WORKING PAPER

ASSESSING THE ECONOMIC IMPACTS OF CAPITAL EXPENDITURES

by

Scott Goldsmith
and
Phillip Rowe

Institute of Social and Economic Research
University of Alaska
Anchorage, Alaska

for

Division of Policy Development and Planning
State of Alaska

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Preface

This document reports on work in progress at the Institute of Social and Economic Research (ISER) on developing methods and estimates for determining the impacts which capital spending has on the Alaskan economy and public sector finances. This first effort applies what are, hopefully, reasonable assumptions to an established analytical framework to generate "rules of thumb" for estimating the economic impacts of $1 of capital spending on different types of projects (Table 6, page 16).

The analysis demonstrates that there is variation in economic impact by project type but not nearly so much as there is across different types of government spending (operating expenditures, for example). Furthermore, the economic impact seems to be determined largely by two factors. One is what proportion of value added (the important components of which are primarily wages and salaries and profits) is earned by nonresidents. The second is what proportion of sales to the construction industry which could be made by Alaskan firms is, in fact, made by firms outside the state. These factors determine how much of the impact of construction spending occurs outside the state.

With better data, the quality of the "rules of thumb" could be improved. More reasonable assumptions may be argued for some parameters. It does not appear, however, that modest changes in the model parameters will significantly alter the results either of the overall impact of capital expenditures or of the ranking of categories of expenditures.

Future work will further scrutinize the model parameters as well as its applicability to regions within the state. A related effort will analyze the fiscal impacts of capital projects in light of the unique fiscal situation of the state.

Comments on this document are requested and appreciated.

ASSESSING THE ECONOMIC IMPACTS OF CAPITAL EXPENDITURES

TABLE OF CONTENTS

LIST OF TABLES

Introduction

When the State of Alaska makes a capital expenditure, a chain of economic impacts is started. The most commonly cited of these impacts is the creation of jobs. In this paper, we examine how and to what degree capital spending affects the economy of the state. This paper includes a discussion of what constitutes a capital expenditure, defines the term economic impact, examines the links between capital spending and the other components of the Alaskan economy, calculates the economic impact of capital spending by broad project types, and discusses additional factors which influence the distribution of economic impacts.

Because of the paucity of data on construction spending in Alaska, the analysis has primarily utilized national data sources. Consequently, the results are preliminary. Work continues on refining the assumptions derived from the data and used in the analysis.

I. Defining Capital Expenditures

Before proceeding with an analysis of economic impacts of capital expenditures, it is necessary to define what we mean by the term capital expenditures. The State of Alaska classifies the following types of spending as capital spending: construction, major maintenance, purchases of expensive equipment, studies which may lead to physical capital projects, acquisition or development of computer software, certain grant and loan programs, and special items requiring large lump sum money transfers (Capital Budget, Fiscal 1981, page 2). Most expenditures less than $25,000 are treated as operating expenditures although they may qualify as a capital expenditure under the above-stated definition.

These types of spending fit generally into three broad categories: facilities and equipment; subsidies to capital; and financial support to local government which can be used for capital spending. Total state appropriations for these categories exceeded $1.39 billion in fiscal year 1981 and $1.95 billion in fiscal year 1982.

Spending for facilities and equipment is the category of spending usually identified as "capital spending," and it is this component of the capital budget that we analyze in succeeding chapters. This category includes new construction of buildings, highways, airports, and harbors as well as reconstruction and major repair; it also includes the acquisition of building sites and the purchase of equipment. As shown in Table 1, state appropriations for the capital projects budget were approximately $1.07 billion in fiscal year 1981 and $1.2 billion in fiscal year 1982. These quantities represent 77 percent and 63 percent of the capital budgets, respectively.

TABLE 1. SELECTED STATE APPROPRIATIONS FOR CAPITAL PROJECTS, FISCAL YEARS 1981, 1982

(thousands of dollars)

Spending Category	Fiscal 1981	Fiscal 1982
Capital Projects	$1,068,333	$1,240,176
Loans	243,335	363,800
Local Government Support for Capital Projects*	83,065	352,431
TOTAL	$1,394,733	$1,956,407

*Includes revenue sharing and municipal assistance.

SOURCE: State of Alaska, The Legislature, Free Conference Committee Report, Operating and Capital Budget, Summary of Appropriations. Fiscal Years 1981, 1982.

The composition of capital projects appropriations for fiscal year 1982 is presented in greater detail in Table 2. It is difficult to accurately categorize all individual budget items into type of project because many items may be lumped together in an appropriation or insufficient information may be provided.[1] Within each category, there are a wide variety of projects included. The existing building/facilities category includes

[1]The classification of projects is based on the brief titles provided in the appropriation bills. Classification of an appropriation is based on the stated major use of the project. For example, planning/engineering includes only appropriations designated as such. However, there may be planning/engineering activities included in new facilities, highways, or airports.

TABLE 2. DISTRIBUTION OF CAPITAL PROJECTS BY FUNCTION AND PROJECT TYPE
FISCAL YEAR 1982

(thousands of dollars)

Function	New Building/ Facility	Existing Building/ Facility	Planning/ Engineering	Highways	Airports	Harbor/ Docks	Water/ Sewer	Power Projects	Equipment	Other	Total
Transportation	1,020	7,377	35,984	131,061	70,147	20,972	-	-	19,679	71,803	358,143
Education	89,552	36,131	2,550	-	-	-	505	-	2,086	5,941	136,765
University of Alaska	10,125	4,000	2,491	50	-	1,599	350	-	6,849	6,311	31,775
Development	19,202	3,967	128,370[a]	2,623	-	-	205	281,280	7,292	21,005	463,944
Social Services	10,254	1,809	-	-	-	-	-	-	567	2,611	15,241
Health	8,826	1,643	50	-	-	-	-	-	2,173	499	13,191
National Resources	-	70	32,952	300	-	-	25,242	-	578	41,624	100,766
Public Protection[b]	24,744	17,961	1,104	-	-	630	-	-	9,225	6,791	60,455
General Government	19,150	1,300	5,982	109	-	-	-	-	12,862	707	40,010
Unclassified	-	-	-	-	-	-	-	-	-	19,886	19,886
Total	182,873	74,258	209,483	134,143	70,147	23,201	26,302	281,280	61,311	177,178	1,240,176
Percent	14.7	6.0	16.9	10.8	5.7	1.9	2.1	22.7	4.9	14.3	

[a]Includes $125.7 million for feasibility studies, acquisition of right-of-way, design, and engineering of power projects.

[b]Includes Administration of Justice.

SOURCE: State of Alaska, The Legislature. Free Conference Committee Report, Fiscal Year 1982, Operating and Capital Budget, Summary of Appropriations.

projects listed as improvements, code upgrade, renovation, reconstruction, and maintenance and repairs. The highways/streets category includes construction, resurface, repave, and extensions. Planning/ engineering includes both general policy planning and more specific design/engineering of building and highways. Equipment purchases include books, school equipment, medical equipment, vehicle purchases, maintenance equipment, etc. The largest categories appear to be power projects, new buildings, and highways, which together comprised 48 percent of the budget. The addition of planning and engineering (including feasibility studies and acquisition of right- of-way) increase the percentage to 65. The distribution of the items in the capital budget in other years may differ from that of 1982; however, the 1982 budget does show the variety of projects undertaken by the state.

The second category of capital spending is for direct loans and loan subsidies which the state makes available for capital investments. This includes state subsidies to the Alaska Housing Finance Corporation (AHFC) for its below-market rate mortgage loan programs; direct funding of Community and Regional Affairs housing programs; and agricultural, fisheries, and mining loan programs. In fiscal year 1982, state appropriations for loan programs for investment in capital totaled $363 million. The economic impact which results from state involvement in these loans depends on how sensitive the profitability (or desirability) of a capital expenditure is to variations in the cost of capital. Since this varies with each industry, the size and composition of the impact varies with each industry. A false component of "impact" in the case of subsidy expenditures consists of the economic activity of those recipients who would have undertaken the subsidized activity in the absence of the subsidy. For example, some proportion of the borrowers who obtained mortgage financing from AHFC would have purchased homes in the absence of the program. While such a buyer receiving AHFC financing may enjoy smaller payments or purchase a more expensive house, the borrower would have bought a home without the program, and the purchase cannot be attributed to that program. We do not consider the economic impact of these loan subsidy programs in this paper.

The final category of capital expenditures is state financial support to local governments for the financing of capital projects. Local governments in Alaska can use Alaska revenue sharing and municipal assistance dollars to reduce taxes, to pay for governmental operations, or to spend on capital projects. In fiscal year 1982, the state appropriated $145 million for these programs, up from $83 million in fiscal year 1981. Additionally, $213 million in per capita grants for local capital projects were appropriated for fiscal year 1982. The economic effect of spending for capital projects by local government are very similar to projects initiated directly by state government, and we do not address them separately in this analysis.

II. Capital Project Recipes

The economic impact of a capital construction project depends upon how the construction dollar is spent. For "bricks and mortar" construction projects, as identified in Table 2, the capital project dollar is spent on many components. In this paper, the inputs to a construction project are referred to collectively as the recipe for the project. The overall recipe for a state facility project may include land acquisition, design services, site preparation, construction costs, and state management costs. The "first cut" of the construction dollar is between "bricks and mortar" and state overhead. The percentage breakdown by component, net of land acquisition, for buildings as estimated by the Department of Transportation and Public Facilities (DOTPF) is shown in Table 3.

Contract construction costs are the largest component of the recipe, constituting 75-87 percent of the total. Architectural and engineering services range from 6-10.5 percent. State management costs range from 5-8 percent. At this aggregate level of the recipe, the major factor associated with variation in the input percentages is the size of project. Both design and administrative costs decline as a percent of total project cost as the price tag on the project increases. These reductions allow a larger percentage of the project budget to be used for the actual construction.

Within the contract construction portion of the construction dollar, major components of cost are onsite wages and salaries, material purchases, equipment costs, overhead costs, and profit to the construction firm.

At this time, there is no data which reports the inputs of labor and materials for construction projects in the State of Alaska.[1] There are two sources of national level data, however, which provide information on the inputs required for construction by type of project: (1) the Labor and Materials Requirement Studies conducted by the U.S. Department of Labor, Bureau of Labor Statistics (BLS), and (2) the Input/Output (I/O) tables prepared by the U.S. Department of Commerce, Bureau of Economic Analysis. Unfortunately, they do not use a consistent classification scheme. The BLS studies examine the mix of materials, labor, and overhead/profit for firms engaged in contract construction work for the government. The input/output table presents a broader picture of construction activity since it represents not only contract construction but also the design elements of the construction process.

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[1] See Appendix B for a discussion of Alaska data sources.

TABLE 3. DISTRIBUTION OF COST OF BUILDING CONSTRUCTION

(percentage)

Project Class Construction Type	Less than $500,000 New	Less than $500,000 Existing[a]	$500,000 to $2,500,000 New	$500,000 to $2,500,000 Existing[a]	Greater than $2,500,000 New	Greater than $2,500,000 Existing[a]
DOTPF Assessment	1.50	1.50	1.50	1.50	1.50	1.50
Land Services	.71	.71	.12	.12	.04	.04
Site Investigation	3.82	3.82	3.85	3.85	.35	.35
Special Services	1.41	1.41	.71	.71	.71	.71
Art Work	.75	.75	.82	.86	.87	.86
Consultant Services (Design)	9.57	10.54	7.45	8.18	6.01	8.36
Administration Review	1.22	1.22	.79	.79	.79	.79
Design Management	1.77	1.77	.91	.91	.91	.91
Construction Management	3.54	3.54	1.99	1.99	1.78	1.78
Construction Services	75.70	74.74	81.86	81.09	87.04	84.70
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

[a]Includes upgrade, additions, or renovations.

SOURCE: Alaska Department of Transportation and Public Facilities, Design and Construction Division.

Table 4, based upon the BLS studies, shows that material purchases consume the largest share of the contract construction budget, followed by labor costs and overhead and profit. For the types of projects most often financed by state government (highways, schools, office buildings, and sewer works), material purchases consume 45-50 percent of the construction budget. Labor costs in these studies range from 24-34 percent. Overhead and profit is the most variable category, comprising 15-30 percent of budget. More detailed compilations in Appendix C show that each type of project uses not only a different mix of inputs among broad categories but also within these categories. Because the BLS data represent a national sample, the variation of input mixes is the result not only of the project type but also of the materials and technology used, which will vary by location.

Labor intensity of construction varies by project type. Federal highway and sewer projects require less labor as an input (in dollars) than does building construction. For example, the 1973 BLS study of highways reported that 24.6 percent of contract construction costs were for labor. Studies of hospitals (1965-66) and federal office buildings show a labor share of 29 percent. (The 1973 office building study reported 34.0 percent labor share.) For residential construction, the proportion of labor required increases as the size of the structure increases (for example, single-unit versus multi-unit structures).[2] There are two possible explanations. First, larger buildings may require more labor-intensive construction techniques than smaller buildings. Second, one determinant of the labor proportion is the wage rate. There is greater likelihood that union workers are involved in larger projects than in the construction of single-family housing.

With the exception of single-family housing and dredging, the project types with smaller wage bills have relatively larger equipment component bills. The cost of construction equipment as a percentage of total contract construction is high for highways (10.2 percent), sewer lines (16.7 percent), and land projects (19.2 percent) and is only 1.3 percent for hospitals and .5 percent for schools. (This variation may be partially the result of different category definitions among the project types.) Generally, projects with a larger spatial element (highways and sewer lines) have a greater equipment component than buildings.

Table 5 is a summary of information on inputs to construction taken from the 1972 national input-output table. (A detailed version of this table is in Appendix C.) The input-output table shows, for each type of construction project, the proportion of inputs purchased from each industry in the economy. The mix is thus by industry rather than by materials. Value added is an additional component of the construction dollar, consisting primarily of wages, profits, and capital consumption allowance.

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[2]Housing is not provided directly by state government. However, the data provide additional information on input mix.

TABLE 4. PERCENT DISTRIBUTION OF CONTRACT COSTS BY PROJECT TYPE

Project Date of Analysis	Onsite Wages & Salaries	Materials & Supplies	Equipment	Overhead[a] & Profit
Federally Aided Highways: 1958	23.9	50.6	12.4[b]	13.1
1973	24.6	44.5	10.2[b]	20.7
Elementary and Secondary Schools: 1959	26.7	54.1	1.4	17.8
1964-65	25.8	54.7	.5	19.0
Sewer Lines: 1962-63	24.3	44.4	11.3	20.0
1971	24.3	35.2	16.7	23.8
Sewer Plants: 1962-63	26.6	49.2	8.2	16.0
1971	25.2	47.0	5.6	22.2
Land Projects: 1959-60	26.0	35.1	19.2	19.7
General Hospitals: 1959-60	28.2	53.3	1.1	17.4
1965-66	29.6	50.4	1.3	18.7
Federal Office Buildings: 1959	29.0	51.4	1.9	17.7
College Housing: 1960-61	29.3	52.6	1.6	16.5
Dredging: 1959-60	32.3	17.3	24.9	25.5
Private Single-Family Housing: 1962	22.1	47.2	1.0	29.7
1969	20.4	43.4	.9	35.3
Private Multifamily Housing: 1971	27.9	44.2	3.1	24.8
Public Housing: 1959-60	35.5	45.0	2.5	17.0
1968	32.4	41.9	1.5	24.2

[a]Includes offsite wages, fringe benefits, construction financing, inventory, other overhead, and profit.

[b]ISER estimate.

SOURCE: Derived from U.S. Department of Labor, Bureau of Labor Statistics. "Labor and Material Requirements for Sewer Works Construction." Bulletin 2003, January 1979, Tables 12, 13, and 14.

TABLE 5. PERCENT DISTRIBUTION OF INTERMEDIATE INPUTS AND VALUE ADDED BY PROJECT TYPE

	Intermediate Inputs			
	Potentially Available in Alaska	Not Available in Alaska	Total	Value Added
New Construction				
Petroleum Pipelines	22.6	44.2	66.8	33.2
Water Supply Facility	28.2	35.4	63.6	36.4
Education Buildings	34.4	27.2	61.6	38.4
Electric Utility Facilities	22.1	38.7	60.8	39.2
Other Nonfarm Buildings	33.4	27.4	60.8	39.2
Residential 1-Unit Structures	46.7	13.7	60.4	39.6
Residential Addition	39.1	21.3	60.4	39.6
Dormitories	36.8	23.3	60.1	39.9
Military Facilities	32.5	27.2	59.7	40.3
Industrial Buildings	19.3	40.3	59.6	40.4
Office Buildings	30.3	29.0	59.3	40.7
Hospitals	31.4	25.6	57.0	43.0
Sewer System Facility	30.5	23.3	53.8	46.2
Highways and Streets	41.4	11.5	52.9	47.1
Resident. 2-4 Unit Structures	37.0	14.9	51.9	48.1
Residential High-Rise Apts.	31.6	19.6	51.2	48.8
Access Structures for Solid Mineral Development	22.1	20.5	42.6	57.4
Conservation and Development Facilities	25.4	14.3	39.7	60.3
Maintenance and Repair				
Highways and Streets	30.5	6.1	36.6	63.4
Water Supply Facility	22.1	14.3	36.4	63.6
Other Nonbuilding Facilities	19.0	11.0	30.0	70.0
Conservation and Development Facilities	15.3	11.5	26.8	73.2
Residential Structures	23.9	22.4	46.3	53.7
Sewer Facilities	31.0	14.0	45.0	55.0
Other Nonfarm Buildings	25.9	17.9	43.8	56.2
Military Facilities	22.8	18.3	41.1	58.9

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, "The Use of Commodities by Industries, 1972," The Detailed Input-Output Structure of the U.S. Economy: 1972, Volume I, Part I, 1979.

We categorize inputs purchased by the construction industry in Table 5 as those which can potentially be purchased in Alaska and those inputs which are not available in Alaska. Material inputs potentially available in Alaska are stone and clay mining, lumber and wood products, petroleum products, and stone and clay products. Other inputs which are potentially available are provided by the following industries: transportation; communications; electric, gas, water, and sanitary services; wholesale/retail trade; finance, insurance, and real estate; services; and government. For new construction, the inputs potentially available in Alaska ranged from 15 to 41.4 percent of total output and from 34 to 78 percent of total inputs required. The types of projects with the highest level of inputs potentially available in Alaska were highways and streets, residential structures (single-unit and 2-4 unit), and educational buildings.[3]

The industries which consistently show a high level of input to construction and which are potentially available in Alaska are wholesale/retail trade and services. The share of wholesale/retail trade to total output ranges from 4.2 percent to 8.4 percent for new public projects and as high as 12 percent for housing- related new construction. The purchase of services ranged from 3.7 to 13.1 percent of total output. A major component of services for construction is professional services which includes engineering and architecture. Design services were 11.2 percent of total output in hospital construction and 11.6 percent in educational building construction.

The classification "potentially available in Alaska" does not mean that these inputs are necessarily provided through the Alaska economy for a given project or project type. Instead, the industries identified in the potentially available category are present in Alaska and may be utilized to some degree. Thus, this category overstates the proportion which will actually be locally supplied.

For new construction as a whole, employee compensation was 77 percent of value added, while for maintenance and repair activities, employee compensation was 85 percent of value added. The value-added figures, therefore, provide an indication of the total labor required in aggregate by a project type. The value-added percentages from the input-output table and the percentage of wages and salaries from the BLS data by project type are, in general, consistent regarding the magnitude of the labor input.

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[3]Housing is not directly constructed by the State of Alaska. Data on the inputs to housing construction are provided for comparison purposes.

A comparison of new construction and maintenance and repair by project type shows that mainenance and repair is more labor intensive than new construction. For all construction industries, value added for new construction was 42 percent of total output. For maintenance and repair construction, value added rises to 58 percent of total output.

III. Economic Impacts of Capital Expenditures

III.A. Types of Impact

The economic impact of a state capital expenditure can be divided into a number of identifiable components. It is important to recognize each one to avoid the confusion which can arise from differing perceptions about what an impact is. In this section, we discuss each element in turn.

EFFECTS DURING CONSTRUCTION

1. Direct effect. This is the direct spending for the purchase of the commodity, services, and labor inputs needed to construct the project.

2. Indirect effect. This is the demand for commodities, services, and labor needed to produce the inputs used to construct the project. For example, a direct material requirement of many construction projects is sand and gravel. When demand for sand and gravel increases because of the expansion of the construction industry, this indirectly puts an increased demand upon those inputs used to produce sand and gravel.

3. Induced effect. The expansion of economic activity attendant to an increase in capital spending will cause disposable personal income to rise because of an increase in wages and salaries, proprietor income, and other property income such as profits, interest, and rents. People will spend a portion of this increase in income on goods and services produced within the economy, and this will increase demand for and production of the products of these industries.

4. Accelerator effect. The expansion of economic activity may require an increase in the amount of investment occurring in the economy either in the business or household sector. Business investment will increase if more buildings or machinery is necessary to deliver the additional products demanded at higher activity levels. Household investment will grow if population in-migration in response to increasing job availabilty occurs. Household investment is primarily housing construction.

This investment is called the accelerator effect because an increase in the rate of growth of business activity or population will increase investment by a much larger proportion. For example, if the rate of population growth were to increase from 3 to 6 percent, the level of activity, rather than the growth rate of activity, in housing construction could double. This effect is a major contributor to boom-bust cycles.

5. Government effect. Economic expansion may require an expansion in government spending even when the initial stimulus for expansion comes from government spending. If businesses expand and population grows, there may be an increased need for public capital facilities such as roads and schools, and for operations such as motor vehicle registration clerks and teachers. An expansion of capital facilities through construction investment can have an effect similar to the accelerator effect in terms of its boom-bust characteristics.

EFFECTS AFTER CONSTRUCTION PHASE

6. Operation and maintenance effect. The maintenance and operation of public facilities created by capital investments requires manpower, commodities, and services. These expenditures are independent of the program expenditures of those government programs housed in the buildings and so on. These expenditures may occur through the private sector, for example, through highway and road maintenance and upgrading contracts.

7. Structural change effect. The economic activity engendered by construction or a change in the economic environment resulting from the existence of the new facility may itself generate an increase, or decrease, in economic activity, which may be termed structural change. This change results from a change in the price or availability of inputs to production or from an increase in consumer market size. For example, a hydroelectric facility which reduces the price of electricity may attract industry which would otherwise not locate in the state. Another example would be a business service, previously offered only in Seattle, which becomes available locally as a result of an increase in the size of the Alaskan market.

8. Speculative effect. The announcement of a project or its construction may cause a speculative effect in the business sector resulting in investment in anticipation of demand which has not yet materialized.

In the analysis which follows, we quantify only the first three components of economic impact--the direct, indirect, and induced effects. This is not because the other effects may be any less important quantitatively but because of the time and funding limitations of the current study. Future efforts will attempt to quantify the other effects.

III.B. Impact Indicators

The economic changes which a capital construction project generates can be measured in a number of dimensions. The most important ones are listed below.

1. Employment. Average annual wage and salary employment figures are used in this study. This may be less than observed jobs created for two reasons. First, the jobs may be seasonal and thus may not last all year. Second, proprietors and partners in their own companies are not counted.

2. Wages and salaries. This is the contribution to income from wage and salary employment.

3. Sales (Output). This is the direct project expenditure plus the sales by other industries generated by the construction activity.

4. Personal income. In addition to wages and salaries, returns to other factor inputs which accrue to individuals are included in personal income. These other returns are primarily net income of proprietors and other small businesses, profits of corporations, net interest receipts, and net rental receipts.

5. Value added. This is the total value of goods and services produced in an economy net of the cost of all purchased inputs used in production. For example, for the construction industry, it is the value of output net of all purchased inputs such as sand and gravel and architectural services. Value added includes personal income as well as profits of corporations not distributed to individuals, other factor payments not distributed to individuals, and a capital consumption allowance (depreciation charge on capital used up in production).

III.C. Economic Impact Summary

Table 6 summarizes our statewide estimates of the economic impacts of the expenditure of $1 million on various types of state capital construction projects. For employment, wages and salaries paid, sales, and personal income, the direct and total (direct plus indirect plus induced) effects are presented.[4]

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[4] Appendix A provides a description of the methodology and assumptions underlying this table.

TABLE 6. ECONOMIC IMPACT OF $1 MILLION OF STATE CAPITAL EXPENDITURES

Project Type[a]	Average Annual[b,c] Equivalent Employment Produced		Wages and Salaries[e] (thousand $)		Output[f] (thousand $)		Personal Income[g] (thousand $)	
	Direct	Total[d]	Direct	Total[d]	Direct	Total[d]	Direct	Total[d]
School	6.33	11.59	$258	$372	$1,000	$1,458	$251	$380
Office	6.69	11.66	275	382	1,000	1,436	263	384
Hospital	6.88	12.14	283	396	1,000	1,453	274	402
Sewers	5.13	9.58	223	323	1,000	1,409	227	339
Highway and Street	4.22	9.28	232	350	1,000	1,497	230	364
Land Reclamation	6.62	11.49	290	397	1,000	1,436	288	409
Highway and Street Maintenance	7.12	12.95	405	540	1,000	1,573	379	534
Nonfarm Building Maintenance	8.30	13.38	348	457	1,000	1,450	336	450

[a]The mix of industries is 81 percent construction, 12 percent government, and 7 percent equipment purchase (no impact) except for sewers, highways, and land reclamation where the split is 96 percent construction and 4 percent government.

[b]At 1982 average wage rate levels.

[c]Employment is that which occurs in Alaska but is independent of the residence of the worker (does not include proprietors).

[d]Total = direct + indirect + induced.

[e]Wages and salaries is that paid to workers for employment which occurs in Alaska independent of the place of residence of the worker.

[f]Sales occurring within Alaska.

[g]The component of value added which accrues to Alaskan residents. Because a portion of wages and salaries, proprietor income, and profits which is project generated accrues to nonresidents, the personal income impact is not much larger than that of wages and salaries.

For example, for school construction, the equivalent of 6.33 jobs on an average annual basis are directly created in the state; and in total, 11.59 jobs are created in Alaska. (The number of jobs actually generated may be larger, but if this were the case, their duration would be less than one year.) Of the million dollars expended, $258 thousand would initially go to pay the wages and salaries of salaried workers. After the indirect and induced effects are counted, the total spent for wages and salaries rises to $372 thousand. Personal income of residents increases by $251 thousand as a direct result of the capital expenditure. The indirect and induced effects add an additional $129 thousand. In addition to wages and salaries, personal income includes profits, but since a portion of both wages and salaries and profits accrue to nonresidents, the direct personal income impact is slightly smaller, and the total effect only slightly larger than wages paid. Finally, the total output generated by the expenditure of $1 million is $1.458 million. Of this, $1 million represents the money spent by the state, and $.458 million represents money spent within the state by businesses and individuals to purchase goods and services from local businesses.

The size of the economic impact varies with the type of project. In general, the more labor-intensive projects, particularly maintenance, will have the larger impacts because a larger portion of each dollar directly spent remains within the economy in these cases.

There is a tradeoff between high employment and high average wage rate for a given wage bill. The higher wage in heavy construction generates less direct employment, but more indirect and induced employment. This is because there is very little indirect employment (interindustry purchases), and induced employment depends upon the local component of personal income. A further consequence of this is that the composition and size of the indirect and induced effects will not vary across project types as much as the direct effects. Thus, for example, the range of direct employment effects varies from 4.22 for highways and streets to 8.30 for nonfarm building maintenance, but the total employment effects of these project types vary only from 9.28 to 13.38.

The ratios of total-to-direct effects, known as type II multipliers, are shown in Table 7. They confirm the variation by project type in the ratio of total-to-direct employment effects, which is primarily a result of differing wage rates. The high ratio of total-to-direct employment in highway and street maintenance, for example, is due to the high average wage for highway maintenance work, and in contrast, the low ratio for state operating expenditures is a reflection of the low average wage (see Table 8). The variation in the ratios across project types for other economic indicators is much less pronounced.

TABLE 7. RATIOS OF TOTAL-TO-DIRECT CHANGE

	Employment	Wages & Salaries	Output	Personal Income
Capital Expenditures				
School	1.83	1.44	1.46	1.51
Office	1.74	1.39	1.44	1.46
Hospital	1.76	1.40	1.45	1.47
Sewers	1.87	1.45	1.41	1.49
Highway and Street	2.20	1.51	1.50	1.58
Land Reclamation	1.74	1.37	1.44	1.42
Highway and Street Maintenance	1.82	1.33	1.57	1.41
Nonfarm Building Maintenance	1.61	1.31	1.45	1.37
State Operating Expenditures	1.46	1.32	1.70	1.33

SOURCE: Table 6 and Table 8.

Table 6 reflects the idea that not all capital expenditure money "reaches the street" as contract construction. Government planning and administration as well as equipment purchases for certain types of facilities consume a portion of capital budgets. For comparison purposes, Table 8 shows the economic impacts of $1 million spent only on contract construction. In general, the impact numbers in Table 8 are slightly lower than those in Table 6 because state government operations, which is omitted as a component in these figures, is very labor intensive. Because of this labor intensity, a larger portion of a dollar expended on state government is expended within the local economy than a dollar expended on contract construction.

TABLE 8. ECONOMIC IMPACT OF $1 MILLION OF STATE CONTRACT CONSTRUCTION

Project Type	Average Annual[a,b] Equivalent Employment Produced		Wages and Salaries[d] (thousand $)		Output[e] (thousand $)		Personal Income[f] (thousand $)	
	Direct	Total[c]	Direct	Total[c]	Direct	Total[c]	Direct	Total[c]
School	5.30	10.62	$240	$355	$1,000	$1,462	$224	$354
Office	5.74	10.70	260	368	1,000	1,435	238	359
Hospital	5.97	11.30	270	385	1,000	1,455	252	381
Sewers	4.64	8.94	210	307	1,000	1,397	212	321
Highway and Street	3.69	8.62	220	335	1,000	1,489	216	347
Land Reclamation	6.19	10.93	280	384	1,000	1,425	276	394
Highway and Street Maintenance	6.71	12.45	400	533	1,000	1,568	371	524
Nonfarm Building Maintenance	7.73	12.83	350	461	1,000	1,452	329	453
State Gov't Operations	17.01	24.88	530	701	1,000	1,700	584	776

[a]At 1982 average wage rate levels.

[b]Employment is that which occurs in Alaska but is independent of the residence of the worker (does not include proprietors).

[c]Total = direct + indirect + induced.

[d]Wages and salaries is that paid to workers for employment which occurs in Alaska independent of the place of residence of the worker.

[e]Sales occurring within Alaska.

[f]The component of value added which accrues to Alaskan residents. Because a portion of wages and salaries, proprietor income, and profits which is project generated accrues to nonresidents, the personal income impact is not much larger than that of wages and salaries.

The project impact, as measured by each indicator, can be broken into sequential rounds of spending to show the track the million dollars of spending leaves in the economy through each round of exchange. In Table 9, we show the sales, by industry, which are generated in each successive round of spending of $1 for school contract construction (now assuming all of each dollar is contracted to the private sector) for six rounds of spending. The first round represents the $1 of sales by the construction industry to government. Round two represents the local purchases by the construction industry to produce the $1 of sales of school facilities. Four local commodities are purchased in the following proportions: sand and gravel--.8¢; wood products--.2¢; fuel oil and asphalt--.4¢; and brick--1.6¢. In addition, local support services are purchased from the transportation industry--1.4¢; communications and utilities--.4¢; wholesale trade--3.1¢; finance--.7¢; and business services--6.6¢. The total of second-round local purchases is 15.2¢. The remainder of the $1 is spent either for purchases outside the economy or on wages and salaries (and other factor payments). In the third round of spending, sales are generated in the support sector from demand created within the support sector itself and from the personal income generated as part of round-two spending. There is no significant demand generated for manufacturing output because manufacturing industries in Alaska that sell to the construction industry do not, by and large, purchase their commodity inputs within Alaska, and there are few manufacturing sales to support industries. Total sales in round three in the support industries is 10.9¢. In subsequent rounds, the spending rapidly tapers off to a negligible amount. In total for the six rounds, sales by industry are ranked as follows: construction--$1; services--$.12; trade--$.097; finance--$.034; transportation--$.029; communications and utilities--$.021; stone and clay manufacture--$.016, stone and clay mining--$.008, petroleum refining--$.004; and wood products--$.002.

III.D. Assumptions Underlying the Impact Analysis

A large number of assumptions underlie the development of Table 6 and should be understood in order to correctly interpret and use the results presented in the table. A complete description of the methodology used to develop the table is presented in Appendix A to which the reader who desires technical details is referred.

1. Generic projects. The table is developed for a typical or average project within each category and so will not be a representation of each and every particular project.

2. Location of purchases. Based upon analysis of the manufacturing sector in Alaska, we assume that most commodity purchases are from manufacturers outside the state. A majority of noncommodity purchases are from producers within the state.

TABLE 9. SALES GENERATED BY $1 of SCHOOL CONSTRUCTION

(cents)

Industry	Round of Spending						
	One	Two	Three	Four	Five	Six	Total
Manufacturing and Mining							
Stone & Clay Mining	0	00.8	0	0	0	0	00.8
Lumber & Wood Products	0	00.2	0	0	0	0	00.2
Petroleum Refining	0	00.4	0	0	0	0	00.4
Stone & Clay Mfg.	0	01.6	0	0	0	0	01.6
Construction							
Schools	100	0	0	0	0	0	100
Support							
Transportation	0	01.4	00.8	00.4	00.2	00.1	02.9
Communications/ Utilities	0	00.4	01.0	00.4	00.2	00.1	02.1
Trade	0	03.1	04.2	01.2	00.8	00.3	09.7
Finance	0	00.7	01.6	00.6	00.3	00.1	03.4
Services	0	06.6	03.3	01.2	00.7	00.3	12.0
Government	0	0	0	0	0	0	0
Total	100	15.2	10.9	3.8	2.2	.9	133.1

3. Residence adjustment for income. A portion of both the wages and salaries and other income components earned will accrue to nonresidents even though the economic activity occurs within the state. We adjust for nonresident earnings based upon a comparison of wages and salaries reported by employers and income tax returns filed by Alaskan residents.

4. Timing of impact. There is no time dimension in this analysis of impact. There is a significant lag between the time a project is funded by the legislature and the time that construction actually occurs which is taken up with facility planning, design, and the bidding and contracting procedure. In fact, construction activities occur over a period of several years and are highly seasonal.

5. Incremental versus average economic impact. We assume in Table 6 that construction activity generates no spinoff investment by the business and residential sectors (an assumption which will be loosened in subsequent analyses), but otherwise we assume that the incremental changes in economic activity which are engendered are similar to average changes measured by industry aggregates. In other words, we assume, for example, that the number of employees hired when construction sales rise from $100 million to $101 million is the same as when sales rise from $10 million to $11 million.

III.E. Supply-Demand Imbalance

When the demand for construction services increases rapidly in a short period of time either because of increased investment activity in the private sector, such as the oil pipeline, or in the public sector, through expansion of the capital budget, or because of subsidization of private capital formation, two effects can be expected. Both are the direct result of demand's exceeding the supply locally available. First, prices will be bid up in the competition for the available supply of workers, materials, and services. Second, in response to higher prices, the supply of these inputs will increase, primarily through the importation of workers and services from outside the state. Profits will also increase for those businesses providing commodities locally.

Both of these effects will reduce the estimates of the impacts resulting from $1 million of government capital expenditures presented in Table 6. First, locally generated demand pull inflation will increase the cost of all inputs to contract construction and other industries asymmetrically. The supply of some items can be increased at no additional cost while other components of contract construction budgets are in relatively fixed supply. In the absence of specific information about relative inflationary tendencies, a first approximation of cost increase would be to increase all costs by the same percentage.

The second effect is to increase the proportion of each dollar spent which "leaks" outside the economy for the purchase of inputs not locally available. This reduces both the direct and total impact of each million dollars of expenditures on capital goods.

It is beyond the scope of this analysis to calculate what the threshold level of demand for the various labor inputs is over which upward pressure on prices begins and a larger-than-"normal" proportion of spending (or income from spending) leaks out of the state. Since labor is the most important locally supplied component of production, however, we can at least show the pattern of change in construction employment in past years and draw some conclusions. Table 10 shows the volatility of past construction employment levels, particularly for heavy construction. Shortages of locally available labor are more likely in periods of rapid growth and less likely in periods following years of declining demand when unemployment in construction may be at a high level. Shortages are also more likely when the rate of growth is faster than expected and when the level of employment is higher.

Since 1961, the average growth in employment has been about 4.5 percent annually. If we arbitrarily define a growth rate of three times the average for all employment as the condition for the threshold of supply constraints, then the period 1964-65, 1974-76, and the present would qualify as times when the conditions for demand inflation and income leakages could be occurring.

III.F. Location

To this point in the analysis, we have concentrated on statewide economic impact. There are, however, two sets of regional factors associated with the economic impact.

First, changing location changes the total purchase price of a project. Table 11 shows two regional cost differential indexes for Alaska.

While each index has a slightly different geographic coverage, both indexes illustrate that building in rural and remote Alaska often costs twice as much as a similar project in Anchorage. These higher costs are caused by higher wage rates, increased materials transport costs, and logistic considerations. The fact that a building costs more in rural Alaska than in Anchorage implies that

TABLE 10. CONSTRUCTION INDUSTRY EMPLOYMENT AND GROWTH RATES

	Total		General		Heavy Construction		Special Trades	
	Employment (000)	Change from Previous Year (%)	Employment (000)	Change from Previous Year (%)	Employment (000)	Change from Previous Year (%)	Employment (000)	Change from Previous Year (%)
1961	4.053	-	1.431	-	1.01	-	1.612	-
1962	3.973	-2	1.302	-9	1.202	19	1.469	-9
1963	4.250	7	1.487	14	1.411	17	1.352	-8
1964	5.827	37	1.937	30	2.049	45	1.841	36
1965	6.455	11	2.063	7	2.224	9	2.168	18
1966	5.864	-9	1.796	-13	2.216	0	1.852	-15
1967	5.992	2	1.702	-5	2.372	7	1.918	4
1968	5.997	0	1.549	-9	2.572	8	1.876	-2
1969	6.652	11	1.835	18	2.596	1	2.221	18
1970	6.893	4	2.092	14	2.424	-7	2.377	7
1971	7.443	8	2.382	14	2.482	2	2.579	8
1972	7.893	6	2.677	12	2.415	-3	2.801	9
1973	7.839	-1	2.682	0	2.055	-15	3.102	11
1974	14.066	79	3.876	45	5.98	190	4.210	36
1975	25.880	84	4.094	6	16.138	170	5.648	34
1976	30.235	17	3.824	-7	20.456	27	5.955	5
1977	19.546	-35	3.469	-9	9.95	-51	6.127	3
1978	12.240	-37	3.596	4	3.327	-67	5.317	-13
1979	10.092	-18	2.801	-22	2.789	-16	4.502	-15
1980 Preliminary	10.3	2	NA	NA	NA	NA	NA	NA
1981 Preliminary	12.1	17	NA	NA	NA	NA	NA	NA
1982 Estimate	14.5	20	NA	NA	NA	NA	NA	NA

TABLE 11. REGIONAL COST DIFFERENTIAL INDEXES

Anchorage = 100

Places	U.S. Department of Defense	Alaska Department of Transportation and Public Facilities
Anchorage	100	100
Barrow	205	
Barter Island	189	
Bethel		150
Cold Bay	158	
Fairbanks	111	106
Fort Yukon	158	
Juneau	95	102
Kenai Peninsula	111	
Kodiak	132	134
Kotzebue	184	
King Salmon	137	
Nome	184	
Sitka		134
Whittier	100	
Regional		
Aleutian Islands	200	225
Arctic Slope Villages		294
Northern Interior Villages		267
Southcentral Village		132
Southeastern Village		181
Western: Large Village		153
Coastal Village		244

SOURCES: U.S. Army Corp. of Engineers
Alaska Department of Transportation and Public Facilities.

$1 million in construction expenditures will have less of an employment impact than that shown in Table 6 if spent in rural Alaska.

The other indicators of impact are not affected by the higher purchase price per se. However, there are two other factors associated with changing location which may affect the construction project recipe and, consequently, all aspects of economic impact. A change in location may change the project design specifications. A brick school may be more suitable in one location, and a wood frame school in another. This affects impact by changing the proportions for the allocation of each dollar of project cost among inputs. Second, when costs change with location, they do not all change by the same proportion as the overall index. Some cost components will become relatively more expensive than others, and cost minimization in design implies the substitution of less costly inputs for the now more expensive ones. For example, construction work on the North Slope increases both the cost of labor and of transportation. Modular construction techniques is a modification of design specification reflecting the fact that the increase in the cost of transportation may be less than the labor cost increase. Consequently, onsite labor is minimized in exchange for a higher overall transportation budget.

We have not yet analyzed variation in construction recipes by location within Alaska. Consequently, we cannot suggest how the economic impact by project type may change as project location shifts. Future efforts will examine this variation.

Second, the spatial distribution of economic impacts varies by project location. In the most extreme case, there would be no localized economic impact in a place if all labor, materials, and equipment were imported and all workers isolated from the local economy. As with the question of how the construction recipe changes with location, this is a topic for further study.

APPENDIX A

ECONOMIC IMPACT METHODOLOGY AND PARAMETERS

A.I. Introduction

An estimate of economic impact, measured as sales, value added, wages and salaries, employment, and other variables by industry can be calculated using an input-output model. Although no current and tested input-output model for Alaska exists, it is possible to build a simplified direct requirements table of the Alaskan economy based upon assumption and secondary sources. We recognize and attempt to minimize the problems of (1) product mix and (2) trade coefficients associated with utilizing the national I-O data at the regional level. We also recognize the fact that one of the most important assumptions of the I-O model, that of linear production functions, is very weak for the trade and service industries where most of the impacts we measure occur. The resultant model serves three functions. First, it provides a method to approximate an estimate of the magnitude of the components of economic impact. Second, it provides a framework for analyzing what relationships in the economy are most important in the determination of the size of the economic impact. Third, it provides an analytically complete description of the process of economic impact. This appendix describes the methodology for the development of such a model for use in the analysis of the economic impact of state capital expenditures and the assumptions used in the assignment of parameter values to the model. Although the input-output framework and methodology is, in general, not appropriate for the analysis of the process of economic growth and development in Alaska (a process in which structural change is important), we can use it to differentiate the impacts of different types of construction projects.

A.II. Input-Output Impact Methodology

An input-output table of total requirements for the regional economy is defined as $(I-A)^{-1}$ where A is the matrix of normalized intersectoral flows $[a_{ij}]$. Each element of $[a_{ij}]$ indicates the percentage of \$1 of input from industry i locally supplied to produce \$1 of output of industry j. Producer prices are used in the calculation so that the trade and transportation elements of input as well as taxes (the difference between producer and purchaser price) are separately identified. Profits and returns to factor inputs are summed into value added. Investment purchases are not included in the flows but are handled as a separate component of final demand as in a national input-output analysis. (The model is thus not a from-to matrix.)

The following measures of economic impact of construction activities can be calculated using the input-output matrix. First, the regional sales impact on each industry of \$1 of spending for final demand is defined as follows:

$$s = [I-A]^{-1}d$$

where s is a vector of sales by industry and d is a vector consisting of zeros except for a one in the construction industry row.

The employment impact by industry is calculated by pre-multiplying the sales vector by a diagonal matrix of coefficients of employment per \$1 of sales by industry $E = [e_{ij}]$ which produces a vector of employment by industry generated by \$1 of final demand e.

$$Es = e$$

In similar fashion, the value added impact, wages and salaries impact, and income impacts can be calculated by premultiplying the sales impact vector by the appropriate diagonal matrix of coefficients of value added, wages and salaries, or income per \$1 of sales by industry. Call these matrices V, W, and Y; and the impact by industry vectors are v, w, and y.

In calculating the impact of construction spending by government, we recognize that \$1 of final demand is composed of two elements--government and construction. This is because of \$1 appropriated to the capital budget for construction projects a portion, r_1, is spent within government on project planning, administration, etc.; and only the remaining portion, r_2, actually gets "onto the street" as construction contracts. This complication in calculating impact is handled by defining a new vector of final demand which is all zeros except for r_1 in the government row and r_2 in the construction row ($r_1 + r_2 = 1$).

Since each element of A, a_{ij}, is a sectoral flow, it is actually the product of two elements, as follows:

$$a_{ij} = x_{ij} * t_{ij}$$

where x_{ij} is a technical coefficient and t_{ij} is a trade coefficient. The x_{ij} element describes the production function for the production of j while the trade coefficient represents that proportion of the good i required in the production of good j which is supplied by the regional economy. The remainder, $(1 - t_{ij}) * x_{ij}$, is imported into the region. The payment for this imported input is a leakage out of the economy.

A further complication is that the estimation of direct input requirements by industry for the construction industry may need to come from information on construction industry purchases by materials. Contract construction planning, management, auditing, and reporting is generally done by task or material components rather than by industry. Consequently, a matrix is necessary which can convert $1 of final demand for construction which is broken down by task or materials into a final demand vector by industry. The typical element of this matrix C, c_{ki}, would be the proportion of task or material type k which is supplied by industry i. Then the set of technical coefficients x_{ij} where j is a particular type of construction project would be the column vector (x_j) formed from

$$x_j = m_j C$$

where m_j is the corresponding row vector containing the task or materials menu for construction project type j.

A.III. A Simplification of the Methodology

Lacking an input-output model for the state, it is still possible to use the theoretical framework of the state transactions table and state income accounts in a simplified manner to generate useful information about the economic impact of state government construction spending. We do this by first assigning reasonable values to all the coefficients in a simplified direct requirements table for Alaska $[a_{ij}]$. Then we calculate the economic impacts for each round of spending generated by a change in exogenous demand represented by a change in state government construction spending. This will provide us with an approximation of the total sales impact by industry without creating an inverse matrix. This approximation can be made as close as possible to s by calculating the impact of additional rounds of spending. The number of calculations required for each succeeding round of spending increases dramatically, but at the same time the additional economic impact declines dramatically so that only a few rounds of spending need be calculated.

This less-than-elegant approach to the determination of impact has two advantages. First, it allows us to trace the size of the impact in each successive round of spending, and second it allows us to trace the contribution of each component of spending at each round of spending.

The approximate sales impact, s_{app}, consists of a separate vector for each round of spending such that round i = s.i, so

$$s.0 + s.1 + s.2 + \ldots + s.N = s_{app}$$

and when N is infinity this series equals s.

If we partition the A matrix into column vectors a_j where a_j is the vector of direct requirements for the production of good j, then sales vectors can be alternatively defined as follows:

$s.0 = d$ the change in final demand

$s.1 = a_j = Ad$ the direct requirements vector

$s.2 = a'_jA' = Aa_j = As.1 = A^2d$

The pth row of this final multiplication can be expanded to show the logic of this expression. It is as follows where n is the number of industries; j, the construction industry; and p, the industry for which the second round impact is being calculated:

$$(a_{p1} * a_{ij}) + (a_{p2} * a_{2j}) + \ldots + (a_{pn} * a_{nj})$$

Each element of this expression is a second-round demand for industry p output generated by the direct demand for one of the inputs used in construction. Together, they represent the second round sales demand for industry p. For the third round, we have

$$s.3 = As.2 = AAa_j = A^2a_j = A^3d$$

Recognizing the emerging pattern, we see that s_{app} can be written in two ways as a function of A.

$$s_{app} = d + Ad + A^2d + A^3d + \ldots = (I + A + A^2 + A^3 + \ldots)d$$

$$s_{app} = d + a_j + Aa_j + A^2a_j + \ldots = d + (I + A + A^2 + \ldots)a_j$$

The second and subsequent round impacts can be presented in a different way which shows, for each input required for final demand, the amount of the subsequent round of spending engendered. This is defined as

$$a'_jA = g.2$$

Here g is a vector in which each element represents the second-round sales in all industries of the first-round purchases of each of the inputs used to produce output j. Thus, the first element of g.2 would be the sales by all industries in the second-round generated by first-round purchases of good 1 by the industry j. Naturally, the sum of the elements of s.2 and g.2 should be equal.

If construction consists of more than one element of final demand such as would be the case if administration, planning, and overhead of government were included as elements in the final product, then there would be two final demand vectors d, and two total sales impact vectors would be generated. The two total sales impact vectors could be weighted and added to obtain the final vector of sales as follows (where $r_1 + r_2 = 1$):

$$r_1 s_{app1} + r_2 s_{app2} = s$$

It is possible to investigate the impacts of different types of construction projects relatively easily. We assume other industries sell to construction but that construction sells only to final demand as investment or government. Thus, to add types of construction activities to the A matrix, it is necessary only to change, or add, columns representing the coefficients of the new project types. An additional row is added, but it is a row of zeros.

Finally, it is possible to close the model with respect to households, investment, and government by moving them from final demand into the A matrix as industries. We will do this only for households.

A.IV. Elements of the Flows Matrix (A)

a. Interindustry Technical Coefficients for Construction (x_{ij} where j is a type of construction)

Table A.1 shows the technical coefficients for a variety of types of construction projects adopted from the national input-output tables. Value added by component is not available by project type, and we have divided intermediate inputs into those which may be available for purchase in Alaska from those which are not. The determination of what may be available locally was on the basis of an analysis of the manufacturing industry in the state summarized in Table A.2.

TABLE A.1. DIRECT REQUIREMENTS BY INDUSTRY FOR DIFFERENT TYPES OF CONTRACT CONSTRUCTION (Technical Coefficients)

	All Types New Construction	Educational Buildings Not Includ. Dormitories	Office Buildings	Hospitals	Sewers	Highways and Streets	Land Reclamation and Flood Control
VALUE ADDED	42.0	38.4	40.7	43.0	46.2	47.1	60.3
INTERMEDIATE INPUTS (INCL. IMPORTS)	58.0	61.6	59.3	57.0	53.8	52.9	39.7
Commodities	39.4	37.9	39.2	35.3	39.4	36.6	25.2
Potentially Available Locally	16.4	10.7	10.2	9.7	16.1	25.1	10.9
Stone & Clay Mining	.8	.8	.5	.5	1.3	4.4	1.8
Lumber & Wood Products	6.9	1.9	1.5	2.4	.5	.7	1.2
Petroleum Refining	1.5	1.5	.6	.5	.7	7.6	4.1
Stone & Clay Manufacturing	7.2	6.5	7.6	6.3	13.6	12.4	3.8
Not Available Locally	23.0	27.2	29.0	25.6	23.3	11.5	28.8
Noncommodities	18.6	23.7	20.1	21.7	14.4	16.3	14.5
Transportation	2.6	2.7	2.5	2.3	2.0	4.0	2.1
Communications	.3	.3	.4	.3	.3	.1	.1
Utilities	.1	.1	.2	.1	.1	-	-
Trade	7.8	6.2	6.5	5.9	5.3	6.6	4.7
Finance/Insurance/Real Estate	1.1	1.3	1.5	.8	1.4	.8	.7
Services	6.7	13.1	9.0	12.3	5.3	4.8	6.9

Table A.1. (continued)

	Maintenance and Repair			Residential Construction			
	Highways and Streets	Other Nonfarm Buildings	All Types	1-Unit Residential	2-4-Unit Residential	Residential Additions	Maintenance and Repair
VALUE ADDED	63.4	56.2	58.0	39.6	48.1	39.6	53.7
INTERMEDIATE INPUTS (INCL. IMPORTS)	36.6	43.8	42.0	60.4	51.9	60.4	46.3
Commodities	23.5	27.2	26.9	37.6	32.2	43.8	29.7
Potentially Available Locally	17.4	9.3	9.5	23.9	17.3	22.5	7.3
Stone & Clay Mining	6.2	-	1.0	.2	.3	.2	-
Lumber & Wood Products	1.6	2.0	2.2	15.6	10.0	16.4	2.4
Petroleum Refining	7.3	2.4	3.1	.7	.7	.3	3.1
Stone & Clay Manufacturing	2.3	4.9	3.2	7.4	6.3	5.6	1.8
Not Available Locally	6.1	17.9	17.4	13.7	14.9	21.3	22.4
Noncommodities	13.1	16.6	15.1	22.8	19.7	16.6	16.6
Transportation	4.7	2.5	2.6	3.4	2.4	2.2	2.2
Communications	.3	.6	.3	.5	.2	.2	.3
Utilities	.2	.3	.2	.2	-	-	-
Trade	3.6	7.4	7.5	10.6	8.3	12.1	11.2
Finance/Insurance/Real Estate	1.4	2.4	1.6	2.0	.8	.6	1.2
Services	2.9	3.4	2.9	6.1	8.0	1.5	1.7

TABLE A.2. PRINCIPAL MANUFACTURING ACTIVITIES IN ALASKA AND THEIR IMPORTANCE IN THE NATIONAL ECONOMY

Industry (SIC Code)	(1) Alaskan Employment In March 1979	(2) Total U.S. Employment (000)	Index of[a] Relative Alaskan Concentration
Total Manufacturing	9,149	21,483	.23
Fish Processing (209)	3,970	155	13.85
Logging Camps (241)	975	102	5.18
Pulp Mills (261)	(500-999)	16	25.84
*Sawmills and Planing Mills (242)	(500-640)	220	1.40
Newspapers (271)	(500-999)	402	1.01
Fertilizer (2873)	(250-499)	13	16.09
Commercial Printing (275)	224	412	.29
Bakery Products (205)	(100-209)	228	.37
Petroleum Refining (291)	(100-137)	104	.62
Machinery (35)	135	2,457	.03
*Fabricated Structural Metal Products (344)		472	.12
*Ready-Mix Concrete (3273)		92	.56
Miscellaneous Foods (20-209-205)	(60-169)	1,158	.05
Book Printing (273)	(20-99)	115	.28
Furniture (25)	(20-99)	507	.06
*Paving and Roofing Materials (295)	(20-57)	35	.60
*Millwork, Plywood, and Structural Lumber (243)	(20-99)	219	.15
Other Printing (27-271-273)	(0-76)	734	.03
*Other Concrete, Gypsum, & Plaster Products Except Ready-Mix Concrete (327-3273)	71	107	.36
Jewelry (391)	44	63	.38
Miscellaneous (39-391)	39	392	.05
Apparel (23)	38	1,333	.02

Table A.2. (continued)

Industry (SIC Code)	(1) Alaskan Employment In March 1979	(2) Total U.S. Employment (000)	Index of[a] Relative Alaskan Concentration
Rubber Products (30)	36	809	.02
Cutlery, Hand Tools, Hardware (342)	(20-57)	185	.11
Boat Building and Repair (3732)	(20-71)	56	.44
*Stone, Clay, Glass Products except Concrete (32-327)	(0-57)	456	.03
*Other Wood Products (245-249)	(0-38)	171	.06
*Other Fabricated Metal (34-342-344)	(0-38)	1,063	.00
*Primary Metal (33)	(0-19)	1,215	.00
*Building Paper and Board Mills (266)	(0-19)	9	.58
Textile Mill Products (22)	(0-19)	869	.01
Chemicals except Fertilizer (28-2873)	(0-19)	911	.01
Electric Equipment (36)	(0-19)	1,961	.00
Instruments (38)	(0-19)	630	.01
Transport Equipment except Boats (37-3732)	(0-19)	1,940	.00
Construction Employment	10,092	4,483	2.25
TOTAL EMPLOYMENT	166,406	89,886	

Note: Only the range of employees in some Alaskan manufacturing industries is given due to disclosure limitations. To calculate the index of concentration, the midpoint of the range is used.

[a]This is a measure of the concentration of this industry in Alaska calculated as [Alaska employment in industry/total Alaska employment] * [U.S. employment in industry/total U.S. employment]

SOURCE: U.S. Department of Commerce Bureau of the Census County Business Patterns 1979

A second source of information on the direct requirements by industry of different types of construction projects is a series of reports by the Bureau of Labor Statistics. Unfortunately, the methodology of these reports precludes a simple conversion of the labor and materials requirements by project type from those studies to the input requirements by industry of the input-output framework. Table A.3 shows the lack of one-to-one correspondence between the elements of the two methodologies.

TABLE A.3. COMPARISON OF INPUT-OUTPUT WITH BUREAU OF LABOR STATISTICS CATEGORIZATION

Input-Output Category	Labor and Materials Requirements Bureau of Labor Statistics
VALUE ADDED	
Employee Compensation	
Onsite Wages	Onsite Wages and Salaries
Offsite Wages	Overhead and Profit
Other Employee Compensation	Overhead and Profit
Other Factor Payments[a]	
Proprietor Income	Overhead and Profit
Profits	Overhead and Profit
Capital Consumption Allowance	Overhead & Profit/Construction Equipment/Rental Value of Owned Equipment
Indirect Business Taxes	Overhead and Profit
INTERMEDIATE INPUTS	
Commodity Purchases	Equipment/Materials/Supplies/ Construction Equipment
Noncommodity Purchases	
Transport and Trade	Equipment/Materials/Supplies
Communications/Utilities/ Finance/Services	Overhead and Profit/Equipment Materials/Supplies

[a]Also includes net interest, rental income, inventory valuation adjustment, business transfers.

b. Components of Value Added in Construction

Nationally, the components of value added have shown some variation over time, as shown in Table A.4. In particular, employee compensation appears to have declined somewhat during the 1970s. This trend is relevant for this analysis because the information we have on the components of value added comes from different sources using somewhat different definitions of the concept and from analyses done at different times.

Employee compensation ranges from 70 to 75 percent of value added in the National Income Accounts in recent years and is 78 percent in the 1972 Input-Output table. The value-added definitions in these studies are similar, but the industries are defined slightly differently. This difference is minor and we ignore it. In the Census of Construction Industries, however, it is considerably less. For the United States in 1977, it is 66 percent, and for Alaska, it is 49 percent. The reason is largely the result of the fact that the Census of Construction Industries includes some payments to services in value added which reduce the employee compensation component of the total. Table A.5 summarizes the value-added information available from the the Census of Construction. Payroll as a portion of value added ranges from 39 to 67 percent nationally. Aside from the problem with the value-added definition from the Census, its industry classifications do not correspond to those of the BEA.

The most important value-added components for this analysis are wages and salaries, proprietor income, and profits. We can safely assume that payments to other components, principally other elements of employee compensation, capital consumption allowance, and indirect business taxes have no further impact on the economy. For the industry as a whole, the capital consumption allowance is slightly larger than indirect business taxes, and together they are about 10 percent of value added (see Table A.4). The capital consumption allowance will vary by type of construction, however, as shown indirectly in Table A.6. This table gives several inferential measures of what capital consumption allowances and returns to nonlabor factors of production are for different types of construction.

Based upon the Census of Construction, wages and salaries is currently about 84 percent of employee compensation. Proprietor income is a significant component of value added as gauged by Table A.7 which shows the structure of the construction industry in terms of employment. Sampling the United States and western states, we see that proprietors are anywhere from 15 to 36 percent as numerous as salaried employees in the industry. Generally, the smaller firms have no payrolls. From this sketchy data, we may

TABLE A.4. COMPONENTS OF VALUE ADDED IN U.S. CONSTRUCTION

(billion current dollars)

	Total	Employee Compensation	Profit Type Income	Capital Consumption Allowance	Net Indirect Business Taxes	Interest	Employee Compensation as a Percentage of Value Added
1979	113.0	82.7	18.2	5.7	4.7	1.7	73
1978	99.9	71.6	17.3	5.3	4.4	1.4	72
1977	86.7	60.9	15.8	4.9	4.0	1.2	70
1976	76.6	54.9	12.7	4.4	3.6	1.1	72
1975	69.9	50.6	10.6	4.3	3.2	1.2	72
1974	69.2	52.4	8.9	3.9	2.9	1.0	76
1973	66.3	49.4	10.0	3.5	2.7	.7	75
1972	59.4	43.8	9.6	3.1	2.4	.4	74
1971	53.6	40.2	8.4	2.7	2.0	.3	75
1970	48.9	37.0	7.6	2.6	1.6	.2	76
1969	46.3	34.7	7.8	2.4	1.3	.2	75
1968	41.3	30.7	7.3	2.2	1.0	.1	74
1967	37.5	27.5	7.1	2.0	.7	.2	73
1966	35.9	26.3	6.7	1.9	.7	.2	73

SOURCE: U.S. Department of Commerce Bureau of Economic Analysis. Special printout on gross product by sector or industry of origin.

TABLE A.5. COMPONENTS OF VALUE ADDED IN CONSTRUCTION

Source	Payroll (million $) Construction	Payroll (million $) Total	Value Added	Net Receipts	Construction Payroll/ Value Added	Construction Payroll/Net Construction Receipts	Payroll/Net Construction Receipts	Total Payroll/ Value Added	Value Added/Net Receipts
UNITED STATES									
Single Family	3,066	3,736	7,297	15,070	42	20	25	51	48
Other Residential	485	646	1,145	2,203	42	22	29	56	52
Operative Bldgs.	1,053	2,026	5,229	10,627	20	10	19	39	49
Industrial Bldgs. and Warehouses	2,247	2,853	4,258	7,545	53	30	38	67	56
Highway and Street	2,927	3,596	7,641	12,546	38	23	29	47	61
Bridge, Tunnel, & Elevated Highway	439	536	963	1,827	46	24	29	56	53
Water, Sewer, and Utility	2,347	2,837	5,523	8,371	42	28	34	51	66
Heavy Const. n.e.c.	5,274	7,298	12,447	17,527	42	30	42	59	71
Nonresidential n.e.c.	3,190	4,275	7,112	12,816	45	25	33	60	55
Structural Steel Erection	556	674	1,184	1,709	47	33	39	57	69
Plumbing, Heating	5,025	6,414	10,681	19,136	47	26	34	60	56
Electrical	4,497	5,483	8,748	13,919	51	32	39	63	63
Masonry	1,350	1,493	2,417	3,678	56	37	41	62	66
Concrete Work	1,043	1,210	2,228	3,862	47	27	31	54	58
Excavating and Foundation	1,021	1,208	2,994	3,930	34	26	31	40	76

Note: The Census defines value added to be net business receipts less payments for materials, components, supplies, and fuels. Included in Value Added is "selected purchased services" composed primarily of repair services for equipment as well as all payments to sole proprietors and partners of firms. This definition is not the same as that used by BEA. The primary differences are that BEA nets out purchased services but adds sales and excise taxes.

SOURCE: U.S. Department of Commerce, Bureau of the Census, 1977 Census of Construction Industries.

TABLE A.5. (continued)

Source	Payroll (million $) Construction	Payroll (million $) Total	Value Added	Net Receipts	Construction Payroll/ Value Added	Construction Payroll/Net Construction Receipts	Payroll/Net Construction Receipts	Total Payroll/ Value Added	Value Added/Net Receipts
ALASKA									
General Contractors Nonresidential NEC	17	22	47	73	36	23	30	47	64
Highway and Streets	43	50	115	180	37	24	28	43	64
Water, Sewer, and Utility	115	133	218	-	53	-	-	61	-
Plumbing	19	24	42	64	45	30	38	57	66
Electrical	80	89	114	138	70	58	64	78	83
Excavation	4	4	13	16	31	25	25	31	81
Structural Steel Erection	3	4	6	7	50	43	57	67	86
Concrete Work	1	1	4	5	25	20	20	25	80
TOTALS									
United States									
1977	43,112	54,980	98,864	164,516	44	26	33	56	60
1972	--	--	68,197	--	-	-	-	-	-
Alaska									
1977	399	464	803	1,130	50	35	41	58	71
1972	-	-	204	-	-	-	-	-	-

TABLE A.6. MEASURES OF CAPITAL INTENSITY OF DIFFERENT CATEGORIES OF CONSTRUCTION

	Rental Payments/ Value Added	Payroll/ Value Added	Capital Expenditures/ Payroll	Gross Book Value/ Payroll
Single-Family Residences	.0143	.512	.101	.713
Other Residential Buildings	.0301	.565	.102	.481
Operative Builders	.0122	.387	.344	1.339
Industrial Buildings and Warehouses	.0319	.670	.0655	.393
Nonresidential Buildings, n.e.c.	.0262	.601	.0763	.477
Highway and Street Construction	.0711	.471	.255	1.867
Bridge, Tunnel, & Elevated Highway Construction	.0652	.557	.171	1.290
Water, Sewer, & Utility Lines	.0660	.514	.195	1.112
Heavy Construction, n.e.c.	.0401	.586	.089	.589
Plumbing, Heating, and Air Conditioning	.0173	.600	.0595	.347
Electrical Work	.0119	.627	.0472	.281
Masonry, Stone Setting, & Other Stonework	.0136	.618	.0660	.354
Carpentry	.0120	.577	.0598	.276
Concrete Work	.0296	.543	.128	.674
Structural Steel Erection	.0338	.569	.0767	.574
Excavating & Foundation Work	.0736	.403	.398	2.193
Wrecking and Demolition Work	.0661	.423	.197	1.453

SOURCE: U.S. Department of Commerce, Bureau of the Census, 1977 Census of Construction Industries, U.S. Summary Table 3.

TABLE A.7. THE STRUCTURE OF THE CONSTRUCTION INDUSTRY

	Alaska		Washington		California		Oregon		Total U.S.
	1977	1972	1977	1972	1977	1972	1977	1972	1977
TOTAL FIRMS									
Number	3,181	1,922	24,185	15,832	102,078	63,469	18,276	12,648	1,200,407
Receipts (10^6\$)	1,508	438	5,514	2,629	32,232	17,844	3,009	1,612	244,816
Employees	16,771	6,777	84,058	61,090	418,941	353,599	45,110	38,281	4,272,659
Proprietor & Working Partners	2,710	1,515	20,696	13,136	88,488	51,932	16,165	10,805	1,013,961
Proprietors/ Employees (%)	16	22	25	22	21	15	36	28	24
FIRMS WITH PAYROLL									
Number	1,385	1,037	11,264	7,994	43,963	34,022	7,181	5,829	480,014
Receipts (10^6\$)	1,422	411	5,131	2,504	29,997	17,198	2,655	1,496	224,665
Average Receipts (10^3\$)	1,027	396	456	313	682	505	370	257	468
FIRMS WITHOUT PAYROLL									
Number	1,796	885	12,921	7,838	58,115	29,447	11,095	6,819	720,393
Receipts (10^6\$)	87	27	383	125	2,236	646	354	117	20,151
Average Receipts (10^3\$)	48	31	30	16	38	22	32	17	28

SOURCE: U.S. Department of Commerce Bureau of the Census. 1977 Census of Construction Industries.

infer that proprietor income may be 15 percent as large as wage and salary income. This is a conservative estimate reflecting the fact that the average proprietor may have a smaller annual wage than a salaried employee.

For simplicity, we assume that for most construction project types, 90 percent of value added is wages and salaries, other employee compensation, proprietor income, and profits. Net of other employee compensation, this equals 78 percent of value added (15% is proprietor income or profit; .84 x 75% = 63% is wages and salaries). For highway new construction, sewers, and land reclamation, we assume only 70 percent of value added is wages and salaries, other employee compensation, proprietor income, and profit. This is equivalent to 61 percent net of nonwage employee compensation. Wages and salaries is 46 percent of value added, and proprietor income and profit equals 15 percent.

c. Trade Coefficients for Construction

The previous two sections have discussed the technical coefficients for different types of construction projects. In fact, only a portion of each input can be purchased within Alaska--independent of any supply constraints on labor or other materials which may, when demand for construction is high, reduce the locally supplied component of inputs. Regional trade coefficient assumptions for construction appear in Table A.8.

Using the analysis of local manufacturing presented in Table A.2, we have identified four types of commodities which may be available locally. We assume that all sand and gravel will be locally provided; 10 percent of lumber and wood products; 25 percent of petroleum products (asphalt); and 25 percent of stone and clay products. For noncommodities, we assume 50 percent will be locally provided and 50 percent imported, except utilities which are all locally supplied.

For value added and particularly for personal income, we assume that other employee compensation, capital consumption allowance, and indirect business tax all "leak out" of the economy. For wages and salaries, proprietor income, and profits, we have information from tax returns and employment wage reports on the net outflow of wages in Alaska in 1978. For the state, the ratio of wages reported by residents to wages paid was .82, indicating that 18 percent of wages paid went to nonresidents in that year. If we assume that (1) wages are more likely paid to nonresidents in seasonal industries and (2) nonresident wages will have some impact on the state economy, then perhaps 75 percent of wages and salaries paid in construction, as well as other components of value added, remains within the economy after the initial round of spending.

TABLE A.8. REGIONAL TRADE COEFFICIENT ASSUMPTIONS USED FOR CONSTRUCTION INDUSTRY

Intermediate Inputs	
Commodities	
Locally Available	
Stone and Clay Mining	1
Lumber and Wood Products	.1
Petroleum Refining	2.5
Stone and Clay Manufacturing	2.5
Not Locally Available	0
Noncommodities	
Locally Available	
Transportation	.5
Communications	.5
Utilities	1
Trade	.5
Finance/Insurance/Real Estate	.5
Services	.5
Value Added	
Employee Compensation	
Wages and Salaries	.75
Other Compensation	0
Other Factor Payments	
Proprietor Income	.75
Profits	.75
Capital Consumption Allowance	0
Indirect Business Tax	0

Notes: Stone and clay mining assumed to be all sand and gravel.

Lumber and wood products consist of lumber camps, sawmills, and fabricated millwork.

Petroleum refining consists of fuels, paving materials, and other products.

Stone and clay manufacturing includes cement redi-mix concrete, concrete block, pipe, tile, bathroom accessories, porcelain, gypsum products, asbestos products, and brick.

Table A.9 shows for western states the percent of receipts earned by construction firms outside the home state. Alaska is much lower than other states, thus providing some indirect confirmation of this leakage assumption.

TABLE A.9. CONSTRUCTION FIRM RECEIPTS FROM WORK OUTSIDE OF HOME STATE

(billion $)

		Total Receipts	Work Outside Home State	Percent Outside Home State
Alaska	1977	1.4	.03	2
	1972	.4	NA	NA
Washington	1977	5.0	.6	12
	1972	2.4	.4	17
California	1977	28.6	3.8	13
	1972	16.8	1.9	11
Oregon	1977	2.7	.3	11
	1972	1.4	.1	7

SOURCE: U.S. Department of Commerce Bureau of the Census, 1977 Census of Construction Industries.

d. Construction-Related Costs

When money is allocated to the capital budget for bricks and mortar, other goods and services must also be purchased. Table A.10 summarizes a State of Alaska Department of Transportation and Public Facilities pro forma analysis of cost allocations for building construction and civil engineering projects. Between 75 and 92 percent of the construction dollar actually becomes contract construction. The remainder is split among project design, either within government or by architectural-engineering firms, project administration, and the purchase of equipment for the facility. A separate analysis by the Department of Highways indicates that during the 1960s and early 1970s, between 64 and 85 percent of capital outlays of the Highway Department were paid out for contract construction. The average was 74 percent with an upward trend over time.

These other components of the capital expenditure dollar must be analyzed in terms of direct requirements in addition to contract construction. We turn to this task in the next section as we complete the regional trade coefficients matrix for nonconstruction industries. (There may be some overestimation of the importance of design and administration in this method of analysis. This is because some elements of design and administration are included in the I-O category of construction industry.)

TABLE A.10. CONSTRUCTION PROJECT COST ALLOCATIONS

(percent)

	Buildings	Civil Engineering Projects
Project Design	6	4
Project Administration by Government Agencies	12	4
Equipment	7	-
Contract Construction	75	92
Reserves for Contingency	5	10
Original Contract	70	82

e. Sectoral Flow Coefficients--Nonconstruction/Noncommodity

The first attempt to construct an I-O model for Alaska was made in the early 1970s. An intersectoral flows model of Alaska was built in 1966 based on employment. At least two attempts to construct Alakan I-O models from national models have been identified (IMPLAN and RIMS). None is satisfactory to serve our purpose.

Table A.11 compares the noncommodity flows sector of the Alaskan I-O model (simplified by the author) with the national I-O model and the 1967 Washington State I-O model. Although there are some similarities between the Alaska and Washington model (the Alaska model was based upon the Washington model), there are some substantial differences, and there are also substantial differences between the regional I-O models and the U.S. models. This is disappointing because one might expect in theory that the "product mix" problem of applying national I-O coefficients to regional analysis might be small for the nonconstruction and noncommodity sector of the economy. The differences result primarily from differences in trade coefficients.

From this comparative table, we derive Table A.12, which is a hypothetical Alaskan direct requirements table for the noncommodity industries. This table is formed on the basis of judgment applied to Table A.11. Basically, the transportation coefficients are from the earlier work, as are those for communications and utilities. Trade industry coefficients are all 1 percent. Finance and services, in a reflection of the significant growth in these sectors in recent years, are set at levels close to those in the Washington I-O table.

TABLE A.11. SECTORAL FLOW COEFFICIENTS FROM THREE ANALYSES

	Construction	Transportation	Communications-Utilities	Trade	Finance	Service
Construction						
United States	0	0	0	0	0	0
Washington	0	1.2	1.1	.1	.6	.4
Alaska	0	1	1	0	0	0
Transportation						
United States	2.6	11.8	.7	1.3	.2	1.4
Washington	1.8	3.6	.5	.7	.5	.1
Alaska	2	5	1	6	0	0
Communications-Utilities						
United States	.4	1.9	14.4	2.9	1.5	2.5
Washington	.8	1.2	8.6	3.1	1.2	5.0
Alaska	1	2	9	1	1	2
Trade						
United States	7.8	2.4	.6	1.4	.4	2.7
Washington	2.8	.9	.3	1.8	1.2	.9
Alaska	1	1	1	0	0	0
Finance						
United States	1.1	4.0	2.7	5.5	13.1	6.5
Washington	.7	2.2	.9	3.0	5.4	1.8
Alaska	0	2	1	1	2	0
Service						
United States	6.7	6.7	4.8	8.7	4.8	9.3
Washington	2.2	1.3	3.5	4.6	3.5	5.6
Alaska	1	1	2	1	1	1
Local Purchase of Noncommodities						
United States	18.6	26.8	23.2	19.8	20.0	22.4
Washington	8.3	10.4	14.0	13.3	12.4	13.8
Alaska	5	12	15	9	4	3
Value Added						
United States	42	60	62	77	73	60
Washington	34	60	69	76	83	64
Alaska	54	40	69	76	89	64

TABLE A.12. HYPOTHETICAL ALASKAN DIRECT REQUIREMENTS TABLE FOR SUPPORT ACTIVITIES

(cents of sales of row industry for $1 of sales of column industry)

	Transportation	Communications-Utilities	Trade	Finance	Service
Construction	0	0	0	0	0
Transportation	5	1	6	0	0
Communications/ Utilities	2	9	1	1	2
Trade	1	1	1	1	1
Finance	2	1	2	3	2
Service	2	3	4	3	5
Local Purchases	12	15	14	8	10
Value Added	60	69	76	86	64

f. Other Regional Trade Coefficients

To complete the regional direct requirements table, trade coefficients are necessary for the manufacturing industries with sales to construction and noncommodity-producing industries. Table A.13 shows the distribution of relevant inputs from the national I-O model for the four primary commodities used in construction that are locally available. From this, we derive Table A.14, Hypothetical Alaskan Direct Requirements Table for Locally Available Commodities. All coefficients are one-half the national values, except for communications and utilities which are equal (consistent with the assumptions to derive Table A.12). The only exceptions are stone and clay mining transport requirements which are double the national average and communications/utilities which are reduced by a compensating proportion.

TABLE A.13. DIRECT REQUIREMENTS FOR LOCALLY AVAILABLE COMMODITIES

(percent)

	Stone and Clay Mining	Lumber and Wood Products	Petroleum Refining	Stone and Clay Manufacture
Value Added	61	38	24	48
Employee Compensation	33	23	10	32
Intermediate Inputs	39	62	76	52
Noncommodities	18	13	14	21
Transportation	1	3	6	9
Communications/Utilities	4	1	2	4
Trade	3	4	1	3
Finance	5	2	2	1
Service	5	3	3	4
Commodities	21	49	62	31
Stone and Clay Mining	2	-	-	6

TABLE A.14. HYPOTHETICAL ALASKAN DIRECT REQUIREMENTS TABLE FOR LOCALLY AVAILABLE COMMODITIES

(cents of sales of row industry for $1 of sales of column industry)

	Stone and Clay Mining	Lumber and Wood Products	Petroleum Refining	Stone and Clay Manufacture
Stone & Clay Mining	0	0	0	3
Lumber & Wood Products	0	0	0	0
Petroleum Refining	0	0	0	0
Stone & Clay Manufacture	0	0	0	0
Construction	0	0	0	0
Transportation	2	2	3	5
Communications/Utilities	3	1	2	4
Trade	2	2	1	2
Finance	3	1	1	1
Service	3	2	2	2
Value Added	61	38	24	48
Employee Compensation	33	23	10	32

g. State Government Purchases

State government is a labor-intensive industry. Table A.15 shows the direct requirements derived from the national I-O table as well as the Washington State table for state and local government. If we net out construction in each case, the value-added components (consisting of employee compensation) are quite similar. For our table, we adopt the national figures without construction and make only one adjustment which reduces services from 9 to 5 percent.

TABLE A.15. STATE AND LOCAL GOVERNMENT PURCHASE COMPOSITION

(percent)

	National		Washington	
	Total	Without Construction	Total	Without Construction
Commodities	9	12	14	21
Construction	22	-	39	-
Noncommodities	14	18	3	7
Transportation	1	2	0	1
Communications/ Utilities	2	3	2	3
Trade	1	1	1	1
Finance	3	3	0	1
Services	7	9	0	1
Value Added (Employee Comp.)	55	70	44	72

h. Personal Consumption Expenditures

Table A.16 shows personal consumption expenditure proportions taken from the national, Washington State, and Georgia Input-Output tables. For state economies, a large proportion of commodities are purchased outside the state, but noncommodities comprise the larger portion of total consumption of noninvestment items. For simplicity, we assume that the marginal propensity to consume in Alaska is .75; that no commodities purchased by consumers are locally produced; and that noncommodity consumption patterns follow the national patterns. In a more sophisticated analysis, we would recognize that there is a declining marginal propensity to consume with increasing income for current residents and also that new migrants have a higher average propensity to consume locally than current residents.

TABLE A.16. COMPOSITION OF PERSONAL CONSUMPTION EXPENDITURES

	United States	Washington	Georgia
Local Commodities	30	15	11
Noncommodities	69	50	57
Trade	19	24	21
Other	-	-	36
Finance	20	7	-
Service	22	14	-
Transportation	3	1	-
Communications/Utilities	5	4	-
Purchased Outside Region	1	35	31

i. Composition of Value Added in Manufacturing and Support

The final element necessary to complete the matrix is the local component of value added in support industries and manufacturing. Table A.17 shows components of value added by industry nationally. We assume the same composition by industry. We further assume that the only components of value added which affect local expenditures are wages and salaries and profit-type income. Of this income, only 90 percent remains within the state while 10 percent leaks out.

TABLE A.17. COMPONENTS OF VALUE ADDED, 1979 NATIONAL AVERAGE

(billion $)

	Total Value Added	Employee Compensation		Profit-Type Income	Capital Consumption Allowance	Net Indirect Business Taxes	Net Interest	Employee Compensation as a Percentage of Value Added
		Total	Wages & Salaries					
Mining	69	24	20	25	14	5	5	34
(Stone & Clay)	5	3	2	1	1	0	0	51
Manufacturing	569	408	333	65	52	30	14	72
(Lumber & Wood)	21	12	10	5	2	1	1	58
(Petroleum Refining)	17	7	5	-2	5	5	2	41
(Stone & Clay)	19	14	11	2	2	1	0	73
Transportation	91	65	54	8	11	4	3	72
Communications	61	32	24	6	12	6	4	53
Utilities	60	19	15	7	12	10	12	32
Trade	392	239	209	53	21	71	7	61
Finance	351	82	68	104	45	50	70	23
Services	302	217	191	54	18	9	5	72
Government	172	172	144	0	0	0	0	100

j. The Partial Direct Requirements Table

Table A.18 is the completed table based upon the foregoing analysis. It shows judgment estimates of purchases by each Alaskan industry (directly and indirectly affected by the sales of the construction and government sectors) from all other Alaskan industries. Several important points regarding the table should be mentioned. First, not all industries, particularly in the manufacturing sector, are shown. This is because some industries sell neither to construction nor to other industries in the state which sell to construction (for example, fish processing). Second, even those manufacturing industries which do sell to construction have few sales within the economy. (The top four rows are almost all zeros.) Third, no industry purchases either construction or government services. We assume construction is all investment and that private production requires no government input. Thus, all the construction and government rows are zero.

k. Employment Value Added and Wages

In order to calculate employment and wage effects of sales, vectors of employment and wages for each dollar of sales by industry are necessary. These are created from data shown in Table A.19. Local value added is automatically calculated by the model because it is closed to consumption.

TABLE A.18. A PARTIAL DIRECT REQUIREMENTS TABLE FOR ALASKA

ROW	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10
1	0.	0.	0.	0.03	0.008	0.005	0.005	0.013	0.044	0.018
2	0.	0.	0.	0.	0.002	0.002	0.002	0.001	0.001	0.001
3	0.	0.	0.	0.	0.004	0.002	0.001	0.002	0.019	0.01
4	0.	0.	0.	0.	0.016	0.019	0.016	0.034	0.031	0.01
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.02	0.02	0.03	0.05	0.014	0.013	0.012	0.01	0.02	0.011
14	0.03	0.01	0.02	0.04	0.004	0.006	0.004	0.004	0.001	0.001
15	0.02	0.02	0.01	0.02	0.031	0.033	0.03	0.027	0.033	0.024
16	0.03	0.01	0.01	0.01	0.007	0.008	0.004	0.007	0.004	0.004
17	0.03	0.02	0.02	0.02	0.066	0.045	0.062	0.027	0.024	0.035
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.375	0.253	0.06	0.28	0.224	0.238	0.252	0.212	0.216	0.276

ROW	COLUMN 11	COLUMN 12	COLUMN 13	COLUMN 14	COLUMN 15	COLUMN 16	COLUMN 17	COLUMN 18	COLUMN 19
1	0.062	0.	0.	0.	0.	0.	0.	0.	0.
2	0.002	0.002	0.	0.	0.	0.	0.	0.	0.
3	0.018	0.006	0.	0.	0.	0.	0.	0.	0.
4	0.006	0.012	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.024	0.013	0.05	0.01	0.06	0.	0.	0.02	0.02
14	0.005	0.009	0.02	0.09	0.01	0.01	0.02	0.03	0.03
15	0.018	0.037	0.01	0.01	0.01	0.01	0.01	0.01	0.18
16	0.007	0.012	0.02	0.01	0.02	0.03	0.02	0.03	0.06
17	0.015	0.017	0.02	0.03	0.04	0.03	0.05	0.05	0.12
18	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.371	0.329	0.368	0.059	0.458	0.381	0.466	0.584	0.

ROW AND COLUMN KEY:

Manufacturing and Mining

1. Stone & Clay Mining
2. Lumber & Wood Products
3. Petroleum Refining
4. Stone & Clay Manufacturing

New Construction

5. Schools
6. Offices
7. Hospitals
8. Sewers
9. Highways & Streets
10. Land Reclamation

Construction Maintenance

11. Highways & Streets
12. Nonfarm Building Maintenance

Support

13. Transportation
14. Communications/Utilities
15. Trade
16. Finance
17. Services
18. State Government
19. Local Component of Value Ad[illegible](ac[illegible], P[illegible]al Co[illegible]ptio[illegible]pend[illegible]es ([illegible])

TABLE A.19. ALASKA INDUSTRY RATIOS OF EMPLOYMENT AND WAGES TO SALES

(statewide averages for 1982)

Industry	Value Added/ Sales	Wages & Salaries/ Value Added	Wages/Sales[a]	Average Annual Wage 1979 Actual	Average Annual Wage 1982 Est.	Employment Per Million $ of Sales
Manufacturing & Mining						
Stone & Clay Mining	61	43	26	29,330	38,129	6.82
Lumber & Wood Products	38	48	18	23,279	30,263	5.95
Petroleum Refining	24	28	7	29,931	38,910	1.80
Stone & Clay Mfg.	48	60	29	27,506	35,758	8.11
New Construction						
Schools	38	63	24	34,815	45,260	5.30
Offices	41	63	26	34,815	45,260	5.74
Hospitals	43	63	27	34,815	45,260	5.97
Sewers	46	46	21	34,815	45,260	4.64
Highways & Streets	47	46	22	45,858	59,615	3.69
Land Reclamation	60	46	28	34,815	45,260	6.19
Construction Maintenance						
Highways & Streets	63	63	40	45,858	59,615	6.71
Nonfarm Building Maintenance	56	63	35	34,815	45,260	7.73
Support						
Transportation	60	60	36	24,736	32,157	11.12
Communications/ Utilities	69	33	23	31,902	41,473	5.55
Trade	76	53	40	14,870	19,331	20.69
Finance	86	20	17	17,271	22,452	7.58
Services	64	63	40	15,259	19,837	20.16
State Government	64	83	53	23,972	31,164	17.01

[a]Not residence adjusted

SOURCES: Value-Added-to-Sales ratio from national Input-Output table. Wages-and-Salaries-to-Value-Added Ratio from national Gross Product Accounts. Average Annual Wage from Statistical Quarterly for 1979. Estimate for 1982 based upon inflation between 1979 and 1982 at 30 percent. New construction wage is net of residential construction.

APPENDIX B. ALASKA DATA SOURCES

During the preliminary stages of this research, we tried to identify Alaska-specific data sources on the industry composition of sales to the construction industry. While the sources we found were not used in this study because of format limitations and the time requirements of the project, they have future potential for studies of this nature. In this appendix, we describe the data sources examined and discuss their inadequacies for the purpose of measuring the economic impacts of construction projects.

Most of the data is produced in the design and construction bidding process for state-financed projects. We concentrated our search for Alaska data with the Department of Transportation and Public Facilities (DOTPF).

1. Bid Schedules

For each proposed construction project, a bid schedule is prepared. The bid schedule provides prospective bidders with specifications of the material inputs required by pay item. Pay items define the tasks to be completed and are the basic organizational unit of a bid. Pay items are defined in Standard Specification Manuals published by DOTPF for different types of construction. Exhibit B.1 is a sample page from a bid schedule for a highway project. The "pay item no." is the reference number for the task to be completed. For example, in Exhibit B.1, pay item number 202(4) is removal of culvert pipe. According to design specifications, 265 linear feet of culvert is to be removed. A construction firm bidding for the project would provide a unit price and a bid amount. These bids include all material, labor, and equipment costs required to complete the task as outlined by the pay item. While a bidding firm will usually develop its cost estimates based on a more detailed breakdown of labor and material inputs, these breakdowns are not required by DOTPF in the bids.

DOTPF independently develops project estimates for each project. These estimates are prepared either by DOTPF cost estimators or under contract to private cost estimators. Under the current system, the state estimates are also provided at the pay item level with no detailed breakdowns.

This system of bidding does not produce project estimates which are disaggregated below the pay item level. In order to be of use for estimating the impact of capital expenditures, a breakdown of labor input, materials, and equipment is required.

EXHIBIT B.1.

The bidder shall insert a unit bid price in figures and in words opposite each alternative pay item listed below.

Pay Item No.	Estimated Quantity	Pay Item Name, with unit bid price or lump sum price written in words	Unit Bid Price or Lump Sum Price	Amount Bid
116(1)	All Req'd	Furnishing and Maintaining Field Office, at ______ per Lump Sum		
116(2)	All Req'd	Furnishing & Maintaining Field Lab at ______ per Lump Sum		
201(18)	All Req'd	Clearing, at ______ per Lump Sum		
202(2)	140	Removal of Pavement, at ______ per square yard		
202(4)	265	Removal of Culvert Pipe, at ______ per Linear Foot		
203(1)	8201	Common Excavation, at ______ per Cubic Yard		

MILL BAY ROAD
PROJECT NO. A80931

SOURCE: Alaska Department of Transportation and Public Facilities.

One possible source of data for economic impact analysis could be the detailed "spread sheets" developed by cost estimators in compiling bids. It is not known whether private contractors would be willing to provide data on labor and materials components from the bid sheets. An alternative would be for state estimators, either in-house or under contract, to develop more detailed cost estimates of projects specifically for the purpose of analyzing economic impacts.

2. Computerized Estimating System

As part of its project evaluation system, DOTPF subscribes to the nationwide ORR estimating system. ORR is a computerized cost estimating system for buildings. The system operates on eight levels ranging from preliminary estimates based on conceptual designs to detailed prebid cost estimates which break out material and labor costs. Currently, DOTPF uses the system for the purpose of analyzing alternate projects and does not use the system for the more detailed cost estimates. We have not investigated the plausibility of using this system. It would be limited to estimation of construction cost for buildings. In addition, the data would provide only an estimate of project inputs since the data are cost estimates, not actual cost experience.

3. Life Cycle Cost Model Data

An alternate approach to developing detailed state data is reflected in the approach used by DOTPF in developing their life cycle cost models in 1976-1977. In order to collect construction cost data, DOTPF cost analysts costed out projects built between 1968 and 1976 using the actual costs of the projects as control totals. The sample of projects which were costed depended on the availability of some cost data and as-built drawings. DOTPF believes that the projects selected were not a representative sample of the state's capital improvement projects. Additionally, the breakdown of costs varied depending on who did the analysis. As stored on computer tape, this data does not break out labor and materials. Instead, project costs are presented by task in a format similar to the pay item coding. Cost data was developed for buildings, airports, and fishery buildings.

4. Life Cycle Cost Model

The final state-specific data source investigated is DOTPF's Life Cycle Cost Model. The model provides estimates of construction costs and operation and maintenance costs for buildings. The Life Cycle Cost is for buildings only, with a heavy emphasis on school buildings. The model uses the building data described in the previous section as well as total cost data from more recent projects. Since the building cost data used in this model was taken from the state accounting/payment system and the Life Cycle Cost data base, the data in the current Life Cycle Cost model is not sufficiently disaggregated for estimating economic impact of capital expenditures.

APPENDIX C

DETAILED MATERIAL LISTS (RECIPES) FOR CONSTRUCTION PROJECTS

TABLE C.1. PERCENT DISTRIBUTION OF CONTRACT COSTS BY PROJECT TYPE

	Federally Aided Highways		Elementary and Secondary Schools	
	1958	1973	1959	1964-65
Onsite Wages and Salaries				
Administrative and Supervisory	2.49	1.40	1.04	.93
Brick Layers	-	-	2.48	2.37
Carpenters	-	1.48	5.00	4.26
Electricians	-	.27	1.90	1.88
Iron Workers	-	.59	.75	.80
Operating Engineers	-	6.05	.51	.70
Painters	-	.07	.88	.90
Plasterers and Lathers	-	-	.72	.52
Plumbers and Pipefitters	-	.05	2.51	2.48
Other Skilled Construction	9.13	1.48	2.11	2.61
Laborers, Helpers, and Tenders	-	8.07	7.77	7.97
Other Occupations	12.28	5.17	1.07	.39
All Onsite Wages and Salaries	23.9	24.6	26.7	25.8
Materials, Supplies, and Equipment				
Mining and Quarrying[a]	7.14	7.80	.38	.86
Lumber and Wood Products[b]	1.11	.90	5.37	5.63
Furniture and Fixtures	-	-	1.04	1.48
Chemicals and Allied Products	.50	.40	.78	.53
Petroleum Refining and Related Products	10.77	9.40	1.12	1.25
Stone, Clay, Glass and Concrete Products	10.56	8.30	13.44	12.96
Primary Metal Products	-	-	4.17	3.04
Fabricated Metal Products	12.27	11.60	17.95	17.82
Machinery except Electrical	-	-	.99	2.48
Electrical Machinery	-	-	5.82	5.39
Construction Equipment	12.40[d]	10.2[d]	1.39	.45
Other Materials and Supplies	8.23	6.20	3.05	2.21
Total Materials, Supplies, and Equipment	63.0	54.7	55.5	55.2
Overhead and Profit[c]	13.10	20.7	17.8	19.0
Total Contract Cost	100.0	100.0	100.0	100.0

TABLE C.1. (continued)

	Sewer Works				
	Lines		Plants		Land Projects
	1962-63	1971	1962-63	1971	1959-60
Onsite Wages & Salaries					
Administrative and Supervisory	2.45	3.30	2.39	3.20	2.63
Brick Layers	.32	.05	.53	.48	-
Carpenters	.58	.29	3.80	3.53	1.66
Electricians	.02	.10	.88	1.44	-
Iron Workers	.10	.05	1.04	1.13	.81
Operating Engineers	4.76	6.63	3.88	2.90	6.27
Painters	-	-	.40	.48	-
Plasterers and Lathers	-	-	-	-	-
Plumbers and Pipefitters	.10	-	1.36	1.81	-
Other Skilled Construction	.66	.73	1.76	2.47	1.79
Laborers, Helpers, and Tenders	10.81	8.19	8.43	6.33	5.98
Other Occupations	4.50	5.01	2.13	1.49	6.86
All Onsite Wages and Salaries	24.3	24.3	26.6	25.2	26.00
Materials, Supplies, and Equipment					
Mining and Quarrying[a]	2.59	1.78	1.30	.58	9.48
Lumber and Wood Products[b]	.44	.79	.94	1.29	2.25
Furniture and Fixtures	-	-	-	.12	-
Chemicals and Allied Products	.20	.59	.56	.46	2.10
Petroleum Refining and Related Products	1.68	2.50	1.06	.66	6.87
Stone, Clay, Glass and Concrete Products	31.12	21.16	9.63	8.22	4.94
Primary Metal Products	4.90	3.83	8.31	5.90	.72
Fabricated Metal Products	1.33	1.14	7.55	7.30	7.17
Machinery except Electrical	1.68	2.33	12.82	17.63	.32
Electrical Machinery	.41	.53	5.46	3.53	.13
Construction Equipment	11.25	16.72	8.18	5.57	19.22
Other Materials and Supplies	.11	.519	1.58	1.34	1.11
Total Materials, Supplies, and Equipment	55.7	51.9	57.4	52.6	54.3
Overhead and Profit[c]	20.0	23.8	16.0	22.2	19.7
Total Contract Cost	100.0	100.0	100.0	100.0	100.0

TABLE C.1. (continued)

	General Hospitals		Federal Office Bldgs.	College Housing	Dredging
	1959-60	1965-66	1959	1960-61	1959-60
Onsite Wages & Salaries					
Administrative and Supervisory	1.10	.95	1.74	1.00	1.52
Brick Layers	1.53	1.48	1.51	2.93	-
Carpenters	3.72	3.85	3.65	4.95	-
Electricians	2.48	2.93	2.64	1.93	-
Iron Workers	.99	.92	1.22	1.14	-
Operating Engineers	.45	.53	.70	.50	.36
Painters	.79	.77	.61	1.05	-
Plasterers and Lathers	1.75	1.81	1.10	1.00	-
Plumbers and Pipefitters	4.00	4.62	2.52	2.84	-
Other Skilled Construction	3.38	3.88	3.42	2.29	.55
Laborers, Helpers, and Tenders	7.53	7.61	9.43	9.32	.55
Other Occupations	.48	.21	.44	.32	29.33
All Onsite Wages and Salaries	28.2	29.6	29.0	29.3	32.3
Materials, Supplies, and Equipment					
Mining and Quarrying[a]	.23	.26	.22	.42	-
Lumber and Wood Products[b]	2.26	2.41	1.76	5.78	-
Furniture and Fixtures	.47	.23	.18	.92	-
Chemicals and Allied Products	.44	.40	.55	.64	1.66
Petroleum Refining and Related Products	.53	.41	.47	.5	11.85
Stone, Clay, Glass and Concrete Products	10.33	9.51	11.51	13.97	-
Primary Metal Products	3.71	4.45	3.90	3.31	-
Fabricated Metal Products	19.07	16.08	17.49	18.37	.63
Machinery except Electrical	4.61	6.26	3.68	1.58	.59
Electrical Machinery	8.49	8.08	9.70	6.16	-
Construction Equipment	1.12	1.29	1.91	1.59	24.89
Other Materials and Supplies	3.20	2.31	1.92	.88	2.59
Total Materials, Supplies, and Equipment	54.4	51.7	53.3	54.2	42.2
Overhead and Profit[c]	17.4	18.7	17.7	16.5	25.5
Total Contract Cost	100.0	100.0	100.0	100.0	100.0

TABLE C.1. (continued)

	Private Single-Family Housing		Private Multi-Family Housing	Public Housing	
	1962	1969	1971	1959-60	1968
Onsite Wages & Salaries					
Administrative and Supervisory	.66	.57	1.62	1.42	1.17
Brick Layers	1.22	1.16	1.40	2.70	2.53
Carpenters	7.65	7.12	7.09	6.78	6.58
Electricians	.62	.61	1.65	1.46	1.88
Iron Workers	-	-	.64	.75	1.13
Operating Engineers	.31	.37	.81	.96	1.00
Painters	2.10	1.49	1.12	1.56	1.59
Plasterers and Lathers	.44	.35	.47	2.41	.97
Plumbers and Pipefitters	1.15	.88	2.12	2.77	3.01
Other Skilled Construction	2.70	2.04	3.15	2.31	2.14
Laborers, Helpers, and Tenders	5.15	5.69	7.20	10.97	9.78
Other Occupations	.11	.10	.64	1.42	.62
All Onsite Wages and Salaries	22.1	20.4	27.9	35.5	32.4
Materials, Supplies, and Equipment					
Mining and Quarrying[a]	.38	.39	.63	.38	.35
Lumber and Wood Products[b]	19.30	16.57	8.81	6.70	6.25
Furniture and Fixtures	-	1.45	1.84	.14	.13
Chemicals and Allied Products	1.07	.81	1.04	.86	.87
Petroleum Refining and Related Products	1.11	.80	.82	.81	.95
Stone, Clay, Glass and Concrete Products	11.37	9.45	10.44	12.87	10.72
Primary Metal Products	2.65	2.24	4.18	3.80	3.99
Fabricated Metal Products	7.04	5.71	7.36	13.54	11.80
Machinery except Electrical	.22	.84	1.76	1.09	1.09
Electrical Machinery	3.13	3.00	4.42	3.99	4.90
Construction Equipment	.98	.89	3.07	2.52	1.51
Other Materials and Supplies	.96	2.16	2.83	.86	.78
Total Materials, Supplies, and Equipment	48.2	44.3	47.2	47.5	43.4
Overhead and Profit[c]	29.7	35.3	24.8	17.0	24.2
Total Contract Cost	100.0	100.0	100.0	100.0	100.0

TABLE C.1 NOTES

a. Nonmetallic mineral except fuel.

b. Except furniture.

c. Includes offsite wages, fringe benefits, construction financing, inventory, other overhead, and profit.

d. ISER estimate.

Note: The BLS has conducted a series of surveys to determine the employment and material requirements for specific types of construction projects since 1959. The project types studied include highways; federal government office buildings; schools; single-family, multifamily, public, and college housing; sewer plants and lines; land projects, dredging; and hospitals. These studies report the input proportions of labor and materials for projects built in the sample year. The reports provide a U.S. average and statistics for four regions of the country: Northeast, South, Northcentral, and West. The BLS samples do not include projects constructed in Alaska. Most of the surveys were completed in the 1960s with the most recent studies (multifamily and sewer works) completed in the 1970s. Due to rounding, detail may not add to subtotals.

The BLS methodology may result in an underestimate of the labor requirements of construction for two reasons. First, the labor component of contracted overhead items is not included. This would include financing, utilities, business services, and legal and professional services. The indirect labor which is counted is that required to produce, transport, and sell the material inputs (see source, page 3). Second, the method used to estimate offsite labor requirements may exclude proprietor employment, an important element in construction, from the total. Furthermore, this underestimate will result in an underestimate of the induced employment effect.

SOURCE: Derived from U.S. Department of Labor, Bureau of Labor Statistics. "Labor and Material Requirements for Sewer Works Construction." Bulletin 2003, January 1979, Tables 12, 13, 14.

TABLE C.2. PERCENT DISTRIBUTION OF INTERMEDIATE INPUTS AND VALUE ADDED BY PROJECT TYPE - NEW CONSTRUCTION

	Petroleum Pipelines 11.0305	Water Supply Facility 11.0306	Educatn. Bldgs. 11.0207	Electric Utility Facility 11.0303	Other Nonfarm Bldgs 11.0209
Inputs Potentially Available in Alaska	22.6	28.2	34.4	22.1	33.4
Stone and Clay Mining and Quarrying	1.0	.2	.8	.1	.6
Lumber and Wood Products	-	.2	1.9	2.8	2.3
Petroleum Refining	6.4	.5	1.5	.2	.6
Stone and Clay	.5	5.4	6.5	6.0	8.3
Transportation	1.9	1.3	2.7	1.5	2.2
Communication	a	a	.3	a	a
Electric, Gas, Water and Sanitary Services	-	a	.1	a	.2
Wholesale/Retail	8.4	6.9	6.2	6.2	6.1
Finance, Insurance, Real Estate	.5	9.7	1.3	.4	1.5
Services	3.9	4.1	13.1	4.9	11.6
Government	-	a	a	a	a
Inputs Not Available in Alaska	44.2	35.4	27.2	38.7	27.4
Chemical, Paints	2.0	.1	.6	.1	.6
Iron, Steel, Nonferrous Metals Manufacturing	21.5	22.2	2.6	7.7	3.1
Heating, Plumbing Products	13.0	8.7	1.3	14.2	10.1
Construction and Mining Machinery	.2	.1	.1	.1	.1
Household Appliances	-	-	.2	a	.2
Electrical, Lighting and Wiring Equipment	.5	.5	2.0	4.4	1.7
Other	7.0	3.8	20.4	12.2	11.6
Total Intermediate Inputs	66.8	63.6	61.6	60.8	60.8
Value Added	33.2	36.4	38.4	39.2	39.2
Total Value of Product	100.0	100.0	100.0	100.0	100.0
Million Dollars in 1972	284.0	1076.0	6425.0	8039.0	2907.6

SOURCE: Derived from U.S. Department of Commerce, Bureau of Economic Analysis. Detailed Input-Output Structure of the U.S. Economy 1972, 1979.

TABLE C.2 (Continued)
NEW CONSTRUCTION

	Resident. 1-Unit Structrs. 11.0101	Resident. Addtns. 11.0105	Dormi-tories 11.0107	Military Facility 11.0505	Indust. Bldgs. 11.0201
Inputs Potentially Available in Alaska	46.7	39.1	36.8	32.5	19.3
Stone and Clay Mining and Quarrying	.2	.2	.6	1.1	.3
Lumber and Wood Products	15.6	16.4	4.0	1.4	.7
Petroleum Refining	.7	.3	.5	1.8	.6
Stone and Clay	7.4	5.6	11.8	7.9	5.6
Transportation	3.4	2.2	1.7	2.3	2.1
Communication	.5	.2	.4	.2	-
Electric, Gas, Water and Sanitary Services	.2	a	.2	.1	-
Wholesale/Retail	10.6	12.1	5.6	6.1	6.3
Finance, Insurance, Real Estate	2.0	.6	1.6	1.0	a
Services	6.1	1.5	10.4	10.6	3.7
Government	a	a	a	a	-
Inputs Not Available in Alaska	13.7	21.3	23.3	27.2	40.3
Chemical, Paints	.4	1.2	.8	.9	.6
Iron, Steel, Nonferrous Metals Manufacturing	1.4	2.8	2.9	4.0	1.5
Heating, Plumbing Products	4.1	7.4	9.6	11.0	19.6
Construction and Mining Machinery	.1	.1	.1	.2	a
Household Appliances	.3	.3	.3	.1	.1
Electrical, Lighting and Wiring Equipment	.6	1.6	1.0	2.0	1.5
Other	6.8	7.9	8.6	9.0	17.0
Total Intermediate Inputs	60.4	60.4	60.1	59.7	59.6
Value Added	39.6	39.6	39.9	40.3	40.4
Total Value of Product	100.0	100.0	100.0	100.0	100.0
Million Dollars in 1972	29260.6	7462.8	370.0	1087.0	5210.0

TABLE C.2 (continued)
NEW CONSTRUCTION

	Office. Bldgs. 11.0202	Hospitals 11.0208	Sewer System Fclty. 11.0307	Highways and Streets 11.0400
Inputs Potentially Available in Alaska	30.3	31.4	30.5	41.4
Stone and Clay Mining and Quarrying	.5	.5	1.3	4.4
Lumber and Wood Products	1.5	2.4	.5	.7
Petroleum Refining	.6	.5	.7	7.6
Stone and Clay	7.6	6.3	13.6	12.4
Transportation	2.5	2.3	2.0	4.0
Communication	.4	.3	.3	.1
Electric, Gas, Water and Sanitary Services	.2	.1	.1	a
Wholesale/Retail	6.5	5.9	5.3	6.6
Finance, Insurance, Real Estate	1.5	.8	1.4	.8
Services	9.0	12.3	5.3	4.8
Government	a	a	a	a
Inputs Not Available in Alaska	29.0	25.6	23.3	11.5
Chemical, Paints	.5	.7	.3	.8
Iron, Steel, Nonferrous Metals Manufacturing	2.8	3.4	10.0	1.3
Heating, Plumbing Products	14.4	9.2	4.7	6.5
Construction and Mining Machinery	a	a	1.8	.2
Household Appliances	.2	.3	a	-
Electrical, Lighting and Wiring Equipment	.1.8	2.1	.3	.9
Other	9.3	10.0	6.2	1.8
Total Intermediate Inputs	59.3	57.0	53.8	52.9
Value Added	40.7	43.0	46.2	47.1
Total Value of Product	100.0	100.0	100.0	100.0
Million Dollars in 1972	6263.0	4180.0	2002.0	10424.0

TABLE C.2 (continued)
NEW CONSTRUCTION

	Residential 2-4 Unit Structures 11.0102	Residential High-rise Apartments 11.0104	Access Structures for Solid Mineral Development 11.0508	Conservation and Development Facilities 11.0506
Inputs Potentially Available in Alaska	37.0	31.6	22.1	25.4
Stone and Clay Mining and Quarrying	.3	.2	1.8	1.8
Lumber and Wood Products	10.0	4.0	1.3	1.2
Petroleum Refining	.7	.3	2.1	4.1
Stone and Clay	6.3	8.2	5.5	3.8
Transportation	2.4	2.0	3.4	2.1
Communication	.2	.3	.1	.1
Electric, Gas, Water and Sanitary Services	a	.1	a	a
Wholesale/Retail	8.3	6.3	4.2	4.7
Finance, Insurance, Real Estate	.8	1.3	.6	.7
Services	8.0	8.9	3.1	6.9
Government	a	a	-	a
Inputs Not Available in Alaska	14.9	19.6	20.5	14.3
Chemical, Paints	.8	.8	.3	.5
Iron, Steel, Nonferrous Metals Manufacturing	1.6	2.4	4.7	2.9
Heating, Plumbing Products	4.5	9.0	5.3	7.0
Construction and Mining Machinery	.1	.1	.3	.3
Household Appliances	.4	.2	.1	a
Electrical, Lighting and Wiring Equipment	.6	.7	3.7	.9
Other	6.9	6.4	6.1	2.7
Total Intermediate Inputs	51.9	51.2	42.6	39.7
Value Added	48.1	48.8	57.4	60.3
Total Value of Product	100.0	100.0	100.0	100.0
Million Dollars in 1972	2702.4	3985.0	355.7	2172.0

TABLE C.2 (Continued)
MAINTENANCE AND REPAIR

	Highways and Streets 12.0214	Water Supply Fcltys 12.0209	Other Non-Bldg Fcltys 12.0216	Conserv. Devlpmt Fcltys 12.0213
Inputs Potentially Available in Alaska	30.5	22.1	19.0	15.3
Stone and Clay Mining and Quarrying	6.2	2.1	1.5	.4
Lumber and Wood Products	1.6	.5	1.9	.8
Petroleum Refining	7.3	3.2	2.5	3.7
Stone and Clay	2.3	3.7	1.8	.7
Transportation	4.7	2.3	1.9	1.2
Communication	.3	.3	.3	.3
Electric, Gas, Water and Sanitary Services	.2	a	.1	.1
Wholesale/Retail	3.6	5.9	4.1	3.6
Finance, Insurance, Real Estate	1.4	1.1	1.4	1.2
Services	2.9	3.0	3.5	3.3
Government	a	a	a	a
Inputs Not Available in Alaska	6.1	14.3	11.0	11.5
Chemical, Paints	.8	3.7	2.6	1.6
Iron, Steel, Nonferrous Metals Manufacturing	a	1.1	.5	.5
Heating, Plumbing Products	3.2	1.2	2.2	1.8
Construction and Mining Machinery	a	a	a	.2
Household Appliances	-	-	a	-
Electrical, Lighting and Wiring Equipment	a	.2	1.0	1.7
Other	2.1	8.1	4.7	5.7
Total Intermediate Inputs	36.6	36.4	30.0	26.8
Value Added	63.4	63.6	70.0	73.2
Total Value of Product	100.0	100.0	100.0	100.0
Million Dollars in 1972	4185.3	1483.0	540.0	602.4

TABLE C.2 (continued)
MAINTENANCE AND REPAIR

	Residential 12.0100	Sewer Fcltys. 12.0210	Other Non-Farm Bldgs. 12.0201	Military Fcltys. 12.0212
Inputs Potentially Available in Alaska	23.9	31.0	25.9	22.8
Stone and Clay Mining and Quarrying	a	1.4	a	1.9
Lumber and Wood Products	2.4	1.6	2.0	1.7
Petroleum Refining	3.1	2.9	2.4	3.8
Stone and Clay	1.8	6.5	4.9	2.1
Transportation	2.2	3.1	2.5	2.4
Communication	.3	.7	.6	.4
Electric, Gas, Water and Sanitary Services	a	.3	.3	.2
Wholesale/Retail	11.2	5.1	7.4	5.7
Finance, Insurance, Real Estate	1.2	3.0	2.4	1.6
Services	1.7	6.4	3.4	3.0
Government	a	a	a	a
Inputs Not Available in Alaska	22.4	14.0	17.9	18.3
Chemical, Paints	6.1	1.6	2.6	2.4
Iron, Steel, Nonferrous Metals Manufacturing	.6	.9	.8	.7
Heating, Plumbing Products	3.5	2.8	2.8	2.9
Construction and Mining Machinery	a	.1	.1	.1
Household Appliances	2.2	-	a	a
Electrical, Lighting and Wiring Equipment	.6	.7	3.2	2.4
Other	9.4	7.9	8.4	9.8
Total Intermediate Inputs	46.3	45.0	43.8	41.1
Value Added	53.7	55.0	56.2	58.9
Total Value of Product	100.0	100.0	100.0	100.0
Million Dollars in 1972	10192.2	623.3	11512.7	795.0

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