+1	+1	+1			
180 WHOLESALE TRADES	Base Projections	185	195	202	214	226	239	254	269			
	With Regulation Costs	—	—	+1	—	—	+1	+1	—			
181 RETAIL TRADES	Base Projections	187	195	204	217	230	245	261	278			
	With Regulation Costs	—	—	—	—	—	+1	+1	—			
190 AUTO REPAIR	Base Projections	214	225	240	257	276	297	320	343			
	With Regulation Costs	—	+1	—	—	+1	+1	—	—			
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											

FORMAT 12-B

PRODUCT SHIPMENTS — SELECTED INDUSTRIES

Regulation: PRICE CRUDE OIL INCREASES 2.5% IN 1978

SECTORS	PRODUCT SHIPMENTS (MILLIONS 1976 $)	YEAR 0 1978	1	2	3	4	5	6	7	8	9	10
5 GRAINS	Base Projections	39966	40991	42221	43441	44601	45762	46953	48164			
	With Regulation Costs	+3	+1	-1	-3	-3	-4	-3	-3			
9 FISHING PRODUCTS	Base Projections	1002	1043	1086	1124	1158	1189	1219	1249			
	With Regulation Costs	—	-1	-1	-2	-2	-2	-2	-4			
15 CRUDE PETROLEUM	Base Projections	40033	39536	39381	39381	39753	38701	38650	38510			
	With Regulation Costs				NO	CHANGE						
34 MISCELLANEOUS FOOD PRODUCTS	Base Projections	11772	12387	12955	13470	13824	14130	14452	14786			
	With Regulation Costs	+1	—	-1	-2	-1	-1	-1	-1			
64 INDUSTRIAL CHEMICALS	Base Projections	47391	49630	52274	54203	56214	58322	60474	62659			
	With Regulation Costs	-71	-115	-132	-145	-154	-162	-169	-177			
76 PETROLEUM REFINING	Base Projections	96223	99026	102036	104804	107133	109606	112038	114375			
	With Regulation Costs	-152	-219	-229	-234	-240	-245	-251	-259			
77 FUEL OIL	Base Projections	21050	21358	21700	22054	22391	22742	23067	23355			
	With Regulation Costs	-32	-46	-47	-47	-47	-47	-47	-48			
78 PAVING AND ASPHALT	Base Projections	3400	3661	3916	4100	4277	4456	4634	4812			
	With Regulation Costs	-1	-1	-1	-1	-1	-1	-1	-1			
91 STEEL	Base Projections	61856	64536	66814	67589	68546	69501	70386	71143			
	With Regulation Costs	-10	-51	-93	-103	-102	-99	-98	-93			
150 SHIP AND BOAT	Base Projections	7879	8493	9076	9319	9640	9983	10172	10180			
	With Regulation Costs	—	-2	-3	-4	-5	-5	-5	-5			
151 RAILROAD EQUIPMENT	Base Projections	4381	4859	5035	4997	4993	5009	5010	5064			
	With Regulation Costs	-1	-5	-7	-7	-6	-4	-4	-3			
169 TRUCKING	Base Projections	48827	52134	55371	57849	60411	62031	65700	68404			
	With Regulation Costs	-6	-19	-27	-32	-34	-34	-35	-34			
170 WATER TRANSPORTATION	Base Projections	10348	10674	11055	11283	11526	11815	12091	12370			
	With Regulation Costs	-6	-10	-12	-12	-13	-13	-13	-14			
171 AIRLINES	Base Projections	23325	24513	25936	26992	28059	29140	30247	31372			
	With Regulation Costs	+1	-7	-12	-15	-16	-17	-17	-17			
173 FREIGHT FORWARDING	Base Projections	1754	1835	1921	1982	2043	2106	2171	2237			
	With Regulation Costs	—	—	-1	-1	-1	-1	-1	-1			
176 ELECTRIC UTILITIES	Base Projections	69464	72603	75944	78830	81299	83794	86313	88840			
	With Regulation Costs	-7	-22	-29	-32	-33	-33	-33	-32			
180 WHOLESALE TRADES	Base Projections	171059	180130	189411	196276	203165	210194	217320	224423			
	With Regulation Costs	-32	-85	-112	-129	-135	-134	-135	-139			
181 RETAIL TRADES	Base Projections	239951	250990	262464	269448	277114	284788	292610	300602			
	With Regulation Costs	+6	-14	-17	-17	-12	-9	-6	-2			
190 AUTO REPAIR	Base Projections	38107	40267	42291	44112	45589	47120	48690	50283			
	With Regulation Costs	-5	-13	-15	-15	-15	-14	-13	-12			
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											

FORMAT 12-C

EMPLOYMENT COMPARISONS — SELECTED INDUSTRIES

PRICE CRUDE OIL INCREASES 2.5% IN 1978

SECTORS (90 ORDER)	EMPLOYMENT (THOUSANDS OF JOBS)	YEAR 0 1978	1	2	3	4	5	6	7	8	9	10
1 AGRICULTURE	Base Projections	3266	3160	3075	2991	2906	2821	2739	2659			
	With Regulation Costs	+1	—	-1	—	—	—	-1	—			
3 PETROLEUM AND GAS	Base Projections	361	370	380	380	380	380	380	380			
	With Regulation Costs				NO	CHANGE						
14 MISCELLANEOUS FOOD PRODUCTS	Base Projections	143	145	147	149	150	151	152	153			
	With Regulation Costs				NO	CHANGE						
31 INDUSTRIAL CHEMICALS	Base Projections	349	352	357	362	366	370	375	381			
	With Regulation Costs	—	—	-1	-1	-1	-1	-1	-1			
38 PETROLEUM REFINING	Base Projections	205	207	209	212	214	215	217	219			
	With Regulation Costs	—	—	—	—	-1	—	—	—			
46 IRON AND STEEL	Base Projections	870	898	922	932	937	940	943	945			
	With Regulation Costs	-1	-1	-1	-1	-2	-1	-1	-1			
72 SHIPS AND BOATS	Base Projections	208	215	221	220	219	219	215	207			
	With Regulation Costs	—	—	—	—	—	+1	—	—			
73 RAILROAD EQUIPMENT	Base Projections	47	50	51	50	48	47	46	45			
	With Regulation Costs				NO	CHANGE						
81 TRUCKING	Base Projections	1389	1440	1484	1509	1526	1540	1551	1561			
	With Regulation Costs	—	—	—	-1	-1	-1	-1	-1			
82 OTHER TRANSPORTATION	Base Projections	668	668	669	665	659	653	647	641			
	With Regulation Costs	—	—	-1	-1	-1	-1	-1	-1			
83 AIRLINES	Base Projections	392	401	409	414	417	419	420	422			
	With Regulation Costs	—	—	—	—	—	-1	—	—			
87 ELECTRIC UTILIES	Base Projections	510	512	516	521	524	526	529	531			
	With Regulation Costs				NO	CHANGE						
84 WHOLESALE AND RETAIL TRADES	Base Projections	20240	20727	21235	21627	21909	22162	22388	22599			
	With Regulation Costs	-1	-2	-4	-4	-4	-4	-4	-4			
86 FINANCE AND SERVICES	Base Projections	22951	23894	24907	25897	26795	27625	28428	29228			
	With Regulation Costs	+1	+1	+2	+2	+1	+1	+2	+1			
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											

Finally, INFORUM has the capability to determine and print out the effect on the consumer price index for gasoline of an increase in the price of crude petroleum. Using the INFORUM model for a 2.5 percent increase in the price of crude, the following results were obtained:

1985 Consumer Price Index - Gasoline
(1976 = 1.00)

Base Run	1.773
With 2.5 Percent Increase in Price of Crude	1.809

By multiplying each index by the 1976 average price for a gallon of gasoline, the regulatory staff can obtain the increase in 1985 in the per gallon price of gasoline at the pump in 1976 dollars. For example, if the average price of gasoline in 1976 is $.60 per gallon, base price of gasoline in 1985 is forecast to be $1.06 per gallon (1.773 x $.60). The price, given a 2.5 percent increase in the price of crude, is forecasted to be $1.09 per gallon (1.809 x $.60). The effect of a 2.5 percent increase in the price of crude in 1978 is to raise the price of gasoline at the pump in 1985 by $.03 in 1976 dollars.

A blank set of cost impact formats is provided at the end of this section for the convenience of the regulatory staff.

BLANK FORMATS

PRECEDING PAGE BLANK-NOT FILMED

FORMAT 8

DIRECT INDUSTRY COSTS

(Deflated)

($ Millions)

Regulation:

Year	Total Industry Costs From Column 10, Format 4 (1)	$WPI_{1976} \div WPI_{Year\ Zero}$ (2)	Deflated Industry Costs (1976 $) (3) = (1) x (2)
0=____			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

FORMAT 9-A

ANNUAL PERCENTAGE PRICE INCREASE

SECTOR 170 — WATER TRANSPORTATION

($ Millions)

Regulation:

Year	Deflated Industry Costs from Column 3, Format 8 (1)	Product Shipments, Sector 170 (2)	Annual Percentage Price Increase (3) = [(1) ÷ (2)] X 100
0=____			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

FORMAT 9-B

ANNUAL PERCENTAGE PRICE INCREASE

SECTOR 15 — CRUDE PETROLEUM (ADJUSTED)

($ Millions)

Regulation:

Year	Deflated Industry Costs from Column 3, Format 8 (1)	Product Shipments, Sector 15 (2)	Annual Percentage Price Increase (3) = [(1) ÷ (2)] x 100
0=___			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

FORMAT 10

COMPARISON OF MAJOR MACOECONOMIC INDICATORS
FOR REGULATION VERSUS BASE

Regulation:

	YEAR										
	0=___	1	2	3	4	5	6	7	8	9	10
GNP (BILLIONS 1976 $) Base Projection											
With Regulation Costs											
Percent Difference *											
WHOLESALE PRICE INDEX (1967 = 100) Base Projection											
With Regulation Costs											
Percent Difference *											
UNEMPLOYMENT RATE (PERCENT) Base Projection											
With Regulation Costs											
Difference											
TRADE BALANCE—EXPORTS MINUS IMPORTS (BILLIONS 1976 $) Base Projection											
With Regulation Costs											
Percent Difference *											

$$* \quad \text{Percent Difference} = \frac{(\text{Projection with Regulation Costs} - \text{Base Projection})}{\text{Base Projection}} \times 100.$$

FORMAT 11-A

DETAILED COMPARISON OF INDUSTRIAL INDICATORS FOR REGULATION VERSUS BASE

SECTOR 170 — WATER TRANSPORTATION

Regulation:

	YEAR										
	0=___	1	2	3	4	5	6	7	8	9	10
PRODUCT SHIPMENTS (MILLIONS 1976 $) Base Projection											
With Regulation Costs											
PRICE INDEX (1967 = 100) Base Projection											
With Regulation Costs											
MERCHANDISE EXPORTS (MILLIONS 1976 $) Base Projection											
With Regulation Costs											
COMPETITIVE IMPORTS Base Projection											
With Regulation Costs											
* EMPLOYMENT IN INDUSTRY (THOUSANDS OF JOBS) Base Projection											
With Regulation Costs											

* From 90 Order Sector 82 "Other Transportation."

FORMAT 11-B

DETAILED COMPARISON OF INDUSTRIAL INDICATORS FOR REGULATION VERSUS BASE

SECTOR 15 — CRUDE PETROLEUM

Regulation:

	YEAR										
	0=___	1	2	3	4	5	6	7	8	9	10
PRODUCT SHIPMENTS (MILLIONS 1976 $) Base Projection											
With Regulation Costs											
PRICE INDEX (1967 = 100) Base Projection											
With Regulation Costs											
MERCHANDISE EXPORTS (MILLIONS 1976 $) Base Projection											
With Regulation Costs											
COMPETITIVE IMPORTS Base Projection											
With Regulation Costs											
* EMPLOYMENT IN INDUSTRY (THOUSANDS OF JOBS) Base Projection											
With Regulation Costs											

* From 90 Order Sector 3 "Petroleum and Gas."

FORMAT 12-A

PRICE COMPARISONS — SELECTED INDUSTRIES

Regulation:

SECTORS	PRICE INDICES (1967 = 100)	YEAR 0= ___	1	2	3	4	5	6	7	8	9	10
5 GRAINS	Base Projections											
	With Regulation Costs											
9 FISHING PRODUCTS	Base Projections											
	With Regulation Costs											
15 CRUDE PETROLEUM	Base Projections											
	With Regulation Costs											
34 MISCELLANEOUS FOOD PRODUCTS	Base Projections											
	With Regulation Costs											
64 INDUSTRIAL CHEMICALS	Base Projections											
	With Regulation Costs											
76 PETROLEUM REFINING	Base Projections											
	With Regulation Costs											
77 FUEL OIL	Base Projections											
	With Regulation Costs											
78 PAVING AND ASPHALT	Base Projections											
	With Regulation Costs											
91 STEEL	Base Projections											
	With Regulation Costs											
150 SHIP AND BOAT	Base Projections											
	With Regulation Costs											
151 RAILROAD EQUIPMENT	Base Projections											
	With Regulation Costs											
169 TRUCKING	Base Projections											
	With Regulation Costs											
170 WATER TRANSPORTATION	Base Projections											
	With Regulation Costs											
171 AIRLINES	Base Projections											
	With Regulation Costs											
173 FREIGHT FORWARDING	Base Projections											
	With Regulation Costs											
176 ELECTRIC UTILITIES	Base Projections											
	With Regulation Costs											
180 WHOLESALE TRADES	Base Projections											
	With Regulation Costs											
181 RETAIL TRADES	Base Projections											
	With Regulation Costs											
190 AUTO REPAIR	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											

FORMAT 12-B

PRODUCT SHIPMENTS — SELECTED INDUSTRIES

Regulation:

SECTORS	PRODUCT SHIPMENTS (MILLIONS 1976 $)	YEAR 0=___	1	2	3	4	5	6	7	8	9	10
5 GRAINS	Base Projections											
	With Regulation Costs											
9 FISHING PRODUCTS	Base Projections											
	With Regulation Costs											
15 CRUDE PETROLEUM	Base Projections											
	With Regulation Costs											
34 MISCELLANEOUS FOOD PRODUCTS	Base Projections											
	With Regulation Costs											
64 INDUSTRIAL CHEMICALS	Base Projections											
	With Regulation Costs											
76 PETROLEUM REFINING	Base Projections											
	With Regulation Costs											
77 FUEL OIL	Base Projections											
	With Regulation Costs											
78 PAVING AND ASPHALT	Base Projections											
	With Regulation Costs											
91 STEEL	Base Projections											
	With Regulation Costs											
150 SHIP AND BOAT	Base Projections											
	With Regulation Costs											
151 RAILROAD EQUIPMENT	Base Projections											
	With Regulation Costs											
169 TRUCKING	Base Projections											
	With Regulation Costs											
170 WATER TRANSPORTATION	Base Projections											
	With Regulation Costs											
171 AIRLINES	Base Projections											
	With Regulation Costs											
173 FREIGHT FORWARDING	Base Projections											
	With Regulation Costs											
176 ELECTRIC UTILITIES	Base Projections											
	With Regulation Costs											
180 WHOLESALE TRADES	Base Projections											
	With Regulation Costs											
181 RETAIL TRADES	Base Projections											
	With Regulation Costs											
190 AUTO REPAIR	Base Projections											
	With Regulation Costs											
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	Base Projections											
	With Regulation Costs											

FORMAT 12-C

EMPLOYMENT COMPARISONS — SELECTED INDUSTRIES

SECTORS (90 ORDER)	EMPLOYMENT (THOUSANDS OF JOBS)	YEAR 0=	1	2	3	4	5	6	7	8	9	10
1 AGRICULTURE	Base Projections											
	With Regulation Costs											
3 PETROLEUM AND GAS	Base Projections											
	With Regulation Costs											
14 MISCELLANEOUS FOOD PRODUCTS	Base Projections											
	With Regulation Costs											
31 INDUSTRIAL CHEMICALS	Base Projections											
	With Regulation Costs											
38 PETROLEUM REFINING	Base Projections											
	With Regulation Costs											
46 IRON AND STEEL	Base Projections											
	With Regulation Costs											
72 SHIPS AND BOATS	Base Projections											
	With Regulation Costs											
73 RAILROAD EQUIPMENT	Base Projections											
	With Regulation Costs											
81 TRUCKING	Base Projections											
	With Regulation Costs											
82 OTHER TRANSPORTATION	Base Projections											
	With Regulation Costs											
83 AIRLINES	Base Projections											
	With Regulation Costs											
87 ELECTRIC UTILIES	Base Projections											
	With Regulation Costs											
84 WHOLESALE AND RETAIL TRADES	Base Projections											
	With Regulation Costs											
86 FINANCE AND SERVICES	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
	Base Projections											
	With Regulation Costs											
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