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A Comparative Analysis of Buyer Patterns in the Asphalt Paver Market

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A COMPARATIVE ANALYSIS OF BUYER PATTERNS IN THE ASPHALT PAVER MARKET

(TITLE)

BY

LEONARD LLEWELLYN DECKER

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INTRODUCTION

The applications of market research techniques to the asphalt paving industry are currently in the early stages of development. One of the leading manufacturers of asphalt finishing machinery has recognized the increasing necessity for valid field data and has implemented a research program designed to fulfill future marketing needs. The machinery being marketed is classified by definition as an industrial product. Being an industrial product rather than a consumer item requires adjustments in the use of marketing research techniques. A limited market, dealing with high cost units, and other influencing factors unique to this specific industrial product further emphasize the need for gathering maximum field information about the users of this equipment and the elements which most affect their business. Because the asphalt paving industry offers many new frontiers of marketing knowledge yet unexplored, it represents an ideal environment for meaningful study and excellent challenge for this research thesis.

CHAPTER I

OPERATIONAL PLAN AND OBJECTIVES

Statement of Purpose

This thesis, in the form of a research study centered on the domestic asphalt paving industry, is structured around a twofold purpose. First, it is designed to demonstrate the utilization of relevant industrial marketing techniques in the total planning, implementation, and analysis of a research study. Second, it is functioning as an actual market investigation for the use of the Marketing Department, Blaw-Knox Construction Equipment, Inc., Subsidiary of White Consolidated Industries. To coincide with both facets of this twofold purpose, the research objectives are focused on the contractor's buying patterns of asphalt finishing machines.

In this study, the asphalt paver market will be approached by stratifying the contractor population into two groups. The paving contractors who are members of the influential professional organization, National Asphalt Pavement Association (NAPA)[1]

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[1]For background on the National Asphalt Pavement Association and membership characteristics, see the section entitled "Profile of NAPA contractor group," page 9.

were placed in one group. Group two consisted of the contractors who were not affiliated with this organization.[2] This line of stratification was necessary to accomplish the planned objectives.

The primary objective of this survey is to examine contractor buying behavior through a comparative analysis of these two groups. The comparison will be based on the collection of data pertaining to the following areas: buying and replacement cycles of equipment; paver ownership; type of work concentration; preferences in buying, renting, or rebuilding equipment; and contractor opinions about future events that may influence the asphalt paving business.

The second major objective of this study is to determine the degree of purchasing influence which NAPA contractors have on the total market sales (units) of asphalt pavers. Findings will be analyzed on both a national and regional basis.

Value of Conducting This Study

On an academic level, the procedure used for conducting this study provided an opportunity for applying the principles of marketing research to a specific industrial product. Going outside the realm of the consumer market usually discussed in classroom examples, this survey utilizes and adapts the concepts of

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[2]For simplicity, the two contractor groups will henceforth be referred to as NAPA and NON-NAPA.

population stratification, random sampling, mail questionnaire design, pretesting, coding and tabulation, statistical validation using the chi-square technique, and analysis of data to coincide with known market peculiarities. Determination of the survey approach to achieve the desired objectives resulted from extensive background study and information gathered from various secondary sources. It is hoped that this paper will provide future students of marketing with some insight into the field of industrial marketing research.

For practical purposes, this survey will provide beneficial field data to meet the marketing needs of a paving equipment manufacturer. Data collected from individual returns will be kept confidential and will be reported and analyzed only in terms of statistical groupings. Knowledge of buyer behavior characteristics and major influences in the market place are the basis for future company planning and growth.

CHAPTER II

BACKGROUND -- ASPHALT PAVER MARKET

Prior to the structuring of this research study, preliminary information files about the asphalt paver market were compiled in three investigative phases. Phase one involved an analysis of commonly accepted characteristics of the two contractor groups, NAPA and NON-NAPA. Available data on the contractor population including company size, volume, and type of work was gathered for each of these test groups. Phase two examined the characteristics and the functions of the specific product, an asphalt finishing machine. All competitive paving units were grouped by size and capabilities for basic pre-survey background information. The third preliminary information phase was the collection of facts concerning direct and indirect market-sales influences. Special attention was directed to market seasonality, apparent contractor buying patterns, and market sensitivity to outside factors. Since the preliminary data compiled for this study provided the basis for developing the hypotheses and structuring the questionnaire, a brief review of the major background points in each phase will facilitate reader understanding of the overall market environment.

Phase I: Characteristics of Paving Contractors[3]

The domestic asphalt paving industry is composed of approximately 7,000 contractor firms. It is estimated that 43 per cent or 3,000 firms are small companies who deal mainly in driveway and patch work. These small contractors may be located in any size community but rarely work outside their local geographic boundaries. The company assets usually consist of a dump truck, a tow-type spreader for placing asphaltic material, one roller, and several hand tools. It is common for this size contractor to purchase his asphaltic materials from a nearby material supplier who operates an asphalt plant. Financial limitations usually prevent the small contractor from buying new or more sophisticated equipment. However, with proper financial backing, a small contractor may upgrade his equipment fleet through the purchase of a self-propelled asphalt paver. More than likely he will purchase a good used paver rather than a new one. Should he advance to a self-propelled paving unit, either new or used, he then is placed into a new contractor classification for marketing purposes.

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[3]No source is available for exact figures on the number of asphalt paving contractors. Government data does not differentiate between asphalt, concrete, dirt, or bridge contracting firms and thus can only serve as an indicator. Estimates in this section are based on data from previous market surveys and information obtained from a nation-wide dealer network.

The remaining 57 per cent of the contractor firms can be considered in the medium-to-large company classification. The common denominator of this contractor group is the ownership and use of a self-propelled asphalt paver in their equipment fleet. These medium-to-large paving companies compete for public work on federal, state, county, and municipal roads as well as soliciting private paving jobs. A closer analysis of this contractor group can be illustrated in an examination of the characteristics differentiating between the medium size firm and the large contractor. Generally accepted indicators of the contracting business size includes annual volume of work, proportional dollar value of equipment assets, work location and quantity of paver ownership (see Table 1).

According to an equipment census of the medium-to-large paving firms conducted in 1966, 52 per cent of the paving contractors are in the large contractor classification and 48 per cent are considered in the medium contractor ranking. The distribution for this census was based upon a contractor population of 3,065 firms. Average paver ownership for the overall medium-to-large contractor group was 2.2 units.[4] Because this group of medium-to-large contractors represents

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[4]"CEM Equipment and Materials Census of U. S. Contractors; Bituminous Pavers," A Report prepared by Construction Equipment and Materials (New York: Conover-Mast Publications, Inc., 1966), p. E-2.

TABLE 1

ANALYSIS OF CONTRACTOR SIZE

Characteristic	Contractor Size Classification	
	Medium	Large
Volume of work (annual)	$120,000 - $1,000,000	$1,000,000 - $40,000,000
Value of assets[a]	$22,000 - $300,000	$300,000 - $12,000,000
Work location	[Local City] - [Local State]	[Local State] - [Several States]
Estimated paver ownership	1 - 2 units	2 - 53 units

[a]CIT Financial Corporation's rating of average assets to volume of work. Assets are estimated at 18 per cent if work volume is less than $400,000. Assets are estimated at 30 per cent if work volume is in excess of $400,000.

the principal buying market for self-propelled pavers, it composes the segment of the asphalt paving industry under study.

To achieve the designated survey objectives, the population was stratified into two contractor groupings. The basis for this stratification was membership in the National Asphalt Pavement Association. This resulted in one group composed of current members (NAPA) and the other group representing non-affiliated contractors (NON-NAPA). The significance of using this criterion, i.e., NAPA membership, in the analysis of the contractor population is substantiated by an examination of the NAPA organization and its typical member characteristics.

Profile of NAPA contractor group

Sixteen years ago, many of the very large asphalt contracting firms grouped together to form a national trade association. Recognizing the need for sharing operational problems and for the promotion of asphalt paving, leading contractors officially organized the National Bituminous Concrete Association (NBCA) in April, 1955. The original planning was provided by the director and officers of the Michigan Asphalt Association. At the time of NBCA's formation, its membership was 100 contractors. The purpose of NBCA was to function as a public relations group on both the state and federal levels. In 1964, the organization changed to its current

name, the National Asphalt Pavement Association (NAPA).[5] At this time, the association expanded its program to include feasibility studies of full-depth asphalt, quality improvement programs to assist member contractors, workman training films, a broader public relations program, and closer relations with aligned associations. As a liaison group, NAPA has achieved good relations with government officials on the state and national levels. Contractor membership is subject to annual fees which are based on a percentage of the individual company's tonnage production. Membership in NAPA at present numbers slightly over 500 firms with some firms participating simultaneously in state paving associations. Because of high annual fees and the specific advantages obtained from membership, only the larger contracting firms belong to the national association. In addition to contractor memberships, NAPA is also supported financially by annual dues from 60 manufacturers.[6]

In summary, the following general statements are accepted within the industry to be characteristic of the NAPA contractor group: (1) NAPA members are generally considered to be the

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[5]National Bituminous Concrete Association, "History of NBCA," Chicago, 1963. (Mimeographed.)

[6]National Asphalt Pavement Association, Membership Directory, 1971 (Riverdale, Maryland: NAPA Headquarters, 1971), p. 45.

large contracting firms who own several pieces of paving equipment. Their exact volume of paving and total equipment ownership is currently unknown. (2) The focus of paving work for NAPA contractors is on the Interstate road projects and state specification paving work. Data indicating the proportional distribution of work in the various job classifications is to be compiled in this study. (3) NAPA contractors annually place higher than the average tonnage of material through each machine, mainly due to their large volume of work and the use of high-capacity pavers. (4) Greater equipment usage and the high costs of downtime due to machine failure require that NAPA contracting firms continue to invest in new equipment. Also, newer bituminous pavers with more sophisticated technological features are necessary to accommodate certain job specifications. Updated equipment offers additional savings of time, cost, and labor. Such engineering and design improvements contribute to the shorter time frequency between new paver purchases by this buyer group. (5) The geographic boundaries in which NAPA firms compete for paving jobs can range from a one state area to paving in several states. (6) Federal or state highway budget policies assert direct influences on the operations of NAPA contractors.

While these stated generalizations suffice for overall industry opinion, more detailed information and statistical data is needed

by equipment manufacturers. Results of this study combined with future research investigations will supply the statistical basis for analysis of buyer behavior within the NAPA membership.

On the state level, 33 local asphalt paving associations[7] are currently organized. The state associations are completely autonomous from the national organization but cooperative efforts are initiated for special projects. Membership in the state associations includes approximately 896 paving firms. Paving companies who could not justify the cost of belonging to the national association usually join and support only their state associations whose fees are substantially lower. Local contracting firms working primarily in one state frequently reflect less concern with national issues and thus benefit most from membership in their state associations.

Profile of NON-NAPA contractor group

Present knowledge of the NON-NAPA contractor group indicates that the average firm works within a one state area. Many members of this group purchase used paving equipment and usually maintain a fleet of older machinery. It is estimated that each year new pavers are purchased by less than

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[7] See Appendix E. "List of State Asphalt Pavement Associations."

one-fourth of the total NON-NAPA contractors. Total new and used paver ownership of this group numbers approximately 5,000-6,000 units, with one-half of the units being 7-15 years old. Much of their work is concentrated on local public and private paving jobs.[8]

This NON-NAPA group consists basically of medium-size contracting firms, plus several larger contractors who do in excess of $1,000,000 of work annually. Working on county, municipal, and local levels, they commonly maintain individual membership in their state asphalt paving association, the local Chamber of Commerce, and similar civic associations. To coincide with their type of paving operations, NON-NAPA contractors purchase the size of finishing machines which best meet their needs. Because many concentrate on local paving, they can operate with less sophisticated machinery. For example, electronic sensing devices are unessential when constructing a driveway or parking lot. Thus a smaller, less costly unit can provide the NON-NAPA contractor with all of the needed versatility. Also, due to the types of work which they perform in comparison to NAPA members, less tonnage per machine is placed annually by this group of contractors.

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[8]No exact figures are available on ownership or equipment age. Estimates are based on previous related research and dealership studies.

In 1968, it was estimated that 3, 500 asphalt plants, being owned by 1, 800 companies, produced the annual volume of asphaltic material used in blacktop paving.[9] It is known that all 500 NAPA contractors own at least one or more plants. Using the 1968 estimate of plants, it can be concluded that less than one-half of the total NON-NAPA group produce their own material. For economic reasons, small companies using limited batch quantities of asphaltic material purchase prepared mixes from local suppliers.

In many cases, the NON-NAPA contractor is a proprietorship or partnership operation. When conducting a research survey, this situation may pose a problem since the owner may function also as the job superintendent, machine operator, bookkeeper, purchasing agent, and president of the firm. Since minimal time is spent in the office, NON-NAPA contractors frequently require a longer time period in which to complete and return the survey questionnaire.

Unlike the NAPA group, many of the unaffiliated contractors are also concrete, dirt, and bridge contractors. In comparison to their total work volume, asphaltic paving may be of lesser importance. Consequently, a large contracting firm (in dollar volume of business) may own only 1-2 paving machines and thus derive less than 20 per cent of its total work volume from paving contracts.

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[9]John Gray, "Testimony before the Joint Senate and House Committee's Hearings on The Deferment of Obligations For Federal-Aid Highway Expenditures for Fiscal Year 1967," March 1, 1967, p.1. (Mimeographed.)

Phase II: Product Groupings

An asphalt finishing machine is the basic unit in a paving contractor's equipment fleet. The primary function of a paver is to place asphaltic materials on a roadway or similarly prepared surface in accordance with the particular job specifications. Since each job may require a different width, depth, and type of asphaltic material, the paver must possess a large degree of versatility. Highway specification paving requires several additional factors, e.g., proper grade and slope of the finished road, material compaction, and quality of finished mat. To meet the multitude of requirements facing paving contractors, the manufacturers of paving machines offer nineteen different models. Thirteen models are rubber-tired units and six models are crawler-mounted units. Each of the nineteen competitive models is designed to meet the needs and requirements of a specific category of work. The smaller, self-propelled unit best satisfies the needs of a city contractor who paves parking lots and driveways. The largest self-propelled unit meets the needs of the paving firm who builds or resurfaces State and Interstate highways.

Before a specific model can be used on State specification work, it must be approved by that particular State Highway Department. This means that if a new machine designed to perform high grade paving is to have a national sales potential it must be approved

by all fifty states. Currently, thirteen of the nineteen models have nation-wide state approval.

The average productive life of an asphalt finisher is estimated at seven years. However, contractors normally measure the productive life of a paver in terms of tonnage placed. After reaching a designated tonnage age, most large contractors place the machine on standby for one season using it only as a spare machine in case of an emergency. The following year, the contractor usually trades the machine in on a new unit. The used machine if operable is sold by the dealer to a smaller parking lot contractor who may have been operating with a tailgate spreader machine (not a self-propelled unit).

An asphalt paver is considered as capital machinery used in the process of constructing a finished product, such as a new road, a city street, or a parking lot. As with most industrial goods, the purchase of a new paver is a sizable investment. The cost of a new asphalt finisher can range from $15,000 to $70,000, thus contractors exercise careful planning and consideration in the purchase process. Some of the following criteria are evaluated prior to buying new paving equipment:

1) Productive life of current machines
2) Volume of work under contract
3) Estimated volume of work in the future
4) Specific machine size required and capabilities
5) Product cost

As with most industrial markets, the population consists of a highly specialized group of buyers. Because the market size is restricted by the number of buyers and limited in sales volume, the sales environment is extremely competitive and demands frequent refinements of product lines. Over the past five years, new technology in the areas of electronics and hydraulic systems has influenced many design changes in present asphalt finishing machines. Also, in the paving equipment market, an existing need for the product preceeds the onset of the purchase cycle. Therefore, asphalt contractors look for and purchase machinery only if they have a current need, i. e. a confirmed contract. The researcher conducting industrial market investigations must have a thorough understanding of the buying environment, knowledge of the technical capabilities of the product, and familiarity with the jargon of the industry. Utilizing needed background information plus the results from previous research efforts, the researcher can conduct a more meaningful survey which will produce useful and realistic results.

Phase III: Market Influences

The asphalt paver market is affected directly and indirectly by various known influences, many of which are also common to the entire construction industry. A brief examination of these major market influences will provide the background information

essential to the understanding of a contractor's point-of-view. In addition, these influences will be reflected in the evaluation of survey data collected.

The single, most important factor which directly controls the market sales of paving equipment is highway construction awards. The volume of awards in any given period of time dictates the level of work activity and thus the need for construction equipment. The events and the time sequence between the initial highway planning stage and the resulting contractor's need for paving equipment is illustrated in Figure 1.

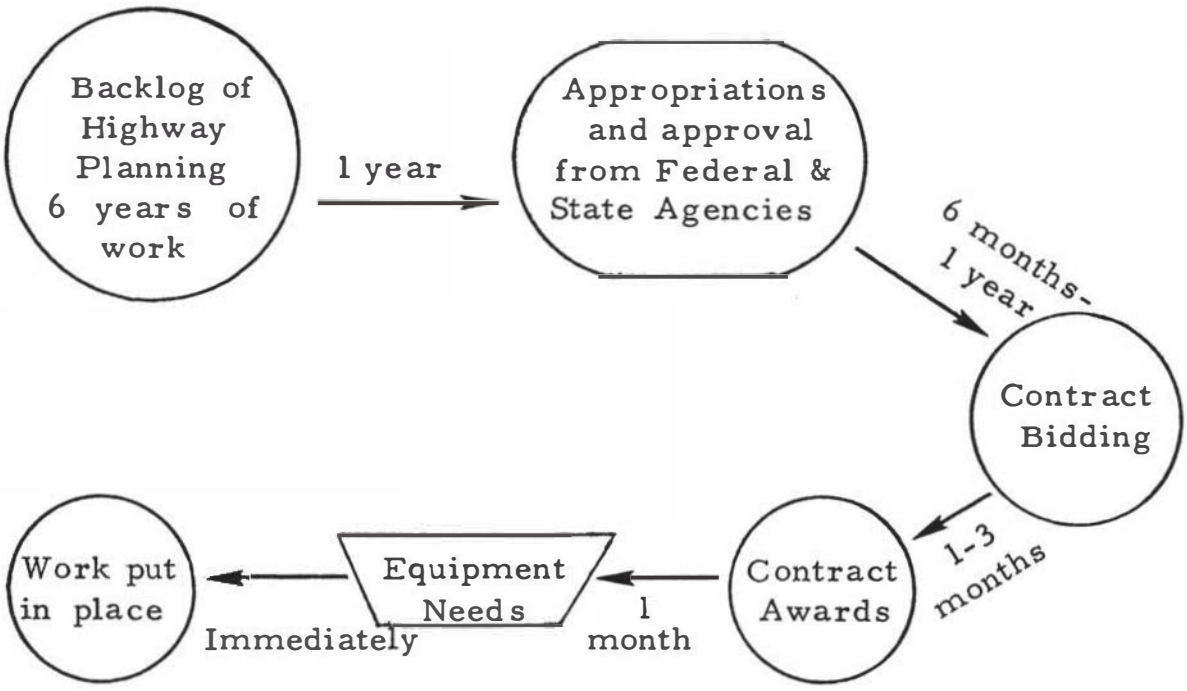

Fig. 1. --Determinants of paving equipment needs

A direct cause-effect relationship is evidenced in that, if contract bidding volume decreases, then the need for equipment likewise declines. Because there is a short span of time between actual bidding and equipment purchases, the causes of fluctuations in bidding volume should be carefully examined by the researcher prior to making a survey of this market.

The funding of paving work originating in State Highway Departments is determined by the three classifications of roads: Interstate highways, ABC highways (Primary and Secondary roads), and State-rural highways. The Interstate system and the ABC system are financed through a matching fund program as established under the Federal-Aid Highway Act of 1956. This legislation created the Federal Highway Trust Fund which is wholly supported from Federal excise taxes on highway users. Currently the trust fund provides money to each State through quarterly apportionments. Interstate highways are funded on a 90 per cent Federal: 10 per cent State matching fund basis. ABC roads are funded equally on a 50:50 ratio.[10] The State-rural highway classification is excluded from Federal funds; thus all paving work of this type must be wholly state supported. In 1970, total capital

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[10]U. S. Department of Transportation, Federal Highway Administration, News; Highway Receipts and Disbursements, 1968-71, FHWA--534 (Dec. 4, 1970).

outlay for highway construction was $8.9 billion with the Highway Trust Fund supplying 50.5 per cent.[11]

During the past five years, the President of the United States has periodically delayed, frozen, or reduced appropriations from the Highway Trust Fund. Because of this direct influence on bidding volume, paving contractors are extremely vulnerable when these reductions occur and thus exercise extreme caution in planning new equipment purchases.

On the local level, contractors who pave driveways and parking lots are not directly affected by major highway cutbacks. However, the effects are later realized when the local contractor finds large firms bidding as competition on the smaller jobs and private work in his area. The passage or defeat of local road construction bond issues likewise affects the need for paving equipment.

A further analysis of contract bidding volume indicates that it has its own distinct annual pattern. This pattern re-occurs and is fairly predictable from year to year. The seasonal pattern in Figure 2 illustrates that the annual peak is in mid-summer and its trough is in mid-winter. This pattern parallels the seasons of the year and is typical in most of the construction industry.

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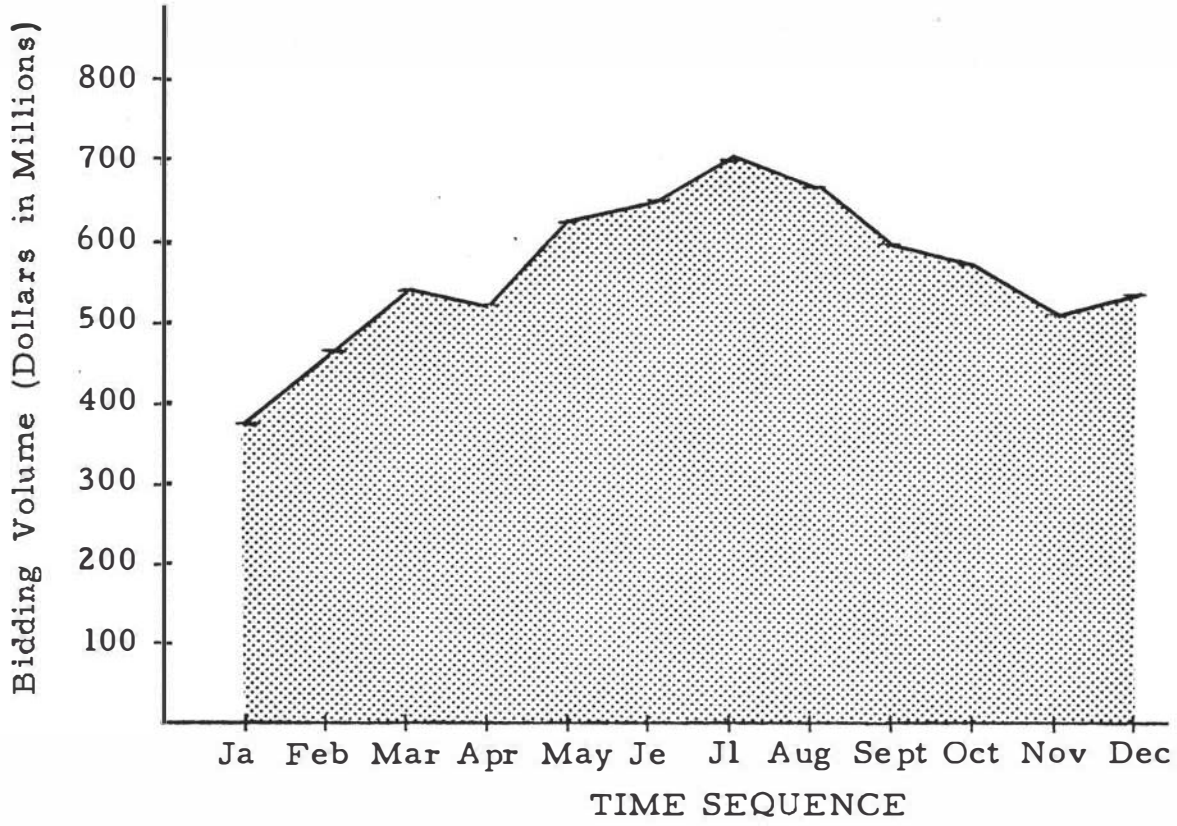
[11]U. S. Department of Transportation, Federal Highway Administration, Federal-Aid Financing and the Highway Trust Fund, FE-Summary (1970).

Fig. 2.--Seasonal Pattern of Bidding Volume



Source: U. S. Dept. of Transportation, Federal Highway Administration, Highway Construction Contracts by State Highway Departments, Jan.-Dec. 1970, Table CA3.

As contract awards move up and down, the market sales for asphalt pavers fluctuate accordingly. Irregular seasonal influences can also affect equipment sales in various regions of the country. An early Spring and a late Fall lengthens the paving season and thus extends the possible selling period for paving equipment.

Other market influences which can be considered traditional factors are: interest rates, tight money, and the state of the general economic environment. Little needs to be said about

these factors except that they have had a noticeable affect upon construction machinery sales during the past three years.[12]

Within the past 18 months three new influencing factors have emerged: high labor costs, shortage of raw asphalt (oil), and great public concern over ecology. The demand for increased wages has altered the types and sizes of machinery purchased. Paving contractors are interested in larger and more productive pavers in order to reduce their labor costs. For similar reasons, equipment downtime and repairs are also considered on new purchases. Often, a product with an initially higher price tag is considered a better buy in the long run if repairs and downtime are less frequent.

During the prime paving season of 1970, several populous areas in the country were faced with a shortage of raw asphalt (oil) required in the production of asphaltic materials. The shortage was attributed to domestic oil refineries many of whom discontinued their production of asphalt cement (a low grade of oil). Many paving firms were operating at 50 per cent of their capacity during this prime paving season. A recent study conducted in 1971

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[12]Construction machinery sales for 1969, 1970, and 1971 (estimated) indicates a stagnant market. Removing inflationary gains indicates a real decline over this three year period. U. S. Department of Commerce, U. S. Industrial Outlook 1971 With Projections Through 1980 (Washington, D. C.: U. S. Government Printing Office, 1971), p. 255.

indicated that 37 per cent of the hot mix companies had to curtail production in 1970 because of an inadequate supply of asphalt cement.[13]

Public concern over ecology programs is costing many contractors an undue burden. Air and noise pollution regulations are becoming prevalent in most metropolitan areas. Contractors must modify their present equipment to meet current requirements and are considering the high levels of engine noise in their purchases of new asphalt finishers.

Definitions of Terminology

Highway Trust Fund.--Established by the Highway Revenue Act of 1956, the Highway Trust Fund provides funding for Interstate and ABC road construction. Revenue collected from taxes on motor fuels and motor vehicles is the financial basis of the trust fund. "The fund places the Federal-Aid Highway program on a wholly highway-user-supported, pay-as-you-build basis."[14]

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[13]National Asphalt Pavement Association, Hot Mix Asphalt Plant and Production Facts 1970, Information Series, 35 (Riverdale, Md.: National Asphalt Pavement Association, 1971), p. 4.

[14]U. S. Department of Transportation, Federal Highway Administration, Stewardship Report on Administration of the Federal-Aid Highway Program 1956-1970 (Washington, D. C.: U. S. Government Printing Office, 1970), p. 17.

Interstate Highways. --Connecting the principal metropolitan areas, cities, and industrial centers, the Interstate highways compose a planned nation-wide road system. When completed in fiscal year 1976, Interstate mileage will represent 1.2 per cent (42,500 miles) of the United States road system.[15]

ABC Roads. --Representing both the primary and secondary road systems, this classification includes the principal feeder lines, linking farms, distribution outlets and smaller communities with the Interstate system. Primary roads are synonymous with the State highways. Secondary roads are also called farm-to-market routes.

Contract Awards. --The dollar value of highway construction through the bid lettings by State Highway Departments is represented in contract awards.

Specification work. --Paving operations on all public highway construction are classified as specification work. Specific requirements are established by the State and Federal Highway Departments pertaining to the quality of the finished work. To insure the desired road quality, every part of the paving operation must adhere to rigid guidelines. If a paving machine fails to meet the

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[15]U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, Highway Statistics 1969 (Washington, D. C.: U. S. Government Printing Office, 1970), p. 166.

proper specifications during an actual operation, the State inspector on the job has the right to shut the work down resulting in lost time and labor costs to the contractor.

Tonnage rate. --The quantity of asphaltic material placed through an asphalt paver is measured in terms of tonnage. Many contractors log the tonnage rate on individual machines to measure the production age of a finishing machine and to insure the proper timing of preventive maintenance.

Revenue sharing. --The Executive Branch of the United States has proposed a program of revenue sharing which will utilize Highway Trust Fund dollars for the development of an over all mass transportation system.

Davis-Bacon Act. --This legislative act, covering all federally funded road construction programs, requires that construction companies maintain a wage scale equal to or above the prevailing rate for the community in which they are working. In essence, this implied that the wage scales to be followed are those prescribed by union contracts. Several States have followed through with similar legislation affecting construction within their jurisdiction.

CHAPTER III

STRUCTURING THE RESEARCH INVESTIGATION

Equipped with sufficient background data, it is now possible to proceed with the structuring of the total research investigation. This chapter will examine the sources of information and the method used in gathering the desired data. The preconceived general hypotheses will be outlined as the groundwork for construction of the questionnaire. The sample selection and survey procedure used for this particular study will be described to substantiate the basis for evaluating the findings to come.

Source of Information and Method of Gathering Data

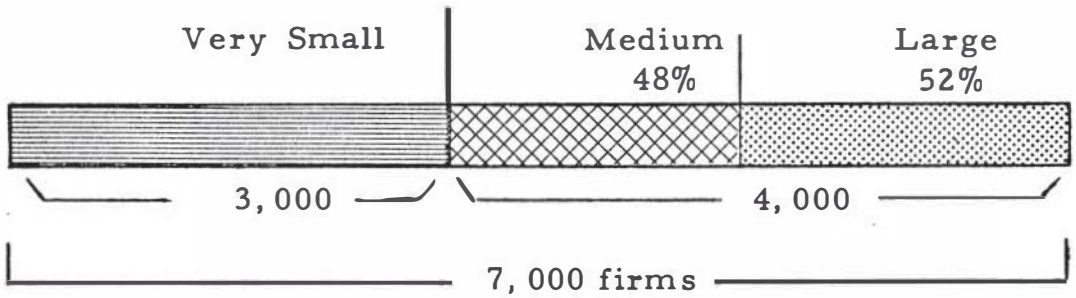
The universe used in this study was limited to domestic asphalt paving contractors who:

(1) Own self-propelled asphalt pavers;

(2) Purchase new asphalt paving machinery.

The universe size is approximately 3,000 firms. Figure 3 illustrates the location of this universe within the estimated total of 7,000 paving firms.

Part A. SIZE OF CONTRACTORS



Part B. OWNERSHIP

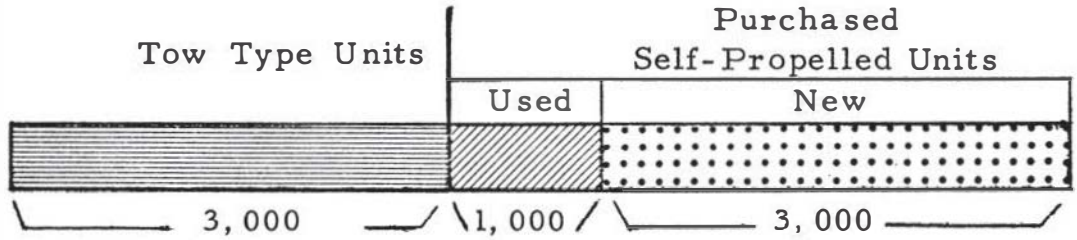


Fig. 3.--Universe Size and Ownership Characteristics

Part A in Figure 3 indicates the three classifications of contractors in groups reflecting their annual volume of paving business. Part B of the illustration indicates the ownership for each respective classification by the type of equipment. The 3,000 small contractors own tow-type units; 1,000 medium size firms own self-propelled units which they purchased on the used

market only; and, 3,000 medium to large contracting firms own self-propelled pavers which are purchased when new. It is this last group of 3,000 which comprises our total universe.

The population list of nearly 3,000 contractors representing the buyer market for new self-propelled asphalt pavers was prepared by the Marketing Department of Blaw-Knox Construction Equipment, Inc. Compiled in the last four years, the list has been under constant revision. The current list used for this study has a population count of 2,931 contractors.

Several sources were employed to gather and screen the names and addresses of each contractor. A dealer organization of 125 companies initially provided names and data about known paving contractors in their geographic areas. In addition, the company's sales force gathered similar data but on a more regional basis. To avoid the development of a biased (pro-company) list, extensive time was spent gathering all known National and State Asphalt Associations' roster lists. Monthly trade publications were examined for the names of paving firms receiving paving contract awards. Each company name was then cross-referenced for possible additions to the list. Contractors in major metropolitan areas were located through the yellow pages and local advertising. Rigid screening and updating procedures were established to insure that the current population list is as complete, accurate, and

valid as possible. To provide a regional comparison of survey data, the contractor population list has been separated into eight geographic sections.[16]

Special attention was given to obtaining the name of the proper official within each contracting firm. Every name appearing on an address label is considered the buying influential within his company. Due to the varying company structures, the title of a buying influential may vary from the president of the firm to the vice president, purchasing agent, or equipment manager. In the event that the correct contact individual had not been identified within a firm, then the survey questionnaire was addressed to the company president.

Using a Mail Questionnaire

There are many advantages to using a mail questionnaire for surveying the asphalt paving industry. Because the contractors are located throughout the United States, it is more economical in terms of time and money to survey a representative group via the mail than to attempt personal or telephone interviews. Since time is very costly to a contractor, little cooperation has been forthcoming in attempted lengthy research investigations. It has

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[16]See Appendix F for the regional distribution and per cent of contractors in each area.

been demonstrated that in this market a brief, simply stated questionnaire usually receives the best response. Using a keying technique, follow-up mailings can be easily accomplished to increase total response to the desired confidence level. Another explicit advantage of the mail questionnaire is that a blind, or fictitious company name can be used. Not revealing the identity of the sponsoring company aids in avoiding possible bias. In this market where there are few competitors, it is especially important that the contractors not associate the survey with any particular company or brand of machinery.

When considering this approach to a research study, the inherent disadvantages of using a mail questionnaire must also be recognized. In this survey of the asphalt paving industry as well as in any study using the mail, the value of the survey is directly related to the accuracy and completeness of the mailing list. Also, due to the nature of the postal system, there is a built-in time lag in obtaining results. The recent hike in postal fees have made this method of surveying considerably more expensive. However, in this industry the mail questionnaire approach remains the most effective method for obtaining desired market data within the allotted cost investment.

Development of Hypotheses

Since NAPA contractors are recognized as influentials in the asphalt paver market, it is the purpose of this study to establish the extent or strength of their influence. Data from previous research investigations has provided the basis for developing several general hypotheses. This study of buyer behavior patterns will either support or refute the following suppositions concerning NAPA contractors' influence in the market place.

Hypothesis 1: Thirty per cent of the self-propelled asphalt pavers in the market place are owned by NAPA contractors.

Hypothesis 2: Two-thirds of the NAPA contractors replace paving machinery within a five year period.

Hypothesis 3: NAPA contractors replace their bituminous pavers at a lower tonnage level than do NON-NAPA contractors. The replacement level (tonnage rate) is in direct correlation with the type of paving work performed by each contractor group.

Hypothesis 4: NAPA contractors perform 50 per cent or more of their paving work on Interstate and ABC primary roads. In comparison, the NON-NAPA group derives the majority of its work volume from city and parking lot paving.

Hypothesis 5: NAPA firms will represent one-third of the contractors planning to purchase new pavers in 1971.

Hypothesis 6: Twice as many NAPA contractors will purchase new pavers in 1971 as opposed to rebuilding their present equipment.

The following hypotheses concerning the current and future business environment will also be tested in this study:

Hypothesis 7: The 1971 paving business is predicted to continue at the same level as 1970.

Hypothesis 8: Among future influencing factors, the revenue sharing of highway trust funds represents the most likely cause of disruption in the paving industry.

Questionnaire Design

The questionnaire was designed with two purposes in mind. First, it must provide adequate research data for testing the validity of the pre-established hypotheses. The total questionnaire should produce the necessary information to determine the degree of purchasing influence NAPA contractors have on the total market sales of asphalt pavers. Each question was structured to enable a comparative analysis between the NAPA and NON-NAPA contractor groups. Second, the questions must represent some value to the recipient, encouraging his participation in a worthwhile study. An adequate return level is necessary to insure a representative sample of the whole market place.

Consideration was likewise given to the educational background of participants in determining the questionnaire length, layout, and ease of completion. Just as the size of the paving companies varies, so does the educational level of those persons who are considered buying influentials. The questionnaire design must appeal equally to both extremes of a vast educational spectrum, from the one with little formal education to the post-graduate individual. The problem of approaching such varied participants was solved by limiting the length of the questionnaire and utilizing a balanced layout. The prepared questions were arranged in two columns, making it possible for a single page to contain the entire questionnaire. The "ease of completion" was accomplished by structuring several questions to be answered by placing a check (✓) mark beside the appropriate response. One fill-in and one ranking question provided the questionnaire with variation and balance.

Each question was designed to collect information for a specific purpose and to function in the testing of the hypotheses. The questions with their assigned purpose and function are outlined as follows:[17]

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[17]See Appendix B-1 for the complete questionnaire in its pretest form. Changes in the questionnaire following the pretest are discussed in the section "Pretesting" on page 42.

Question	Purpose and Function
1. Do you presently own self-propelled asphalt pavers? ( ) Yes Qty. _____ ( ) No	1a. Immediate elimination of those contractors who may have gone out of business. 1b. Determines the quantity of pavers presently owned by each contractor group. 1c. Provides a measurement of the contractor's size.
2. How frequently do you purchase new pavers? Frequency / How many units? ( ) Yearly Qty. 1 2 3 4 5 6 ( ) 2-3 Yrs. ( ) 4-5 Yrs. ( ) 6-7 Yrs. ( ) 8-9 Yrs.	2a. Determines if the purchase cycle is different for NAPA and NON-NAPA contractors. 2b. Establishes a business-wide average turnover cycle for pavers.
3. At what tonnage rate do you replace your pavers? ( ) Less than 200,000 tons ( ) 200,000 - 300,000 tons ( ) 300,000 - 400,000 tons ( ) 400,000 - 500,000 tons ( ) 500,000 tons and over	3a. Determines the replacement cycle of a paver. 3b. Provides for comparison of the purchase cycle in Question No. 2 with the tonnage replacement rate. 3c. Determines tonnage rate differences between the two groups.
4. What percent of your paving work is done in the following areas? ___% Interstate base or top paving ___% State specification work ___% County or municipal work ___% Parking lots and driveways	4a. Establishes the correlation between the area of work and the tonnage replacement rate. 4b. Provides for comparison of the two contractor groups.

Question	Purpose and Function
5. Planned paver purchases in 1971 will be: ( ) 1-2 pavers ( ) 3-4 pavers ( ) 5-6 pavers ( ) Other ____	5a. Determines the 1971 buying influence of NAPA vs. NON-NAPA contractors. 5b. Develops a regional buying pattern for 1971.
6. Considering the volume of work in your area during 1971, do you plan to: ( ) Purchase additional pavers ( ) Rent or lease required pavers ( ) Rebuild present pavers ( ) Present fleet is adequate	6a. Determines how a contractor plans to organize his equipment fleet; i.e., buy, rebuild, or rent. 6b. Provides for comparison of how the two contractor groups plan their equipment needs in 1971. 6c. Allows comparison of volume of work predicted by contractors with their plan towards equipment balance.
7. What is your prediction of the 1971 paving work in your region? ( ) Up 20% over 1970 ( ) Up 10% over 1970 ( ) Remaining the same as 1970 ( ) Declining from 1970	7a. Shows a correlation between the contractor's prediction and plans for equipment needs. 7b. Provides for comparison between predictions given by each group.
8. In your opinion, which event will <u>most adversely</u> affect the volume of paving in the future? Rank from 1-5 (1=most effect, 5=least effect)	8a. Provides for comparative viewpoints of the two groups. 8b. Indicates the focus of concern by contractors in the market place.

Events to be ranked in Question No. 8 were listed as follows:

_____ Shift in state matching fund from 50:50 to 70:30
_____ Revenue sharing program of highway trust funds (proposed)
_____ Further restriction of the Davis-Bacon Act
_____ Federal or State cutbacks in highway programs
_____ Other _____
_____

Question No. 8 reflects the important events affecting the future direction of road building in the United States. The amount of future road building will establish the need for asphalt paving equipment. The events listed in Question No. 8 are all currently considered possible adverse market influences. The revenue sharing program of highway trust funds is presently under consideration. This proposal is a special program separate from the much publicized general treasury revenue sharing. The purpose of the highway revenue sharing program is to divert dollars originally slated for road building into mass transportation. If enacted, this diversion of highway dollars will seriously affect future paver sales. Federal and State cutbacks in highway programs began in 1966 under the Johnson Administration. Since that time several highway slow-downs have been imposed as a means of limiting Federal spending in an inflationary economy. Further cutbacks would obviously reduce future paver sales. The Davis-Bacon Act, which in effect supports union wages on all

Federal highway projects, was suspended earlier this year. Its suspension brought chaos in the industry.

> "President Nixon's Feb. 23 suspension and Mar. 29 reinstatement of the Davis-Bacon prevailing wage law are still affecting construction planning. Due to delays in getting new wage determinations, for example, the Minnesota Highway Department had to cancel seven projects from its April 23 letting and says 14 more projects may be affected in its May 28 letting."[18]

Contractors faced with such uncertainty in labor planning and possible bid cancellations may reconsider new paver purchases. When the shift in State matching funds from the traditional 50:50 Federal-State funding to a 70:30 ratio takes place in fiscal year 1973, there may occur a slackening of bid volume in anticipation of the change. States may decide to postpone scheduled bidding until the new ratio becomes effective in hopes of getting more for their money. A delay of contract awards could also temporarily affect future paver sales.

Sample Selection

In this survey of asphalt paving contractors, several statistical approaches were used to determine the proper sample size and method of sample selection. Since great similarities exist among the contracting firms under study, it is possible to yield

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[18]"ENR--Construction Week," Engineering News Record, April 29, 1971, p. 3.

an accurate estimate of the entire population from the responses of a sample group. The homogeneity of the test group is further established since only those firms who are known purchasers of new asphalt pavers were considered part of the total contractor universe of 2,931 firms. The following methods were employed to compute the required sample size and select the primary sampling units.

Sample size. -- The appropriate sample size was determined in accordance with pre-established precision requirements. With an error of no more than 5 per cent and a level of confidence of 90 per cent, it was desirable to estimate the proportion of paving contractors who intend to purchase new asphalt finishers in 1971. The annual sales volume of asphalt pavers compared to the number of contractors indicates that never more than 30 per cent of the population purchases new units each year.[19] Therefore, the universe proportion of those contractors who annually purchase new pavers is 0.30. The required sample size is computed using the formula for the interval estimate of π.[20]

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[19]Based on a five year trend.

[20]Charles T. Clark and Lawrence L. Schkade, Statistical Methods for Business Decisions (Cincinnati: South-western Publishing Co., 1969) p. 313.

$$N = \pi\ (1-\pi) \left[\frac{Z\alpha}{E}\right]^2$$

$$N = (0.30)\ (0.70) \left[\frac{1.64}{.05}\right]^2$$

$$N = 226$$

E = allowable error of 0.05
$Z\alpha$ = level of confidence of 90 per cent (1.64)
π = universe proportion of 0.30
N = sample size

The necessary sample size is 226 contractors. Assuming that the sample return will not fall short of 40 per cent nor exceed 60 per cent, it was necessary to increase the size of the sample group accordingly. Therefore, to insure a sample return from 226 participants, a total of 450 sampling units were used. In addition, a total of 50 contractors were designated as an adequate sample size for the pretest study.

Method of sampling. -- To insure that each unit in the contractor universe would have an equal and independent probability of being selected, a random sampling procedure was used to draw the required sample. This method involved the use of a table of random numbers to achieve a completely randomized sample from the 2,931 contractor list.

As previously explained, the universe was stratified into the two contractor groups, NAPA and NON-NAPA. The contracting

firms in each list were numbered consecutively beginning with 001, 002, ... n. A sample size of 225 numbers were selected from each of the two contractor lists using Klock's Tables of Random Numbers.[21] The specific table, column, and starting digit within the random numbers booklet were selected by drawing three starter numbers out of a box. The selecting process began with the NAPA list using the starter number and moving forward through the series of tables until 225 contractor numbers were selected. Random numbers exceeding the largest number assigned in the list were ignored. Likewise, once a random number had been chosen, in all succeeding occurrences it was ignored. To complete the total sample, 225 NON-NAPA contractors were chosen from the second list using the same procedure. A new starter number was used to initiate the selection of the NON-NAPA sample group. When completed, the total sample list included 450 contractors. After the primary sample was determined, 25 additional firms were randomly selected from each of the two lists to supply the needed 50 pretest units.

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[21]John M. Klock and James W. Klock, Klock's Tables of Random Numbers (Detroit, Mich.: Central Publishing, 1966). This source contains a series of twenty random tables which provide 20,000 random digits. Sampling tests indicate that the average digit variance for the twenty tables will be no greater than three-tenths of one per cent.

The primary sample was charted on a United States map to illustrate the geographic distribution of the randomly selected firms. Resulting regional clusters reflect the basic geographic concentrations of paving contractors across the United States.[22]

Survey Procedure

To avoid participant bias in answering the questionnaire, the study was conducted using a blind (fictional) company name. The assumed name was Industrial Researchers, P. O. Box 562, Charleston, Illinois. Since previous research studies of the asphalt paver market have been made under this name, contractors find it familiar and are more apt to respond. Former research attempts in this market revealed that among contractors there is an apparent lack of interest in providing information solely for the purpose of educational learning. Therefore, the use of a blind company was most important to this study.

As an incentive for contractor participation, a summary of the survey findings was offered to those who entered their company name at the bottom of the questionnaire. Since little market data is available on the asphalt paving industry, the

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[22]For a geographic distribution of the sample, see Appendix G.

willingness to share market knowledge is in itself an incentive. To encourage greater participation a stamped, self-addressed envelope was provided for the contractor's convenience.

To facilitate the identification of each contractor group and their regional location it was necessary to key the questionnaires. A small pin prick was made in the right hand side of each questionnaire. Identification of each contractor was made possible by using the coordinates of the column and line punches in a data processing card. This type of keying made possible the preparation of a follow-up mailing list and was used in both pretest and final survey runs.

Pretesting

A pretest was employed to check for possible weaknesses in the questionnaire design. Particular attention was given to each pretest return for the detection of apparent misunderstandings, lack of clarity in instructions, or difficulty in answering specific questions. The pretest was mailed out four weeks prior to the main survey. From the pretest sample size of 50 contractors, 18 questionnaires were returned for a 30 per cent response.

Based upon the analysis of the pretest, several changes were made in the questionnaire design. A copy of the pretest

questionnaire and the revised form appear in Appendix B.

The alterations were made as follows:

1. Question No. 3: Because none of the contractors indicated that they replaced their pavers at less than 200, 000 tons, the bottom limit was changed to less than 300, 000 tons.

2. Question No. 6: The phrase 'purchase additional pavers' was changed to 'purchase new pavers'. This eliminated the twofold meaning of buying a new paver or buying to expand his paver fleet.

3. Question No. 8: The question was rephrased to indicate that the events in the list were to be ranked from 1-5 in order of greatest importance, not rated on an individual basis of a 1-5 scale.

4. Question No. 8: To insure an unbiased arrangement of the four events, a table of random numbers was used to rearrange the order of their listing.

In addition to testing the questionnaire design, the pretest also was used to check for a balance in the number of returns from each contractor group. Ten returns were received from the NON-NAPA group as compared with eight returns from the NAPA contractors. This indicated that approximately an equal return could be expected from both groups in the main survey. The pretest served not only as a test run for the full scale study, but also functioned in planning the tabulation process. The necessary computer programs were prepared and tested utilizing the results from the pretest questionnaires. The total

pretest procedure was important to this survey in the elimination of several question weaknesses, confirmation of an expected balance in returns from both contractor groups, and the preparation of a system for the rapid tabulation of data.

Collecting Data From The Sample

As previously indicated, a sample size of 450 contractors was used in this study. The main survey was mailed out on May 4, 1971. Three weeks later a follow-up mailing was made to those who had not responded. A note was attached to the survey letter and a second copy of the questionnaire was included for the contractor's convenience.[23] The first week of July was set as the cut off date for all returns. Contractor participation totaled 229 responses for a 50.9 per cent return.

The NAPA group had a return rate of 56 per cent compared to a 45 per cent return for NON-NAPA contractors. Activity in the paving business increased sharply in late May and early June which may account for the 11 per cent difference in return rates between the two groups. A few weeks earlier when the pretest was conducted, business was slower and the return rates for both groups were almost identical. Generally, the NON-NAPA firms were much slower in returning their questionnaires.

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[23] See Appendix C for a copy of the follow-up note.

Seven of the 229 returns were rejected because the company had recently sold out, gone out of business, or the owner had deceased. Useable responses totaled 222 for a return level of 49.3 per cent. Thirty-six contractors requested a copy of the summary of findings. On August 20, 1971 a summary sheet was mailed to each requesting contractor.[24]

Editing, Coding and Tabulation

Each of the 222 questionnaires were edited for legibility, completeness, uniformity of marking responses, and clarity of intended answers. An orange pencil was used to indicate corrections that were necessary. Most of the required editing was on Question No. 8 where several contractors had ranked only three or four of the listed events. To insure proper tabulation, the remaining event was assigned the last number. When only one event was indicated by an X mark, it was edited by assigning the rating of one. The returns were then sorted into the two contractor groups and identified by their designated geographic areas.

With the assistance of the Data Processing Department, Eastern Illinois University, a card layout plan was prepared to

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[24]See Appendix D for the summary sheet mailed to the contractors.

facilitate the recording of questionnaire data onto one punched card per return. Each possible response to the eight questions was assigned a column number on the card. Using a numerical coding process, the answers from each questionnaire were manually recorded onto data sheets from which the key punching task was performed.[25] The prepared computer programs were employed to tabulate the results of the study. Each question in the study was tabulated separately indicating the results from both contractor groups in matrix form. Several questions were also tabulated to indicate regional results for each group.

Chi-square Analysis

To determine the validity of the sample, the chi-square test was applied to eight regional groups representing a geographical distribution of the sample and the universe. Chi-square analysis frequently is used to measure the "goodness of fit" of the sample (observed) distribution to the universe (expected) distribution.[26] The purpose is to measure, then establish or reject

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[25]For examples of the card layout and data sheet see Appendix H.

[26]Robert Ferber, Statistical Techniques in Market Research (New York: McGraw-Hill Book Company, Inc., 1949), p. 275.

the existence of a high degree of conformity between these two distribution patterns. Slight differences within acceptable limits are considered the result of sampling variation.

The chi-square test then determines " . . . the maximum differences that could normally be expected to occur as a result of sampling variations."[27] The chi-square denoted as X^2 is expressed in the following algebraic formula.[28]

$$X^2 = \sum_{i=1}^{s} \left[\frac{(X_i - \Theta_i)^2}{\Theta_i} \right]$$

In this case, the value of X_i represents the 222 sample returns and Θ_i is the actual universe of 2,931 contractors.

Utilizing a probability of 0.02 as a critical level, the criteria for determining if the sample is representative of the contractor universe in the eight regional groups is stated in the following steps:

(1) Hypothesis 1: The observed distribution is representative of the contractor universe if the X^2 computed value is equal to or less than 16.622.

(2) Hypothesis 2: The observed distribution is not representative of the contractor universe if the X^2 computed value is greater than 16.622.

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[27] Ibid., p. 261.

[28] Ibid., p. 260.

(3) Using n-1 or 7 degrees of freedom and a probability of 0.02 requires a X^2 value of 16.622.

(4) Criterion: Accept H_1 if $X^2 \leq 16.622$

Thus, observed differences can be considered to result from sampling variations.

Accept H_2 if $X^2 > 16.622$

Thus, observed differences are believed to be real differences beyond the acceptable sampling variations.

Before applying the chi-square analysis, the observed values were adjusted to fit the 2,931 contractor base. The X_i value was determined by multiplying the observed returns from the eight areas by 13.203. Using the observed and expected distributions, the chi-square is computed in Table 2. The resulting computed value of X^2 is 15.241, which means that the probability of obtaining a value of X^2 larger than 16.622 is greater than 0.02. Therefore, we must accept the first hypothesis and the conclusion that the difference between the universe distribution and the sample return distribution is believed to be a result of sampling variation caused by chance selection. On the basis of this validation, the sample returns are assumed to be representative of the population.

TABLE 2

COMPUTATION OF X^2 FOR FREQUENCY DISTRIBUTION OF THE SAMPLE AND UNIVERSE IN EIGHT GEOGRAPHIC AREAS

Regions	Sample Return	Sample X_i	Contractor Population Θ_i	$(X_i - \Theta_i)$	$(X_i - \Theta_i)^2$	$\frac{(X_i - \Theta_i)^2}{\Theta_i}$
1	25	330	336	- 6	36	0. 107
2	45	594	615	- 21	441	0. 717
3	42	555	551	4	16	0. 029
4	33	436	378	58	3364	8. 899
5	20	264	296	-32	1024	3. 459
6	26	343	351	- 8	64	0. 182
7	14	185	196	- 11	121	0. 617
8	17	224	208	16	256	1. 231
TOTAL	222	2931	2931	0	----	X^2=15. 241

Degrees of freedom = n-1 or 7

X_i = Sample return multiplied by 13. 203 (Contractor population divided by Sample return = 13. 203)

P = 0. 02

CHAPTER IV

FINDINGS OF THE SURVEY

The tabulated research data from the 222 returns will be analyzed and interpreted in light of the pre-established hypotheses and basic objectives of the study. For consistency, each question will be approached using the following procedure:

(1) Comparative analysis of the two contractor groups.

(2) Analysis of regional (area) findings. (Available on questions 1, 4, 6, and 7 only)

(3) Summary of responses and pertinent applications to the total market.

(4) Measurement of actual findings to the pre-established hypotheses.

QUESTION NO. 1: DO YOU PRESENTLY OWN SELF-PROPELLED ASPHALT PAVERS?

Only contractors who presently own self-propelled asphalt pavers were accepted as participants in this study. Several who indicated in this question that they had recently gone out of business or sold their paving equipment were eliminated.

The responses from 124 NAPA contractors indicated that they currently own a total of 543 self-propelled asphalt pavers.

The average ownership per NAPA contractor was 4.38 pavers. The NON-NAPA group reported current ownership totalling 249 units. The average fleet size for a contractor in this group was 2.54 pavers.

The results indicate that the average NAPA contractor owns 1.72 times as many units as does the average non-affiliated contractor. Generally, this proportion holds true throughout the market. However, when the data was grouped by the eight geographic areas, an exception appeared in Area 5 (Mid and North Central States) where NON-NAPA contractors had a slightly higher average ownership.

TABLE 3

AVERAGE PAVER OWNERSHIP PER CONTRACTOR IN EACH GEOGRAPHIC AREA

Geographic Area	Average Unit Ownership Per Contractor	
	NAPA	NON-NAPA
1	4.73	2.80
2	3.86	1.88
3	4.53	2.37
4	4.26	4.00
5	3.25	3.50
6	3.06	1.50
7	13.50	3.10
8	5.11	2.00

Table 3 reveals that NAPA firms in Area 5 own 0.25 less units than their counterparts. This unusual situation resulted recently from a rapid increase in highway work which encouraged all contractors to increase their fleet size. A ranking of average ownership figures in Table 3 shows that Area 6 (Texas and South Central States) had the lowest unit ownership per contractor for both the NAPA and NON-NAPA groups. This would indicate that the available work volume in that area is spread over a large group of paving contractors.

In Table 4, the projection of average ownership figures to the total market indicates that the current paver population is 8,372 units. Using the contractor base of 2,931, the average paver ownership per contractor for the total market is 2.85 units.

TABLE 4

OWNERSHIP OF THE CURRENT PAVER POPULATION

Group	Average Ownership per Contractor	Contractor Population	Total Units
NAPA	4.38	504	2,207.5
NON-NAPA	2.54	2,427	6,164.5
Total Market	2.85	2,931	8,372.0

This resulting average of 2.85 units is comparable to the ownership study conducted in 1966 by Construction Equipment and Materials which found the average unit ownership to be 2.2 pavers.[29] A similar study undertaken by the same firm two years later placed average paver ownership per contractor at 2.4 units.[30] According to current findings, the average ownership per company has increased 0.45 units since 1968.

The strong market influence of NAPA contractors is illustrated in the comparison of group ownership to group size in Figure 4. Over 2,200 bituminous pavers are owned and operated by the NAPA group which represents only 17.2 per cent of the paving companies.

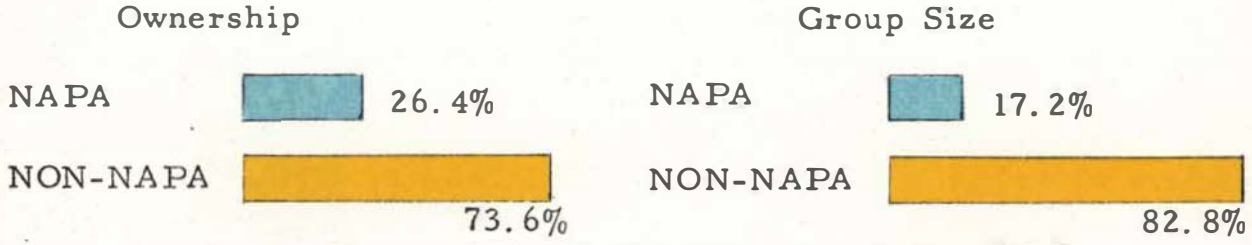

Fig. 4.--A Comparison of Group Paver Ownership to Group Population

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[29]"CEM Equipment and Materials Census of U.S. Contractors; Bituminous Pavers," A Report prepared by Construction Equipment and Materials (New York: Conover-Mast Publications, Inc., 1966), p. E-2.

[30]"CEM Equipment and Materials Census of U.S. Contractors; Bituminous Pavers," A Report prepared by Construction Equipment (New York: Conover-Mast Publications, Inc., 1968), unpaged.

When resulting figures are compared to the original hypothesis, it indicates that slightly less than the 30 per cent of the self-propelled asphalt pavers in the market place are owned by NAPA contractors. The study indicated that actually 26.4 per cent of the paver population is presently owned by this group.

QUESTION NO. 2: HOW FREQUENTLY DO YOU PURCHASE NEW PAVERS? HOW MANY UNITS?

The frequency of new paver purchases was significantly different for each contractor group. As Figure 5 illustrates, the nine year purchasing cycle for NAPA firms closely resembles a normal distribution pattern while the cycle for NON-NAPA firms is weighed heaviest in the six to nine year period.

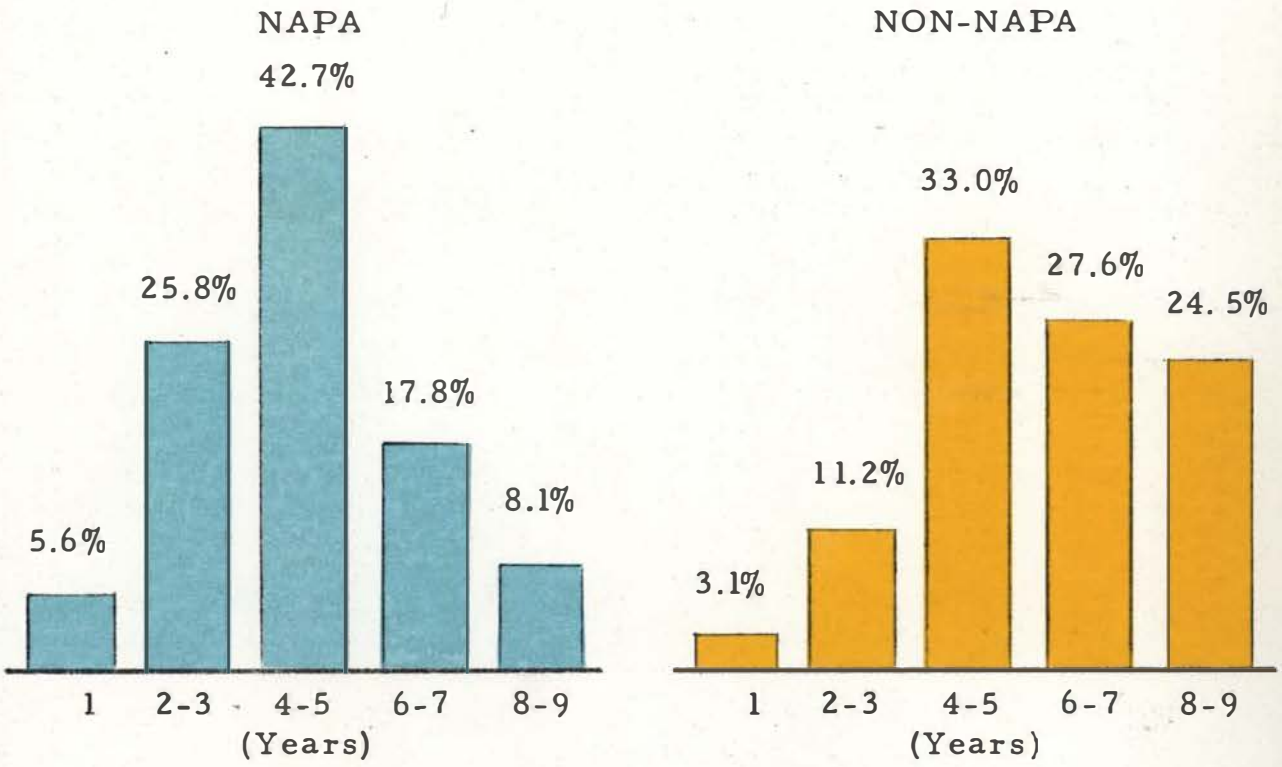

Fig. 5.--Comparison of Purchasing Patterns for NAPA and NON-NAPA Contractor Groups.

Within a five year span, 74.1 per cent of the NAPA group will purchase an asphalt paver compared to 47.9 per cent purchasing in the NON-NAPA group. Over 50 per cent of the NON-NAPA contractors appear in the buying market at a six to nine year interval. The median of the new paver purchases by NAPA firms is 4.4 years as compared to 6.1 years for NON-NAPA companies.

In connection with the buying frequency, the number of paver units purchased within each time span was also requested. The results show that 39.5 per cent of the NAPA firms purchase two or more units during their given frequency period. A comparison of the over all results for each contractor group is presented in Table 5.

TABLE 5

CONTRACTORS' PURCHASING PATTERNS BY NUMBER OF UNITS

Group	Number of pavers purchased at one time					
	1	2	3	4	5	6
NAPA	60.5%	31.5%	4.8%	2.4%	-	0.8%
NON-NAPA	74.5%	21.4%	1.0%	2.1%	1.0%	-

Quantity purchases of two or more units within a given frequency interval occurred most often in the four to five year time span. This pattern was true for both contractor groups.

Data from both parts of Question No. 2 were combined to reveal a clearer analysis of the market influence asserted by each group. The tabulation program provided a matrix which individually computed the percentage of contractors who purchase 1, 2, 3, etc. units within each frequency interval. Grouping this data with the number of projected contractor firms in each of the five frequency intervals it was possible to arrive at the cumulative paver purchases of both contractor groups in a nine year period. A yearly average was computed by dividing the total number of purchases in each frequency period by the value of the intervals mid-point; e.g., 2.5, 4.5, 6.5.[31]

The results indicate that over a nine year span the yearly average paver purchases by all contractors is 827 units. Over all NAPA contractors could be expected to account for 25.2 per cent of the annual paver sales. This is comparable to the previously mentioned 26.4 per cent of the paver population presently owned by the NAPA group. Table 6 indicates the average quantity of pavers which will be bought annually by those contractors in each frequency interval. It is of interest to note that 13 per cent of the annual paver sales are from contractors who yearly purchase

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[31]For the computation determining annual paver purchases by group, see Appendix J-1.

TABLE 6

AVERAGE PAVER PURCHASES IN EACH FREQUENCY INTERVAL

Frequency	Purchases (Number of Units)		
	NAPA	NON-NAPA	Total
Yearly	32	75	107
2-3 Years	70	88	158
4-5 Years	79	247	326
6-7 Years	18	122	140
8-9 Years	9	87	90
Total	208	619	827

one or more units. However, the greatest number of purchases each year comes from the group of contractors who appear in the buying market every four to five years.

The original hypothesis states that two-thirds of the NAPA contractors replace paving machinery within a one to five year time span. Actual findings indicate that three-fourths (74.1%) of the NAPA contractors buy within this specified time period.

QUESTION NO. 3: AT WHAT TONNAGE RATE DO YOU REPLACE YOUR PAVERS?

Findings indicate that the cycle of paver replacement based on tonnage rate closely resembles the patterns revealed in Question No. 2, the frequency interval of new paver purchases. Figure 6 below indicates the percentage of contractors in each group who replace pavers at the specified tonnage levels.

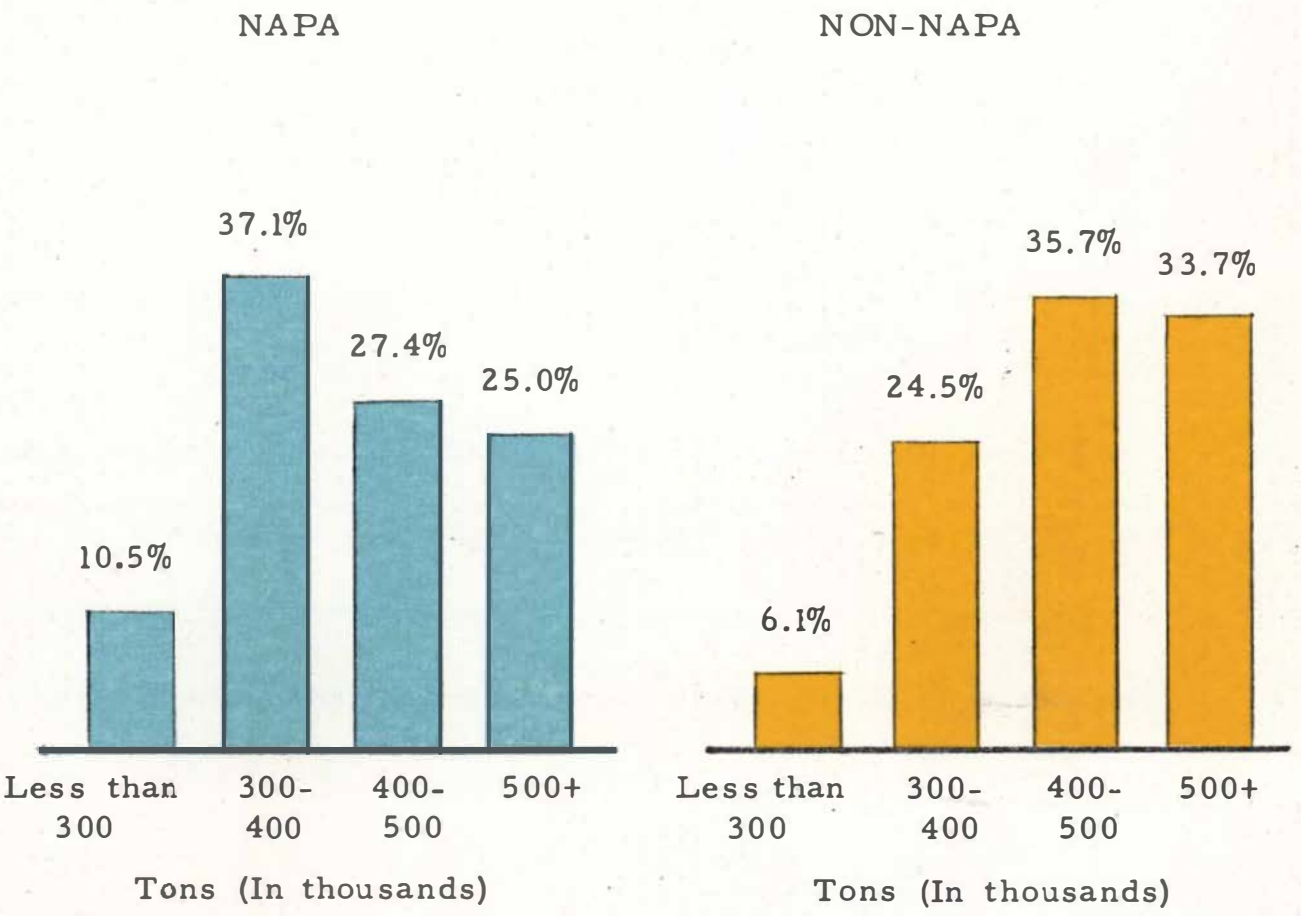

Fig. 6.--Paver Replacement Cycle by Tonnage Rate

Not only do NAPA contractors purchase more frequently but also they replace their equipment at lower tonnage levels than the

NON-NAPA firms. The largest share of NAPA contractors replace their equipment between 300,000-400,000 tons, while the greatest number of NON-NAPA contractors replace between 400,000-500,000 tons. One-third (33.7%) of the NON-NAPA firms process 500,000 tons or more of asphalt through each unit before trading. The data indicates that the median tonnage for replacement by NAPA contractors is 409,000 tons and the median tonnage rate for NON-NAPA is 454,000 tons per unit.

Projecting the results to the total contractor market, it is found that two-thirds (66.4%) of all paving contractors lay a minimum of 400,000 tons of asphalt before paver replacement.

The stated hypothesis that NAPA contractors replace their bituminous pavers at a lower tonnage level than NON-NAPA firms was proven to be true. When the frequency of new paver purchases in Question No. 2 is compared with the tonnage rate of replacement for each contractor group, it can be seen that more tons per unit are placed each year by NAPA contractors than by the NON-NAPA firms. Using average values, it is found that the NAPA group places approximately 91,000 tons annually through their pavers while the NON-NAPA group places approximately 74,000 tons.

QUESTION NO. 4: WHAT PER CENT OF YOUR PAVING WORK IS DONE IN THE FOLLOWING AREAS?

The findings indicate that State specification paving is the primary work area of NAPA contractors. NON-NAPA firms most often perform work in the parking lot and driveway paving areas. Figure 7 illustrates a comparison of the average per cent of time worked by the two groups in each of the four paving classifications.

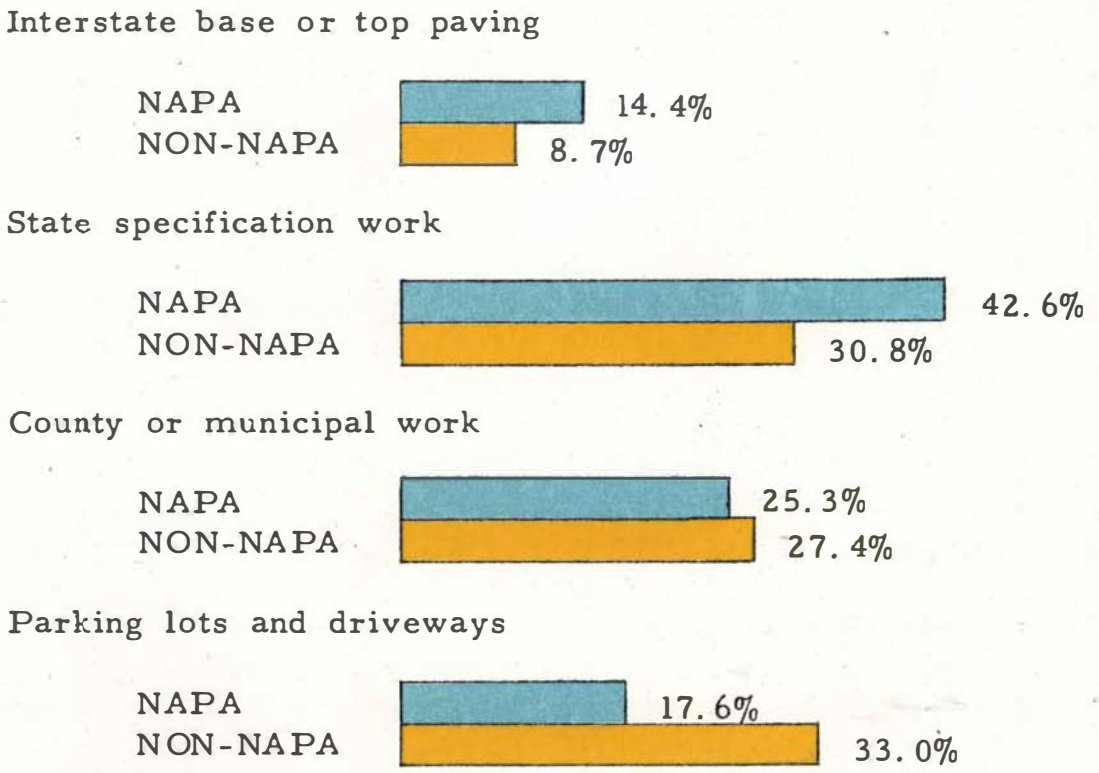

Fig. 7.--Type of Paving Work Done by Each Contractor Group.

The NAPA group performs 57 per cent of its work on Interstate and State specification paving while the NON-NAPA group derives only 39.5 per cent of its paving business from these same work areas.

The greatest difference between the two groups for one area of work concentration was found in the parking lot and driveway paving classification. NAPA firms derive only 17.6 per cent of their work from this area, while NON-NAPA firms derive 33 per cent.

The type of paving work performed by the two contractor groups supports the findings in Questions No. 2 and No. 3. The long duration of time between paver purchases for the NON-NAPA group is understandable when over 60 per cent of their work is concentrated on county and parking lot type paving. Since this type of paving requires less sophisticated machinery, older units can be adequately used.

As observed in Question No. 3, the average annual tonnage rate per unit is higher for NAPA contractors than for NON-NAPA firms. This observation is confirmed since the majority of NAPA's work is on Interstate and State specification projects which normally require high tonnage rates.

A regional analysis identifies the areas having the strongest emphasis on each type of paving work. The findings are summarized as follows:

(1) Interstate paving represents a larger portion of the contractors work in the area west of the Mississippi. Interstate work was strongest in Area 5 (Mid and North Central States).

(2) State specification work was fairly consistent among the eight areas. Area 2 (Central Eastern States) could be considered the strongest region for State highway paving.

(3) County or municipal work is considered strongest in Area 4 (Midwest States).

(4) Parking lot and driveway paving is most common in Area 3 (Southeastern States).

The pre-established hypothesis that NAPA contractors perform over 50 per cent of their work on Interstate and State specification paving is supported since the exact measurement is 57 per cent. It is likewise true that NON-NAPA contractors concentrate in excess of 50 per cent of their paving in the classifications of county, municipal, parking lots, and driveway work. It was determined that the actual measurement for NON-NAPA is 60.3 per cent in these areas.

QUESTION NO. 5: PLANNED PAVER PURCHASES IN 1971 WILL BE: _____ UNITS

Within the NAPA group 37.9 per cent of the contractors indicated plans to buy an asphalt paver in 1971. From the NON-NAPA group 19.4 per cent likewise stated plans to purchase during the given year. None of the participants indicated that they would be purchasing more than two asphalt pavers at this time.

Applying the above percentages to the total contractor population, it is found that NAPA members can be expected to purchase 28.9 per cent of the new pavers in 1971. This figure is slightly higher than the 26.4 per cent of the paver population owned by NAPA members as found in Question No. 1. In addition, findings from Question No. 2 indicated that over a nine year period NAPA contractors could be expected to purchase on the average 25.2 per cent of the annual paver sales. Actual findings show that planned NAPA purchases will be up over 3 per cent during 1971.[32] Considering the entire contractor population of 2,931 firms, 22.6 per cent of all contractors should buy a paver in 1971.[33]

The original hypothesis stated that in 1971 NAPA members will represent one-third of the firms purchasing new pavers. This estimate was slightly high since actual findings show that 28.9 per cent of the firms buying new paving equipment will be NAPA contractors.

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[32]This figure is based on the assumption that each contractor will purchase only one paver this year. However, it is understood that some contractors may purchase two units during 1971. The responses to this question did not differentiate exact numbers but provided only ranges of units.

[33]See Appendix J-2 for computations.

QUESTION NO.6: CONSIDERING THE VOLUME OF WORK IN YOUR AREA DURING 1971, DO YOU PLAN TO: PURCHASE, RENT, OR REBUILD?

The two contractor groups plan to organize their equipment fleets using different approaches to the three options: buy, rent, or rebuild. The results as summarized in Table 7 indicate the percentage of contractors planning to employ each possible alternative. Since multiple answers were possible, the total number of responses exceed the 222 base value.

TABLE 7

PLANNED APPROACHES TO SATISFY PAVING EQUIPMENT NEEDS IN 1971

Alternatives	NAPA	NON-NAPA
Purchase new pavers	37.9%	19.4%
Rent or lease required pavers	4.8%	6.1%
Rebuild present pavers	16.9%	19.4%
Present fleet is adequate	54.0%	67.4%

The percentages for NAPA contractors in Table 7 indicate a definite preference for purchasing new equipment rather than rebuilding their old pavers. Over one-half (54%) of the firms believed their present fleet to be adequate for the 1971 paving season.

The NON-NAPA group plans to organize their equipment needs in quite a different fashion. Results show that 19.4 per cent planned to purchase new pavers while an equal amount indicated plans to rebuild presently owned machinery. A small portion (6.1%) of the contractors intend to rent or lease required pavers. The majority (67.4%) of the NON-NAPA firms indicated that their present paver fleet was adequate. The results imply that a NON-NAPA contractor will strongly consider the possibility of rebuilding his present equipment prior to purchasing a new paver.

A regional analysis was undertaken to study the responses for the two alternatives, rent or rebuild. The results indicate that the highest percentage of contractors planning to rent or lease pavers were located in Area 7 (Southwestern States) where 14 per cent of the participants selected this course of action. This is most typical of California contractors who have in the past supplemented their fleets by renting needed equipment. Area 5 (Mid Central States) represented the weakest location for rental equipment. On the other hand, 30 per cent of the contractors in Area 5 represented the highest percentage of firms planning to rebuild their current pavers. The weakest location for rebuilding pavers was in Area 2 (Central Eastern States) where only 11.1 per cent of the group selected this alternative.

Applying the survey findings to the total contractor population, it can be concluded that 22.6 per cent (662) of the firms plan to purchase new pavers in 1971. Renting or leasing paving equipment is probable for 5.9 per cent (172) of the companies while 19 per cent (556) of the firms plan to rebuild their present equipment. Contractors considering their current fleet to be adequate accounted for 65.1 per cent (1.908) of the firms.[34] From the over all results it appears that renting or leasing of paving equipment is the least desirable option. In periods of expanded work volume, the alternative to rent could become increasingly important.

The pre-established hypothesis was correct in that twice as many NAPA contractors would purchase new pavers in 1971 as opposed to rebuilding their present equipment. Findings from this question show that actually 2.2 times as many NAPA contractors plan to buy rather than rebuild their old machinery. This conclusion explains part of the reason for the more rapid replacement of NAPA owned pavers. As noted in Question No. 2, NAPA firms most frequently replace every two to five years as compared to four to seven years for the NON-NAPA company. Generally, the choice to purchase or rebuild pavers is of less concern to the NAPA contractor, but represents a significant decision to NON-NAPA firms.

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[34]For computations, see Appendix J-3.

QUESTION NO. 7: WHAT IS YOUR PREDICTION OF THE 1971 PAVING WORK IN YOUR REGION?

NAPA contractors predicted that the volume of work will remain the same or decline slightly from the 1970 level. NON-NAPA firms were more confident that business would remain the same in 1971. Figure 8 illustrates the predictions which were made by each contractor group.

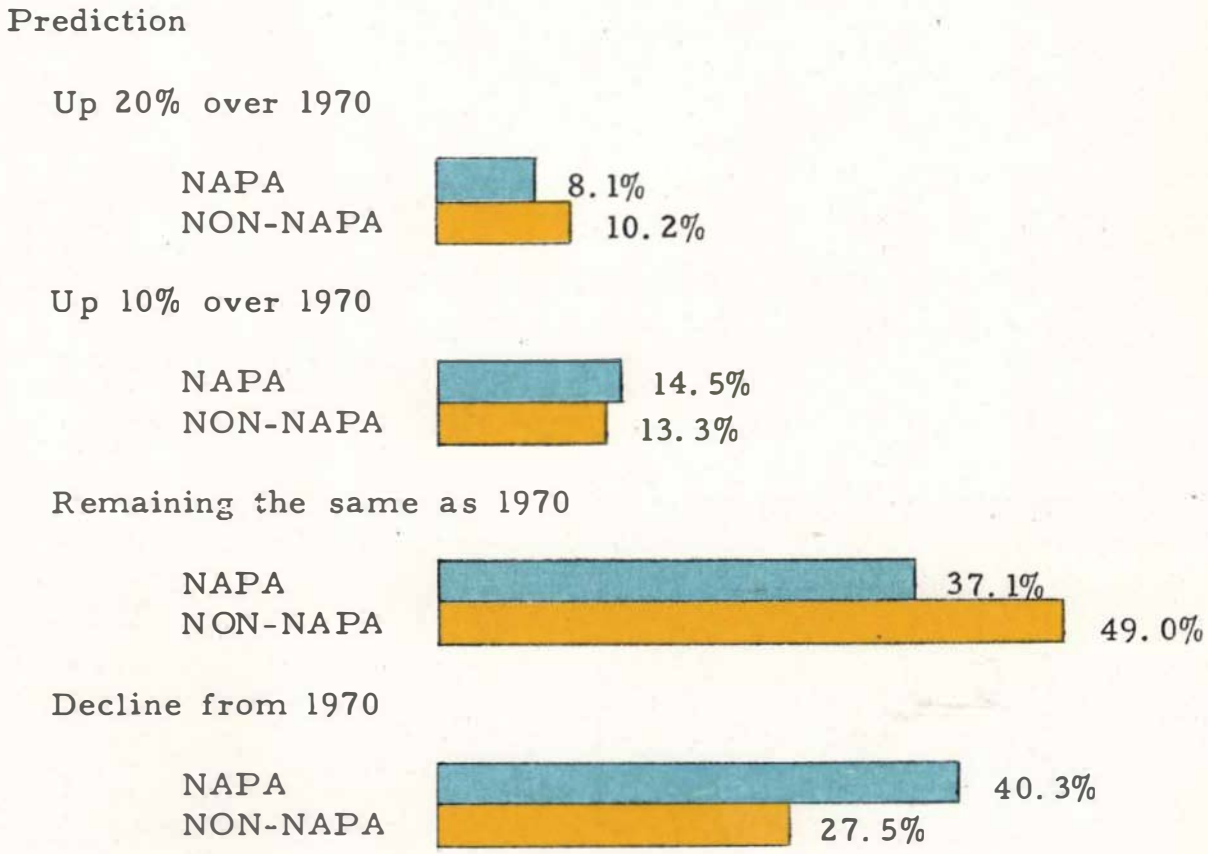


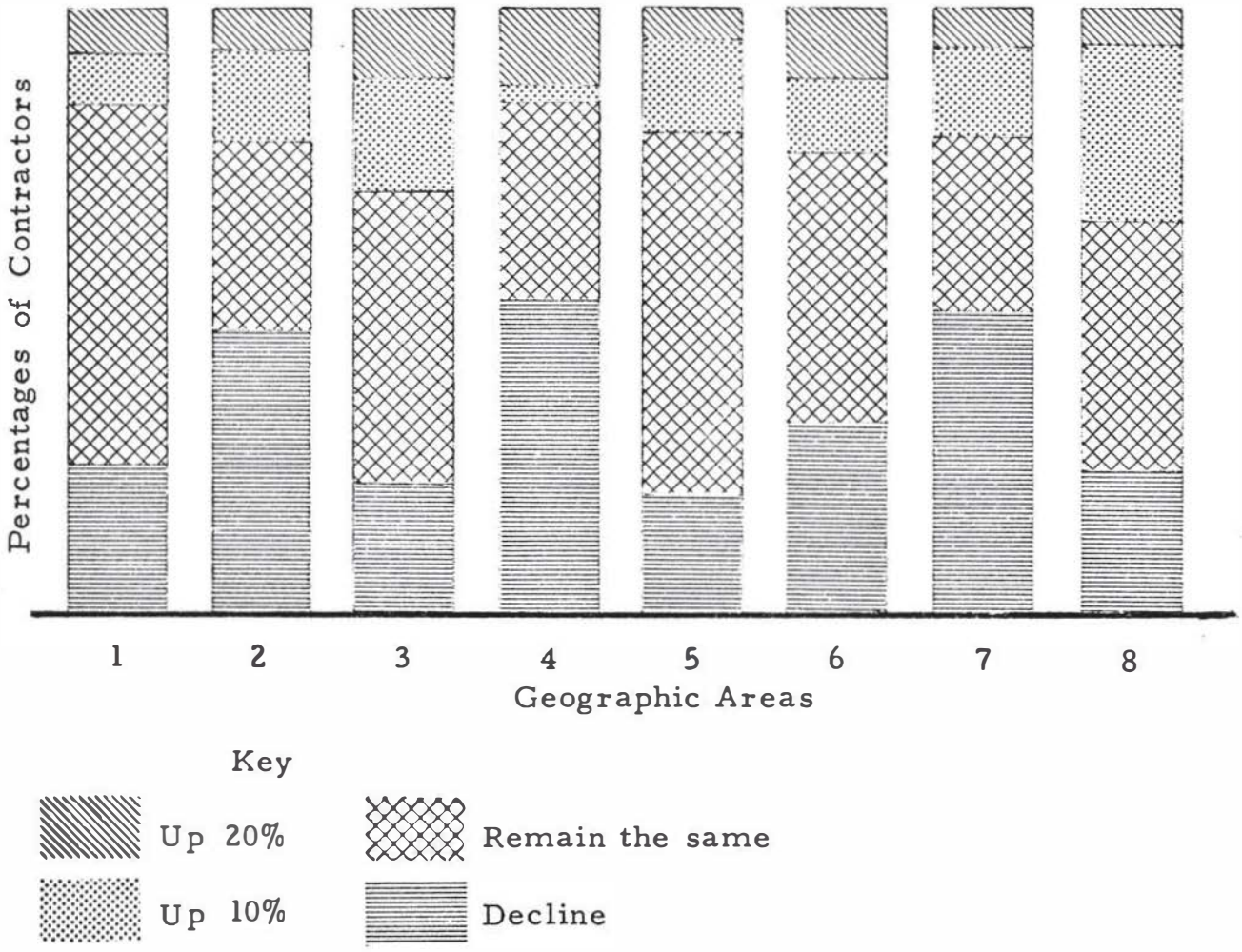
Fig. 8.--Predictions of Paving Business Trends in 1971 as Compared to 1970.

Almost an equal segment of each group predicted that 1971 paving work would be up 10 per cent or more. The largest portion of each group, however, indicated that work volume would

either remain the same or decline from the 1970 level. NAPA contractors were most pessimistic with 40.3 per cent predicting a decline in over all work volume. Forty-nine per cent of the NON-NAPA contractors expect the level of paving work to remain the same. It should be noted that the prediction from each group was influenced by their particular type of work concentration. As discussed in Question No. 4, NAPA firms derive most of their work from Interstate and State specification projects while NON-NAPA firms concentrate heavily on State, municipal, and private paving work.

An analysis of the composite regional findings indicates that work volume will basically remain the same in five geographic areas and decline in the other three regions. Figure 9 illustrates the predictions made by contractors for their own geographic area. Sixty per cent of the contractors in Area 1 (North Eastern States) and Area 5 (Mid Central States) indicated that work volume would remain the same in 1971. Over 40 per cent of the contractors in Area 3 (Southeastern States), Area 6 (South Central States) and Area 8 (Northwestern States) likewise predicted that their work volume would remain the same. A decline in paving work was projected by 47 per cent of the contractors in Area 2 (Central Eastern States). In addition, 50 per cent of the firms in Area 4 (Midwest States) and Area 7 (Southwestern States) indicated that work volume

Fig. 9.--Contractor Prediction of Paving Business in 1971 by Geographic Area.



would be lower in 1971. Because each region encompasses five or more States, it should be noted that each State and municipality has its own road program. Annual budgetary shifts can be expected to influence the contractors prediction of work volume thus accounting for the variance in opinion within each area. The regional findings as illustrated in Figure 9 can be considered the probable pattern of work volume in each geographic area.

Applying the survey results to the total contractor population, it is found that almost one-half (47%) of all firms would expect work volume to remain the same in 1971. Figure 10 illustrates the composite market findings.[35]

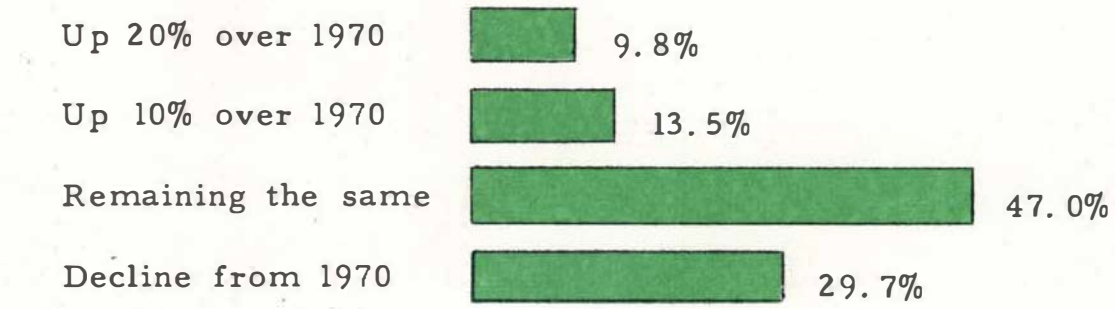


Fig. 10. --Work Volume Predictions for 1971.

The original hypothesis was correct in stating that the 1971 paving business would continue on the same level as 1970. This would support the strong possibility that annual paver purchases will likewise remain equal to the 1970 level.

QUESTION NO. 8: IN YOUR OPINION, RANK THE EVENTS WHICH WILL MOST ADVERSELY AFFECT THE VOLUME OF PAVING IN THE FUTURE?

The findings reveal that both contractor groups ranked the four given events alike. The one event considered by both groups to have the most adverse effect upon the volume of paving in the

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[35]The computations for composite market findings appear in Appendix

future was Federal or State cutbacks in highway programs. Because this problem has been a continuous threat for the past five years, contractors weighted it heavily. Table 8 presents the percentage of contractors who gave a ranking of 1, 2, 3, 4, or 5 to the given events.

TABLE 8

CONTRACTOR RANKING OF MAJOR EVENTS AFFECTING PAVING IN THE FUTURE

Ranking	Event	Percent of Contractors	
		NAPA	NON-NAPA
1	Federal or State cutbacks in highway programs	63.7%	68.4%
2	Revenue sharing program of highway trust funds (proposed)	36.4%	39.5%
3	Shift in State matching fund from 50:50 to 70:30	41.8%	41.1%
4	Further restriction of the Davis-Bacon Act	63.3%	46.5%
5	Other	67.7%	56.8%

The ranking of "1" (most adverse effect) was given to Federal or State cutbacks in highway programs by nearly two-thirds of each contractor group. Ranked as the second most adverse effect was the proposed revenue sharing of highway trust funds. Even though this proposed sharing program will not take affect for at least

two to three years, contractors foresee definite problems resulting from this legislation.

The shift in State matching funds from the current 50:50 ratio to the new 70:30 ratio received over all the ranking of "3". Contractors are presently unsure of the possible results which may occur from this change. During the transition period a slowdown in work volume may occur, but this would be considered only a temporary adjustment. Of the events listed in this question, the ranking of "4" (a less adverse effect) was given to the further restriction of the Davis-Bacon Act. NON-NAPA contractors were not greatly concerned about the removal of the Davis-Bacon Act since much of their work is on the local and private levels.

The ranking of "5" (least adverse effect) was generally assigned by both contractor groups to the write-in section entitled "Other". The most frequently mentioned concern by both groups was the state of the general economy. Several contractors listed high labor rates and runaway inflation as having serious implications on their business. The second most frequently mentioned event was the fear of another asphalt oil shortage. As previously noted, several contracting firms were operating in 1970 at one-half of their productive capacity because of the oil shortage.

Other events also mentioned several times included the current pressures from the ecology movement which has forced

additional costs upon paving contractors. Comments concerning local bond programs and State revenues were likewise entered as possible adverse effects in the future.[36]

The pre-established hypothesis was proven to be wrong in that the revenue sharing of the highway trust fund was not considered the most adverse event. Contractors have over the past five years felt the results of Federal and State cutbacks and have not ruled out the possibility of future cuts. Since revenue sharing was ranked second by contractors, it is recognized in the field as a serious potential threat.

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[36]See Appendix J-5 for the complete percentage tabulation for Question No. 8.

CHAPTER V

CONCLUSIONS

The findings from this study of the asphalt paving industry reveal that the buying patterns of the two contractor groups are contingent upon several factors. The frequency of new paver purchases is determined by an estimated tonnage rate for replacement. The tonnage is consumed at a predictable rate directly related to the type of paving work most often performed by the contractor and the volume of work available in his geographic area. The comparative analysis of buying patterns for the NAPA and NON-NAPA contractor groups provided insight into the purchasing environment for bituminous pavers. The results of this survey more clearly defined the existing buyer patterns among contractors for each of the following topics:

(1) Average paver ownership

(2) Frequency of new paver purchases

(3) Tonnage replacement rate

(4) Preference for buying, renting, or rebuilding pavers

To summarize the findings: the pattern of paver ownership revealed that NAPA members typically own 4.38 pavers per contractor while the NON-NAPA group owns 2.54 units per firm. Industry-wide ownership figures show the average units per contractor to be 2.85 which is an increase over the last six years. The frequency of new paver purchases appears to be a reflection of the type of work common to each contractor group. NAPA firms focus on Interstate and State specification paving which requires high tonnage productivity and sophisticated equipment. Their most common frequency of purchase is every two to five years. NON-NAPA firms derive most of their work from county, municipal, parking lot, and driveway projects which can be completed with less sophisticated or older machines. Their area of work concentration allows more time between required paver purchases. Most often, NON-NAPA firms replace their pavers every four to seven years. There were a few NON-NAPA firms who were the exceptions to this pattern in that they did considerable work in Interstate and State specification paving. For these firms, the purchasing and replacement cycles followed a pattern similar to the NAPA firms. Using paver tonnage rate as a measurement for equipment replacement, it was found that 47.6 per cent of the NAPA firms replace at 400,000 tons or less. The NON-NAPA

firms normally replace at 400,000 tons or more. One-third of the latter group considers paver replacement only after placing over 500,000 tons.

Based on the current statistical data obtained in this study, it is possible to more accurately measure the degree of purchasing influence NAPA contractors have on the total market sales of asphalt pavers. The NAPA group consists of only 504 contractors who represent 17.2 per cent of the total contractor universe. This small group of firms currently owns 26.4 per cent of the self-propelled paver population. Planned purchases during 1971 show that 28.9 per cent of the contractors who intend to buy will come from the NAPA group.

The market influence of this select group can also be seen by their characteristic buying patterns. Typically, NAPA contractors replace their current equipment 18 months sooner than do their counterparts. When buying, NAPA firms more frequently consider the purchase of two or more units at one time. This was reflected in that 39.5 per cent of the NAPA firms indicated multiple purchases during their replacement cycle. The consideration to rebuild presently owned equipment is unattractive to NAPA firms as their responses indicated that 2.2 times as many firms buy instead of rebuilding. The strength of NAPA's influence on the total

market sales of asphalt pavers ranges from one-fourth to one-third of the annual purchases. Based on these facts and supporting regional data, it can be concluded that NAPA contractors are strong influentials in the asphalt paving market.

Highlighting the contractors' predictions of the 1971 paving season, it can be concluded that work volume will remain equal to the 1970 level. This estimate is significant to manufacturers of paving equipment since machinery sales closely parallel the trend in work volume. Findings suggest that regional sales may fluctuate slightly from last year's figures, but that over all paver sales should equal the 1970 total.

The future of the asphalt paving industry may be altered by several potentially adverse events. Contractors indicated the greatest concern over possible cuts in future Federal and State highway programs. The threat of a revenue sharing program using money from the Highway Trust Fund likewise is disturbing to many contractors. Other comments by several participants included remarks about the general economy and current ecology legislation. All of these factors are recognized by contractors as having possible serious implications for the future paving industry.

CHAPTER VI

RECOMMENDATIONS

The survey findings indicate that NAPA contractors represent a sizable purchasing group. Their frequent appearance in the buying market suggests that a paving equipment manufacturer should direct special attention to this group. A direct advertising and sales promotion program should be designed specifically for NAPA members. In addition, a yearly study of this group should be undertaken to monitor possible shifts in their buying patterns. Since the NAPA group is small enough to handle each contractor separately, an individual company profile should be maintained for each member. Each company's profile would contain: current paver ownership, age of each machine, area of work concentration, normal tonnage replacement rate, size of operation and names of key employees. A feedback program from field sources could be used to continuously update the profile program.

By applying the survey findings to existing marketing programs, full value of this study can be realized. Utilizing the regional ownership data from this study and the manufacturer's

historical sales data, it is possible to estimate the company's regional market share without conducting a full ownership census. In addition, the findings can be used as the basis for developing new marketing strategies. The buying patterns as defined in this survey serve as excellent tools for forecasting paver sales potential. The feasibility of using these buying patterns in a statistical forecasting matrix warrants further consideration.

The findings as given suggest three areas in which additional investigation is recommended. They are as follows:

Area 1: Pursue an exploratory study to locate those contractors who annually purchase an asphalt paver. Findings indicate that 13 per cent (106 of the firms) make an annual purchase. Determine who they are and their brand preferences.

Area 2: Study the contractors' type of work concentration and its relationship to paver purchases. How much of an influence does the work area have upon a contractor's buying patterns? Can the dollar volume of work available in each type of paving area be used to project paver sales?

Area 3: Examine part sales among NON-NAPA firms. Findings from Question No. 6 indicated that a large number of this contractor group planned to rebuild equipment in 1971. Determine how new paver sales could be expanded to replace the rebuilt equipment.

APPENDIX

Industrial Researchers

APPLIED MARKETING SYSTEMS

P. O. BOX 562 CHARLESTON, ILLINOIS 61920

May 4, 1971

Dear Contractor:

We would appreciate your help in answering the few brief questions about the asphalt paving industry on the enclosed blue sheet.

This study is being conducted in partial fulfillment of the requirements for a Masters Degree in Business Administration at Eastern Illinois University. Industrial Researchers are assisting with this project.

The objective of this study is to measure the volume of paving work in 1971 and its effect upon equipment needs.

Your response will be used in statistical groupings and will in no way reflect individual answers. Because this study is being sent to a limited group, your individual participation is highly important in obtaining a representative response.

If you are interested in receiving a copy of the findings, simply indicate by writing in your company name at the bottom of the questionnaire. A stamped, self-addressed envelope is enclosed for your convenience.

Your help in making this a successful study is appreciated.

Leonard Decker
Graduate Student

Enclosure
LD:sc

RESEARCH QUESTIONNAIRE

Please use a (✓) check mark or give the appropriate answer as indicated:

1. Do you presently own self-propelled asphalt pavers?

( ) Yes Qty. _____
( ) No

2. How frequently do you purchase new pavers?

Frequency	How many units?
( ) Yearly	
( ) 2-3 Years	Qty. 1 2 3 4 5 6
( ) 4-5 Years	
( ) 6-7 Years	
( ) 8-9 Years	

3. At what tonnage rate do you replace your pavers?

( ) Less than 200,000 tons
( ) 200,000 - 300,000 tons
( ) 300,000 - 400,000 tons
( ) 400,000 - 500,000 tons
( ) 500,000 tons and over

4. What percent of your paving work is done in the following areas?

____% Interstate base or top paving
____% State specification work
____% County or municipal work
____% Parking lots and driveways

5. Planned paver purchases in 1971 will be:

( ) 1-2 pavers
( ) 3-4 pavers
( ) 5-6 pavers
( ) Other ____

6. Considering the volume of work in your area during 1971, do you plan to:

( ) Purchase additional pavers
( ) Rent or lease required pavers
( ) Re-build present pavers
( ) Present fleet is adequate

7. What is your prediction of the 1971 paving work in your region?

( ) Up 20% over 1970
( ) Up 10% over 1970
( ) Remaining the same as 1970
( ) Declining from 1970

8. In your opinion, which event will most adversely affect the volume of paving in the future? Rank from 1-5 (1=most effect, 5=least effect)

____ Shift in state matching fund from 50:50 to 70:30
____ Revenue sharing program of highway trust funds (proposed)
____ Further restriction of the Davis-Bacon Act
____ Federal or State cutbacks in highway programs
____ Other _____

_____

THANK YOU FOR YOUR COOPERATION

Comments:

RESEARCH QUESTIONNAIRE

This study is being conducted in partial fulfillment of the requirements for a Masters Degree in Business Administration with the assistance of Industrial Researchers.

All responses will be used in statistical groupings and will not reflect individual answers. Your assistance in making this a successful study is appreciated. If you are interested in receiving a copy of the findings, please indicate at the end of the questionnaire.

L. Decker

RESEARCH QUESTIONNAIRE

Please use a (✓) check mark or give the appropriate answer as indicated:

1. Do you presently own self-propelled asphalt pavers?

( ) Yes Qty. _____
( ) No

2. How frequently do you purchase new pavers?

Frequency	How many units? (Circle one)
( ) Yearly	
( ) 2-3 Years	Qty. 1 2 3 4 5 6
( ) 4-5 Years	
( ) 6-7 Years	
( ) 8-9 Years	

3. At what tonnage rate do you replace your pavers?

( ) Less than 300,000 tons
( ) 300,000 - 400,000 tons
( ) 400,000 - 500,000 tons
( ) 500,000 tons and over

4. What percent of your paving work is done in the following areas?

_____% Interstate base or top paving
_____% State specification work
_____% County or municipal work
_____% Parking lots and driveways

5. Planned paver purchases in 1971 will be:

( ) 1-2 pavers
( ) 3-4 pavers
( ) 5-6 pavers
( ) Other _____

6. Considering the volume of work in your area during 1971, do you plan to:

( ) Purchase new pavers
( ) Rent or lease required pavers
( ) Re-build present pavers
( ) Present fleet is adequate

7. What is your prediction of the 1971 paving work in your region?

( ) Up 20% over 1970
( ) Up 10% over 1970
( ) Remaining the same as 1970
( ) Declining from 1970

8. In your opinion, rank the events which will most adversely affect the volume of paving in the future?

Rank from 1-5 (1=most effect, 5=least effect)

_____ Revenue sharing program of highway trust funds (proposed)
_____ Federal or State cutbacks in highway programs
_____ Further restriction of the Davis-Bacon Act
_____ Shift in state matching fund from 50:50 to 70:30
_____ Other _____

THANK YOU FOR YOUR COOPERATION

Comments:

RESEARCH QUESTIONNAIRE

This study is being conducted in partial fulfillment of the requirements for a Masters Degree in Business Administration with the assistance of Industrial Researchers.

All responses will be used in statistical groupings and will not reflect individual answers. Your assistance in making this a successful study is appreciated. If you are interested in receiving a copy of the findings, please indicate at the end of the questionnaire.

Thank you,

L. Decker

APPENDIX C.

FOLLOW-UP NOTE

REMINDER: I need your help to complete my thesis. Please take a moment to fill out the enclosed questionnaire.

Because of the limited time allowed, full contractor participation is important to make this a valid study.

A post paid 8¢ envelope is enclosed for your convenience.

Your cooperation is greatly appreciated.

[redacted]

L. Decker

Industrial Researchers
APPLIED MARKETING SYSTEMS
P. O. BOX 562 CHARLESTON, ILLINOIS 61920

SUBJECT: SUMMARY OF THE ASPHALT CONTRACTOR SURVEY

Your response to the recent survey of the asphalt paving industry was greatly appreciated. Since my thesis in nearing completion, it is now possible to forward to you a copy of the summary of findings which you requested.

The attached summary states the concensus of contractor opinion on the average replacement period of asphalt pavers, prediction of the 1971 paving work volume, and those events which can adversely affect paving in the future.

All responses were used in statistical groupings and in no way reflected your individual answers. I hope that the summary of findings proves most interesting to you.

Thank you for your cooperation in making this a successful study.

Sincerely,

Leonard Decker
Graduate Student

Enclosure.
LD/jd

APPENDIX D-2. SUMMARY OF FINDINGS FROM THE ASPHALT PAVING CONTRACTOR STUDY

(Conducted May 4, 1971)

THE AVERAGE FREQUENCY OF NEW PAVER PURCHASES IS EVERY 4-5 YEARS.

TWO-THIRDS OF THE CONTRACTORS REPLACE THEIR ASPHALT FINISHERS AFTER LAYING AT LEAST 400,000 TONS OF MATERIAL.

APPROXIMATELY ONE IN EVERY FIVE CONTRACTORS PLANNED TO PURCHASE A NEW PAVER IN 1971.

FIVE PER CENT OF THE CONTRACTORS PLANNED TO RENT OR LEASE ASPHALT FINISHERS DURING 1971. FIFTY-THREE PER CENT INDICATED THAT THEIR PRESENT PAVER FLEET WAS ADEQUATE.

CONTRACTOR PREDICTION OF 1971 PAVING WORK:

A CUTBACK IN FEDERAL OR STATE HIGHWAY PROGRAMS WAS RANKED AS THE NUMBER ONE EVENT WHICH CAN MOST ADVERSELY AFFECT THE VOLUME OF PAVING IN THE FUTURE. REVENUE SHARING OF HIGHWAY TRUST FUNDS WAS RANKED SECOND.

APPENDIX E.

STATE ASPHALT PAVEMENT ASSOCIATIONS

Alabama Asphalt Pavement Association
Montgomery, Alabama

Arkansas Asphalt Pavement Association, Inc.
Little Rock, Arkansas

California Asphalt Pavement Association
North Hollywood, California

Connecticut Bituminous Concrete Producers Association
Norwich, Connecticut

Delaware Asphalt Pavement Association
Dover, Delaware

Asphalt Contractors Association of Florida
Altamonte Springs, Florida

Georgia Asphalt Pavement Association
Atlanta, Georgia

Illinois Asphalt Pavement Association
Springfield, Illinois

Asphalt Pavement Association of Indiana, Inc.
Indianapolis, Indiana

Asphalt Paving Association of Iowa
Des Moines, Iowa

Kansas Asphalt Pavers Association, Inc.
Topeka, Kansas

The Plantmix Asphalt Industry of Kentucky, Inc.
Frankfort, Kentucky

Louisiana Asphalt Pavement Association, Inc.
Baton Rouge, Louisiana

STATE ASSOCIATIONS CONT.

The Maryland Asphalt Association, Inc.
Baltimore, Maryland

Massachusetts Asphalt Pavement Association
Weston, Massachusetts

Michigan Asphalt Paving Association, Inc.
Lansing, Michigan

Minnesota Asphalt Pavement Association, Inc.
St. Paul, Minnesota

Mississippi Asphalt Pavement Association, Inc.
Jackson, Mississippi

New Jersey Asphalt Pavement Association
Princeton, New Jersey

Asphalt Producers Association of Metropolitan New York, Inc.
Flushing, New York

New York State Bituminous Concrete Producers Association, Inc.
Albany, New York

Carolina Asphalt Pavement Association, Inc.
Raleigh, North Carolina

Flexible Pavements, Inc.
Columbus, Ohio

Oklahoma Asphalt Pavement Association
Oklahoma City, Oklahoma

Asphalt Pavement Association of Oregon
Salem, Oregon

Asphalt Manufacturers Association of Western Pennsylvania
Pittsburgh, Pennsylvania

Pennsylvania Asphalt Pavement Association
Lemoyne, Pennsylvania

STATE ASSOCIATIONS CONT.

South Carolina Asphalt Pavement Association
Columbia, South Carolina

Tennessee Plant-Mix Asphalt Association
Nashville, Tennessee

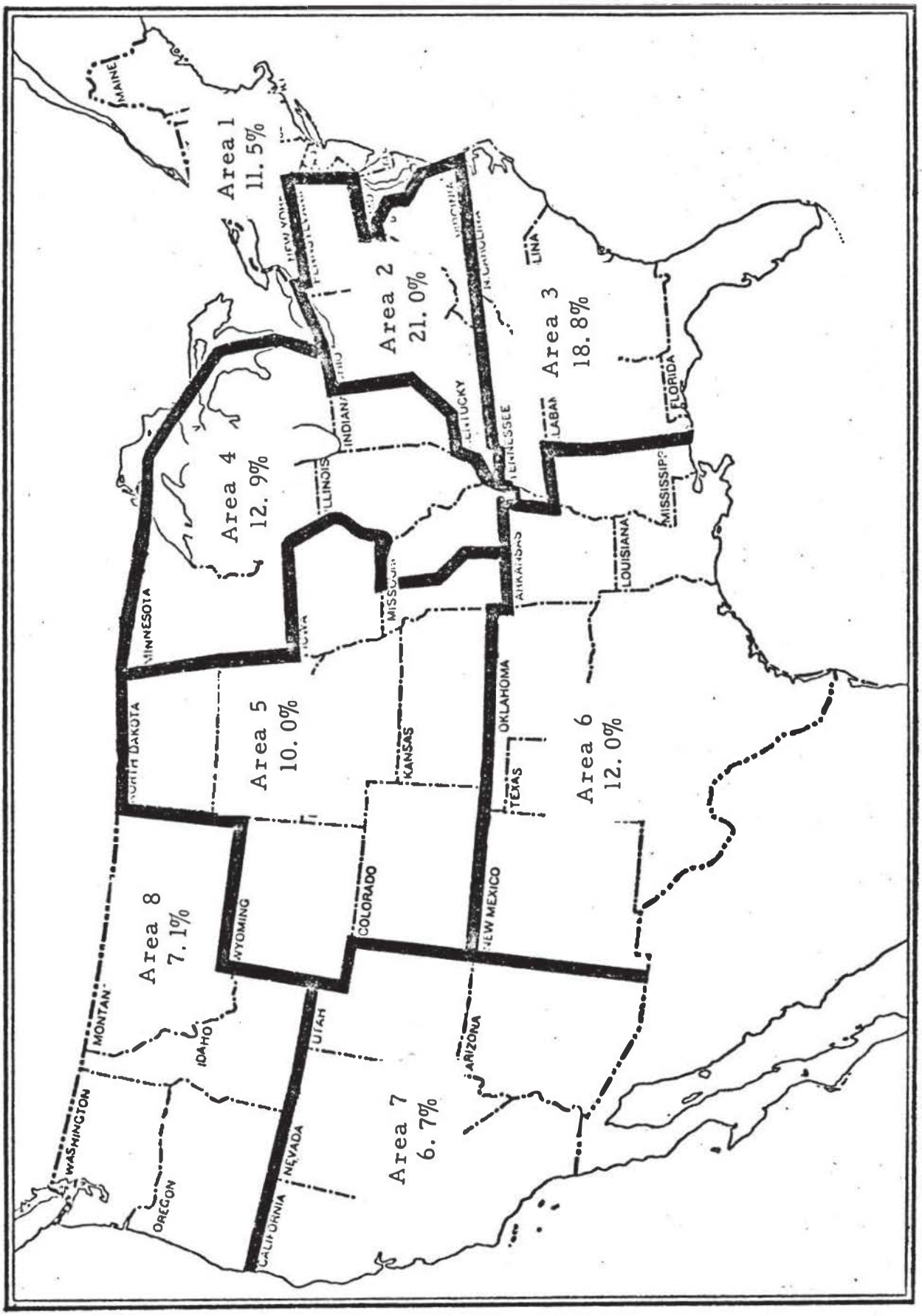
Texas Hot Mix Asphalt Pavement Association
Austin, Texas

Virginia Asphalt Association, Inc.
Richmond, Virginia

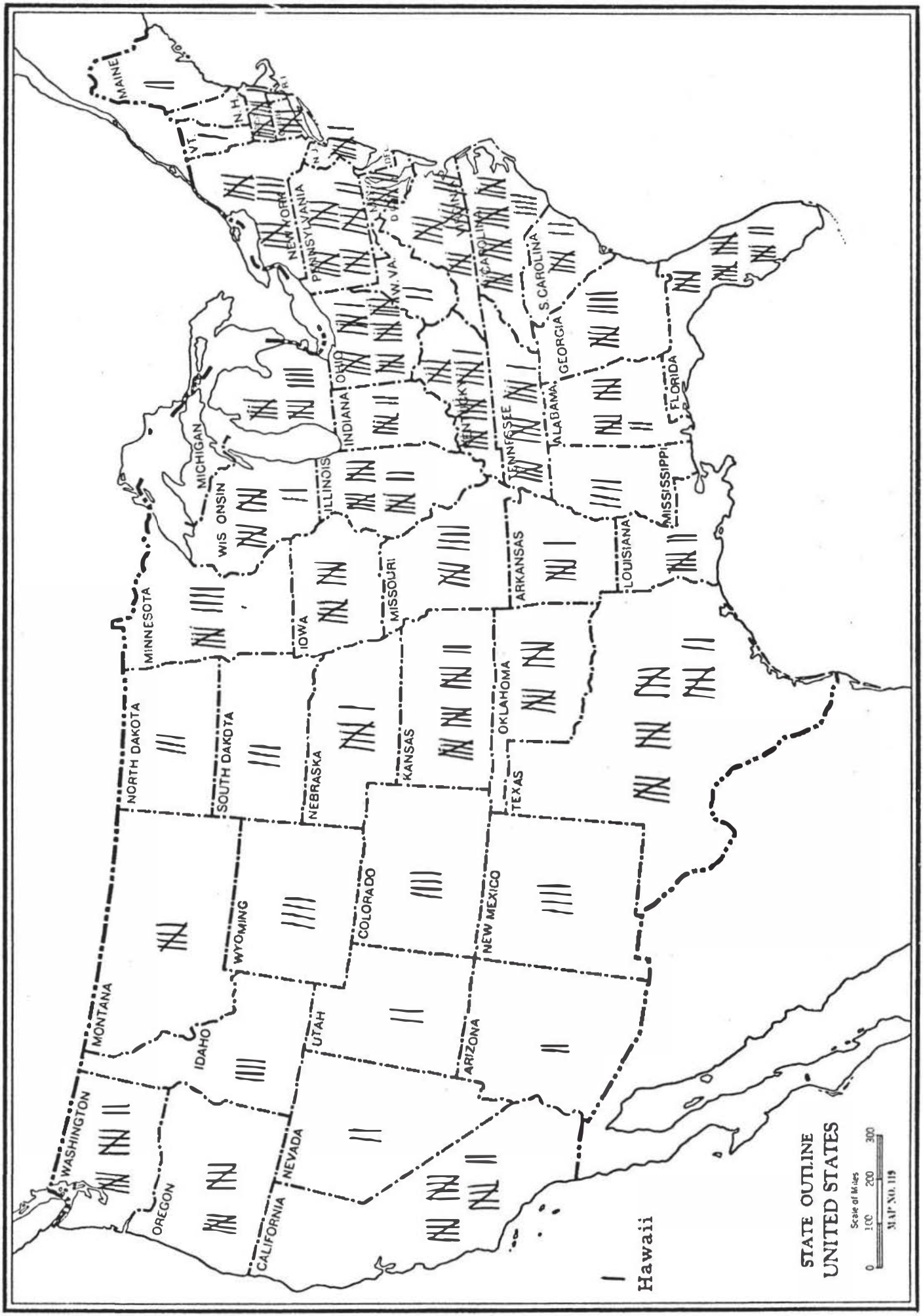
Asphalt Paving Association of Washington, Inc.
Seattle, Washington

Wisconsin Asphalt Pavement Association
Madison, Wisconsin

APPENDIX F. REGIONAL DISTRIBUTION OF CONTRACTORS



APPENDIX G. GEOGRAPHIC DISTRIBUTION OF THE SAMPLE



IBM

IBM System/360 Assembler Coding Form

PROGRAM

PROGRAMMER | DATE

PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH

STATEMENT

Name | Operation | Operand | Comments

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 45 50 55 60 65

RESPONDENT NUMBER

CONTRACTOR GROUP

REGIONAL AREA

QUESTION NO. 1

QTY. OF OWNERSHIP

QUESTION NO. 3

QTY PURCHASED

QUESTION NO. 2

QUESTION NO. 4 PER CENT OF WORK

QTY. FOR "OTHER" QUESTION NO. 5

QUESTION NO. 6

QUESTION NO. 7

QUESTION NO. 8

CONTRACTOR WRITE-IN ON QUESTION NO. 8

CODING

```
00000111011111 00          1012341 11111
     222 —  222   100      2       222222
       3     333     100   3       333333
       4     444       1004        444444
       5     55                     55555
99999  6    99   6          9
       7    —
       8
```

APPENDIX H. TABULATION FORMS

Card Layout

*A standard card form, IBM electro 6509, is available for punching source statements from this form.
Instructions for using this form are in any IBM System/360 Assembler Reference Manual.
Address comments concerning this form to IBM Corporation, Programming Publications, Department 232, San Jose, California 95114.

NAPA GROUP

Leonard Decker

COMPUTER 7-21-71 PUNCHED

TABULATION DATA

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38 → 80 REMARKS
Q-1	0	0	6	5	0	1	4	1	0	5	3	3	2	0	0	0	0	0	0	0	6	0	0	4	0	1	−	1	0	0	0	3	3	1	4	2	5	
Q-2	0	1	7	0	1	1	3	1	0	1	4	1	4	0	0	0	0	5	0	0	3	0	0	2	0	1	−	1	0	0	0	4	1	2	4	3	5	
Q-3	0	1	9	0	0	1	4	1	0	2	3	2	3	0	0	0	0	5	5	0	4	5	0	0	0	1	0	0	0	1	1	4	0	1	0	0	0	
Q-4	0	2	5	0	0	1	4	1	0	4	3	2	2	0	0	0	3	4	0	3	3	0	3	3	4	0	0	0	0	1	3	0	1	0	0	0		
Q-5	0	2	5	8	0	1	6	1	0	1	4	1	1	0	5	0	0	5	0	0	0	0	0	0	4	0	0	0	0	1	3	2	1	4	3	5		
Q-6	0	2	6	0	0	1	2	1	0	4	3	1	2	0	5	0	0	0	0	0	2	5	0	2	5	1	−	1	0	0	0	2	1	2	5	3	4	COMPLETION OF INTERSTATE PROGRAM
Q-7	0	2	7	5	0	1	4	1	0	3	3	2	2	0	0	0	0	5	0	0	3	0	0	2	0	1	−	1	0	0	0	3	1	2	4	3	5	
Q-8	0	2	7	8	0	1	2	1	0	6	3	1	4	0	2	0	0	5	0	0	2	0	0	1	0	4	0	0	0	1	4	1	3	4	2	5		
Q-9	0	4	8	0	0	1	8	1	0	3	3	1	3	0	2	5	0	2	5	0	2	5	0	2	5	1	−	1	0	1	0	3	0	0	0	1	0	
Q-10	0	4	8	5	0	1	2	1	0	1	4	1	3	0	0	0	0	0	0	0	5	0	0	5	0	1	0	0	0	1	3	2	1	5	3	4		
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Q-12	0	4	9	0	0	1	1	1	0	4	5	4	4	0	0	0	0	2	0	0	5	0	0	2	0	4	0	0	0	0	1	4	4	1	5	2	3	DIVERSION OF GAS TAX FROM ROADS
Q-13	0	5	0	0	0	1	8	1	0	6	2	1	4	0	5	0	0	3	0	0	1	0	0	1	0	1	−	1	0	0	0	2	0	1	0	0	0	
Q-14	0	5	5	2	0	1	6	1	0	4	5	1	4	0	7	0	0	2	0	0	8	0	0	2	1	−	1	0	0	0	2	2	1	4	3	5		
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APPENDIX H. TABULATION FORMS

93

Data Sheet

APPENDIX I. HIGHWAY CONSTRUCTION CONTRACTS AWARDED

(In thousands of dollars)

0A-3

STATE	Contracts financed partially or entirely with Federal funds 2/: Interstate System contracts: Cost	Federal funds	Miles	Other Federal-aid contracts: Cost	Federal funds	Miles	Force account: Cost	Federal funds	Miles	Total: Number of contracts	Cost	Federal funds	Miles	Contracts financed without Federal funds 2/: Contract: Cost	Miles	Force account: Cost	Miles	Toll facilities: Cost	Miles	Total: Number of contracts	Cost	Miles	Total, all contracts 2/: Cost	Miles
ALABAMA	81,119	72,948	46	31,161	17,718	97	2,131	1,051	*	137	114,411	91,717	152	20,593	272	3,707	225	-	-	141	32,300	497	146,711	649
ALASKA	-	-	-	57,704	53,511	399	-	-	-	47	57,704	53,511	399	-	-	-	-	-	-	-	-	-	57,704	399
ARIZONA	19,611	18,499	17	22,995	16,745	85	-	-	-	45	42,606	35,244	102	4,875	24	583	12	-	-	27	5,458	36	48,064	138
ARKANSAS	21,826	20,529	30	31,993	15,156	209	-	-	-	81	53,819	35,685	238	15,022	61	-	-	-	-	20	15,022	61	68,841	299
CALIFORNIA	241,070	212,661	162	97,936	64,292	123	-	-	-	254	339,006	276,955	285	98,766	187	-	-	-	-	373	98,766	187	437,772	472
COLORADO	37,007	33,757	76	28,150	16,609	155	-	-	-	97	65,157	50,366	231	7,147	303	-	-	-	-	62	7,147	303	72,504	534
CONNECTICUT	46,450	41,417	2	1,531	765	-	-	-	-	33	47,981	42,182	2	13,224	18	-	-	-	-	76	13,224	18	61,205	20
DELAWARE	18,018	15,917	6	10,843	5,422	13	-	-	-	14	28,861	21,339	19	13,360	54	-	-	-	-	37	13,360	54	42,221	73
FLORIDA	74,843	66,463	293	25,902	13,135	82	-	-	-	74	100,485	79,595	375	93,485	1,116	-	-	-	-	301	93,485	1,116	193,970	1,491
GEORGIA	35,038	31,553	61	40,615	20,793	163	-	-	-	88	75,653	52,346	224	14,752	109	-	-	-	-	88	14,752	109	90,405	333
HAWAII	17,825	15,887	6	2,873	1,627	13	-	-	-	12	20,698	17,514	19	2,050	-	-	-	-	-	24	2,050	-	22,748	19
IDAHO	20,524	13,935	47	13,540	10,998	88	-	-	-	43	34,254	24,933	135	5,197	100	-	-	-	-	19	5,197	100	39,451	235
ILLINOIS	3/ 160,774	136,537	-	86,527	44,212	224	3/ 3,585	2,705	-	408	250,886	183,554	224	198,487	273	2,140	-	-	-	638	200,627	273	451,508	497
INDIANA	66,172	59,874	25	41,631	22,516	55	-	-	-	66	107,803	82,474	80	39,990	31	2,271	5	-	-	32	42,261	38	150,064	110
IOWA	3/ 42,797	37,928	43	38,498	19,662	410	3/ 279	205	-	284	81,574	57,795	453	43,872	488	-	-	-	-	223	43,872	488	125,446	941
KANSAS	13,059	11,692	32	17,381	19,863	315	51	25	-	200	50,441	31,560	347	-	-	-	-	-	-	-	-	-	50,441	347
KENTUCKY	58,259	50,269	10	55,928	27,586	72	-	-	-	62	114,187	77,851	82	18,304	440	7,291	647	46,122	5	654	72,277	1,092	186,464	1,174
LOUISIANA	90,899	70,087	17	16,458	8,190	46	-	-	-	30	107,357	78,286	81	63,095	838	-	-	-	-	182	63,095	838	170,452	921
MAINE	3/ 21,199	19,019	6	9,978	5,222	22	3/ 140	126	-	37	31,417	24,372	28	6,902	13	-	-	-	-	23	6,902	13	38,319	41
MARYLAND	12,343	11,108	26	13,505	7,991	10	-	-	-	27	25,848	19,099	36	37,585	305	-	-	691	-	78	38,276	305	64,124	341
MASSACHUSETTS	3/ 44,029	42,686	5	21,476	12,383	26	3/ -	-	-	40	71,504	55,069	31	10,615	31	-	-	-	-	76	10,615	31	82,119	62
MICHIGAN	118,109	105,100	40	50,615	28,547	274	123	106	-	181	169,126	133,761	314	11,191	178	128	-	-	-	57	11,319	178	180,445	492
MINNESOTA	3/ 49,596	44,910	32	61,994	29,400	605	3/ 621	573	-	245	112,211	74,903	637	10,490	251	-	-	-	-	78	10,490	251	172,701	868
MISSISSIPPI	3/ 56,009	50,286	15	31,850	16,238	338	3/ 1,941	984	-	127	89,800	67,510	353	10,214	239	11	-	-	-	94	10,225	239	100,025	592
MISSOURI	62,893	56,614	49	38,259	20,227	90	-	-	-	54	101,152	76,841	139	29,221	233	-	-	-	-	53	29,221	233	130,373	372
MONTANA	51,319	46,836	103	21,583	15,315	283	-	-	-	123	72,902	67,121	386	3,304	92	-	-	-	-	20	3,304	92	76,206	478
NEBRASKA	15,674	14,091	25	28,297	13,463	203	153	78	6	131	44,124	27,562	234	12,104	274	-	-	-	-	55	12,104	274	56,228	508
NEVADA	3/ 21,071	19,726	45	6,579	6,197	18	3/ 39	34	-	25	27,649	25,957	63	1,600	40	-	-	-	-	12	1,605	40	29,469	101
NEW HAMPSHIRE	15,026	13,057	9	12,051	5,861	18	3/ -	-	-	32	27,077	18,918	27	1,412	6	-	-	-	-	22	1,412	6	28,489	33
NEW JERSEY	3/ 73,525	64,437	24	54,342	25,503	22	3/ 1,771	1,540	-	56	129,638	91,480	46	46,199	1	-	-	2,430	-	32	46,629	1	178,267	47
NEW MEXICO	31,368	29,104	32	17,064	11,932	93	-	-	-	41	48,432	41,036	125	263	11	26	-	-	-	4	289	11	48,721	136
NEW YORK	99,262	76,022	19	223,200	101,795	70	-	-	-	81	322,462	177,817	89	150,432	299	-	-	-	-	108	150,432	299	472,894	388
NORTH CAROLINA	43,280	36,033	77	35,940	21,716	60	-	-	-	43	79,220	57,769	137	64,548	2,929	-	-	-	-	227	64,548	2,929	143,768	3,066
NORTH DAKOTA	19,566	16,761	95	22,670	13,278	888	294	171	8	167	41,550	30,010	991	272	20	-	-	-	-	2	272	20	41,822	1,011
OHIO	3/ 153,347	135,327	46	81,118	41,256	68	3/ 2,425	1,991	-	109	234,790	178,274	114	48,051	48	117	-	-	-	89	48,160	48	286,950	162
OKLAHOMA	22,328	19,582	39	33,265	16,880	130	-	-	-	151	55,593	36,462	169	14,198	435	-	-	-	-	116	14,198	435	69,791	604
OREGON	61,355	56,607	73	26,776	19,654	105	-	-	-	80	88,131	76,261	178	15,741	110	-	-	-	-	56	15,741	110	103,872	288
PENNSYLVANIA	130,965	114,909	24	115,661	55,092	82	-	-	-	88	246,626	170,001	106	111,369	269	-	-	-	-	188	111,369	269	357,995	375
RHODE ISLAND	13,238	11,906	2	2,056	1,152	1	-	-	-	11	15,294	13,058	5	-	-	-	-	-	-	-	-	-	15,294	5
SOUTH CAROLINA	37,880	32,458	72	27,891	14,026	317	-	-	-	116	65,771	46,484	389	28,171	657	-	-	-	-	59	28,171	657	93,942	1,046
SOUTH DAKOTA	3/ 18,607	16,785	25	26,028	14,493	372	3/ 460	380	3	107	45,095	31,658	400	9,501	213	-	-	-	-	34	9,501	213	54,596	613
TENNESSEE	3/ 84,375	75,722	72	36,242	19,620	319	3/ 320	215	17	132	120,937	95,557	408	19,471	196	-	-	-	-	57	19,471	196	140,408	604
TEXAS	3/ 111,942	95,028	117	127,300	64,577	623	3/ 1,099	801	-	200	240,341	160,406	740	81,956	1,378	908	15	-	-	207	82,864	1,393	323,205	2,133
UTAH	37,325	35,177	80	17,608	14,806	62	-	-	-	61	54,933	49,978	142	6,381	86	-	-	-	-	22	6,381	86	61,314	228
VERMONT	27,061	24,228	50	6,022	3,138	16	-	-	-	26	33,083	27,366	66	435	1	-	-	-	-	2	435	1	33,518	67
VIRGINIA	117,180	109,182	51	57,848	34,270	154	-	-	-	119	175,028	143,452	205	46,017	125	-	-	-	-	145	46,017	125	221,045	330
WASHINGTON	58,167	50,905	68	25,344	15,431	100	-	-	-	89	83,511	66,336	168	10,566	398	-	-	-	-	78	10,566	398	94,077	566
WEST VIRGINIA	149,373	134,409	52	91,623	52,573	47	-	-	-	82	240,996	186,982	99	24,780	957	-	-	-	-	318	24,780	957	265,776	1,056
WISCONSIN	3/ 14,996	12,544	1	41,946	20,633	159	3/ 1,982	989	56	144	57,924	34,166	216	43,521	483	842	34	-	-	210	44,363	517	102,287	733
WYOMING	15,037	16,712	95	15,376	12,597	129	-	-	-	48	33,403	29,309	224	6,640	178	-	-	-	-	36	6,640	178	40,043	402
DIST OF COL	29,280	26,352	3	3,032	1,664	6	-	-	-	45	32,312	26,016	9	-	-	-	-	-	-	-	-	-	32,312	9
TOTAL JAN DEC 1970	2,867,044	2,520,184	2,365	2,030,445	1,116,462	8,260	17,314	12,054	99	4,995	4,914,803	3,656,760	10,724	1,524,356	14,772	17,984	938	49,243	5	5,655	1,591,583	15,715	6,506,386	26,439
JAN DEC 1969	3,069,271	2,724,752	3,065	1,997,989	1,085,862	8,454	21,407	15,531	132	5,380	5,088,667	3,626,145	11,671	1,442,305	15,127	18,498	1,432	77,999	36	5,518	1,538,802	16,595	6,627,469	28,266

1/ Contracts awarded and force account work authorized by State agencies for highways, including Federal-State, Federal-State-local, and State-local cooperative work, and a small amount by the Federal Government for national park and forest roads, etc. Work on local roads and streets is included only when contracted or performed by the State or when Federal funds are involved.

2/ When there is an entry for cost, but not for miles, the contract was either for less than one mile or for excavation or structures not measurable in miles.

3/ Included with force account authorizations, but not included with contracts awarded, are the force account authorizations for work on the Interstate System as follows: Illinois, $2,667,000; Iowa, $19,000; Maine, $140,000; Michigan, $123,000; Minnesota, $489,000; Mississippi, $22,000; Nevada, $16,000; New Jersey, $1,575,000; Ohio, $1,506,000; South Dakota, $328,000; Tennessee, $272,000; Texas, $623,000; Wisconsin, $1,000.

APPENDIX J-1a.

FREQUENCY OF NEW PAVER PURCHASES

Part a. NAPA Group

Frequency	Per cent of Contractors (X)	Group Size (Y)	Projected Distribution (XY)
Yearly	5.6%	504	28
2-3 Years	25.8%	504	130
4-5 Years	42.7%	504	216
6-7 Years	17.7%	504	89
8-9 Years	8.1%	504	41

Frequency	Projected Contractor Distribution (XY)	Per cent of Contractors[a] Units Purchased (P)				Number of Contractors Units Purchased (XYP)				Total Units Projected
		1	2	3	4	1	2	3	4	
Yearly	28	85.7%	14.3%	-	-	24	4	-	-	32
2-3 Years	130	65.6%	34.4%	-	-	85	45	-	-	175
4-5 Years	216	50.9%	34.0%	15.1%	-	110	73	33	-	355
6-7 Years	89	68.2%	31.8%	-	-	61	28	-	-	117
8-9 Years	41	60.0%	20.0%	-	20.0%	25	8	-	8	73

[a]In those cases where only one contractor indicated a given unit count, his representation was moved to the next nearest significant value.

APPENDIX J-1b.

FREQUENCY OF NEW PAVER PURCHASES

Part b. NON-NAPA Group

Frequency	Per cent of Contractors (W)	Group Size (Z)	Projected Distribution (WZ)
Yearly	3.1%	2427	75
2-3 Years	11.2%	2427	272
4-5 Years	33.6%	2427	815
6-7 Years	27.6%	2427	670
8-9 Years	24.5%	2427	595

Frequency	Projected Contractor Distribution (WZ)	Per cent of Contractors[a] Units Purchased (P)				Number of Contractors Units Purchased (WZP)				Total Units Projected
		1	2	3	4	1	2	3	4	
Yearly	75	100.0%	-	-	-	75	-	-	-	75
2-3 Years	272	81.8%	18.2%	-	-	223	49	-	-	221
4-5 Years	815	63.6%	36.4%	-	-	519	296	-	-	1111
6-7 Years	670	81.5%	18.5%	-	-	549	124	-	-	794
8-9 Years	595	75.0%	25.0%	-	-	446	149	-	-	744

[a]In those cases where only one contractor indicated a given unit count, his representation was moved to the next nearest significant value.

APPENDIX J-1c.

FREQUENCY OF NEW PAVER PURCHASES

Part c. Unit Value Computation

NAPA Group

Frequency	Frequency Mid-Point	Total Unit Value	Average Annual Paver Purchases (Total Value ÷ Mid-Point)
Yearly	1.0	32	32
2-3 Years	2.5	175	70
4-5 Years	4.5	355	79
6-7 Years	6.5	117	18
8-9 Years	8.5	73	9
Total	---	---	208

NON-NAPA Group

Frequency	Frequency Mid-Point	Total Unit Value	Average Annual Paver Purchases (Total Value ÷ Mid-Point)
Yearly		75	75
2-3 Years	2.5	221	88
4-5 Years	4.5	1111	247
6-7 Years	6.5	794	122
8-9 Years	8.5	744	87
Total	---	---	619

APPENDIX J-2.

PLANNED PAVER PURCHASES

Group	Per cent of Contractors (X)	Group Size (Y)	Projected Buying Contractors (XY)
NAPA	37.9%	504	191
NON-NAPA	19.4%	2,427	471

Group	Projected Buyers	Per cent Distribution
NAPA	191	28.9%
NON-NAPA	471	71.1%
Total	662	100%

Note: Total contractor universe (2,931 firms) divided into the projected number of buyers (662) shows that 22.6 per cent of the contractors plan to buy in 1971.

APPENDIX J-3.

PLANNED APPROACHES TO SATISFY PAVING EQUIPMENT NEEDS IN 1971

NAPA Group

Alternatives	Per cent of Contractors (X)	Group Size (Y)	Projected Distribution (XY)
Purchase new pavers	37.9%	504	191
Rent or lease	4.8%	504	24
Rebuild	16.9%	504	85
Fleet is adequate	54.0%	504	272

NON-NAPA Group

Alternatives	Per cent of Contractors (W)	Group Size (Z)	Projected Distribution (WZ)
Purchase new pavers	19.4%	2427	471
Rent or lease	6.1%	2427	148
Rebuild	19.4%	2427	471
Fleet is adequate	67.4%	2427	1,636

Composite Data

Alternatives	Projected NAPA Distribution (XY)	Projected NON-NAPA Distribution (WZ)	Projected Contractor Distribution (XY+WZ)
Purchase new pavers	191	471	662 (22.6%)
Rent or lease	24	148	172 (5.9%)
Rebuild	85	471	556 (19.0%)
Fleet is adequate	272	1,636	1,908 (65.1%)

APPENDIX J-4.

PREDICTION OF 1971 PAVING WORK

NAPA Group

Prediction	Per cent of Contractors (X)	Group Size (Y)	Projected Distribution (XY)
Up 20%	8.1%	504	40
Up 10%	14.5%	504	74
Remain Same	37.1%	504	187
Decline	40.3%	504	203

NON-NAPA Group

Prediction	Per cent of Contractors (W)	Group Size (Z)	Projected Distribution (WZ)
Up 20%	10.2%	2427	248
Up 10%	13.3%	2427	323
Remain Same	49.0%	2427	1,189
Decline	27.5%	2427	667

Composite Data

Prediction	Projected NAPA Distribution (XY)	Projected NON-NAPA Distribution (WZ)	Projected Contractor Distribution (XY+WZ)
Up 20%	40	248	288 (9.8%)
Up 10%	74	323	397 (13.5%)
Remain Same	187	1,189	1,376 (47.0%)
Decline	203	667	870 (29.7%)

APPENDIX J-5.

RANKED EVENTS WHICH WILL MOST ADVERSELY AFFECT THE VOLUME OF PAVING IN THE FUTURE

NAPA Group

Events	Percent of Contractors Ranking Events (1-5 Scale)				
	1	2	3	4	5
Revenue sharing	23.4%	36.4%	27.5%	4.4%	6.5%
Federal or State cutback in funds	63.7%	23.2%	12.1%	1.1%	-
Restriction of the Davis-Bacon Act	3.2%	2.0%	10.9%	63.3%	20.4%
Shift in matching fund	7.3%	33.3%	41.8%	14.5%	5.4%
Other	2.4%	5.1%	7.7%	16.7%	67.7%
Total	100%	100%	100%	100%	100%

NON-NAPA Group

Events	Percent of Contractors Ranking Events (1-5 Scale)				
	1	2	3	4	5
Revenue sharing	11.2%	39.5%	30.1%	14.1%	2.7%
Federal or State cutback in funds	68.4%	19.7%	5.5%	2.8%	1.3%
Restriction of the Davis-Bacon Act	3.1%	3.9%	16.4%	46.5%	32.4%
Shift in matching fund	6.1%	30.3%	41.1%	16.9%	6.8%
Other	11.2%	6.6%	6.9%	19.7%	56.8%
Total	100%	100%	100%	100%	100%

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