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THE TRANSFERABILITY OF UNEMPLOYED AEROSPACE MANPOWER TO OCEANOGRAPHY

A FEASIBILITY STUDY

UNIVERSITY OF SOUTHERN CALIFORNIA • SEA GRANT PROGRAM • LOS ANGELES, CALIFORNIA 90007

THE TRANSFERABILITY OF

UNEMPLOYED AEROSPACE MANPOWER

TO OCEANOGRAPHY

by

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Overview

A. Purpose of the Study

The purpose of this study is to determine the transferability of aerospace manpower to oceanography. This study focuses on the unemployed aerospace manpower since they exist as the presently available supply, and that they represent a human resource that is not being utilized. The geographical focus was upon Southern California since this geographical area employs 14.8% of the total national aerospace employment.

B. Rationale

By answering five basic questions, the feasibility of transferring aerospace manpower to oceanography could be determined. These five questions in order were:

1) What and where is the demand for oceanography employment?

2) What are the educational and working qualifications for employment in oceanography?

3) Can aerospace manpower satisfy these requirements?

4) What are the employment desires of the aerospace manpower?

5) What is the receptivity of the oceanographic employers towards the unemployed aerospace manpower?

Chapter I

THE STATE OF AEROSPACE

The aerospace industry built itself into the world's leading producer of commercial aircraft, enabled man to land on the moon, and created a military arsenal of respected weapontry, but now its wares decline in demand due to five factors. The circumstances responsible for this dilemma are the declines in Commercial Sales, NASA funding, and military expenditures; the scuttle of the SST; and the low profitability of the industry. The effects of such a decline are not minor, for they involve massive unemployment and the National economic health. High unemployment in concentrated areas creates adverse economic conditions initially in those areas and then throughout others. The graph on the following page illustrates the decline from 1.4 million total aerospace employees in 1968 to 1.0 million in 1971. [1] The graph also reveals that California employs about 40% of the total; however, the regional distributions have remained fairly constant, indicating that no one region has been unproportionally affected. [2]

TABLE V

PERCENT DISTRIBUTION OF EMPLOYMENT IN THE AEROSPACE INDUSTRY BY GEOGRAPHIC AREA IN THE UNITED STATES[a/]
MARCH 1970 - MARCH 1971

Geographic Area	March 1970	June 1970	December 1970	March 1971
TOTAL U.S.	100	100	100	100
New England and Middle Atlantic	19.9	20.2	20.3	20.1
East North Central	4.2	4.3	4.1	4.1
West North Central	5.9	6.0	6.1	6.1
South Atlantic	10.1	10.0	9.9	9.9
South Central	6.4	6.7	6.5	6.3
Mountain	2.6	2.8	3.0	3.1
Pacific	40.9	39.8	40.0	40.4
Undistributed	10.0	10.2	10.1	10.0

a/ Derived from data supplied to the Association in its semi-annual survey of employment. Geographic area boundaries follow those of the U.S. Bureau of the Census. To prevent disclosure of individual company data, no area with 4 or less establishments is shown separately.

No real knowledge or compassion for the situation can be interpreted by aggregate graphs and tables, for they are not expressive of the situation. To best describe the decline of aerospace employment, one must investigate the individuals involved. To give the startling magnitude of the situation, these individuals must be expressed in terms of thousands. The following is a comparison of 1970 to 1971 employment. [3]

...Employment in aircraft production, and research and development is expected to decline from 551,000 to 460,000, a drop of 16.5 percent.

...Missile and space employment is expected to decline from 515,000 to 432,000, a 15.0 percent decrease.

...Commerical transport aircraft employment is expected to decline from 114,582 to 90,094, a 21.4 percent decrease.

...Helicopter employment also is expected to show a decline of 25.9 percent, falling from 36,004 to 26,661.

...Production workers are expected to decline from 624,000 to 503,000, a decline of 19.4 percent.

...Employment of scientists and engineers is expected to decline from 205,000 to 175,000, a decrease of 14.6 percent.

...Technicians are expected to decline from 68,000 to 58,000, a decrease of 14.7 percent.

Of those mentioned above, the breakdown of their employment positions would be: [4]

17% Engineers and Scientists
6% Technicians
48% Production
29% Administrative

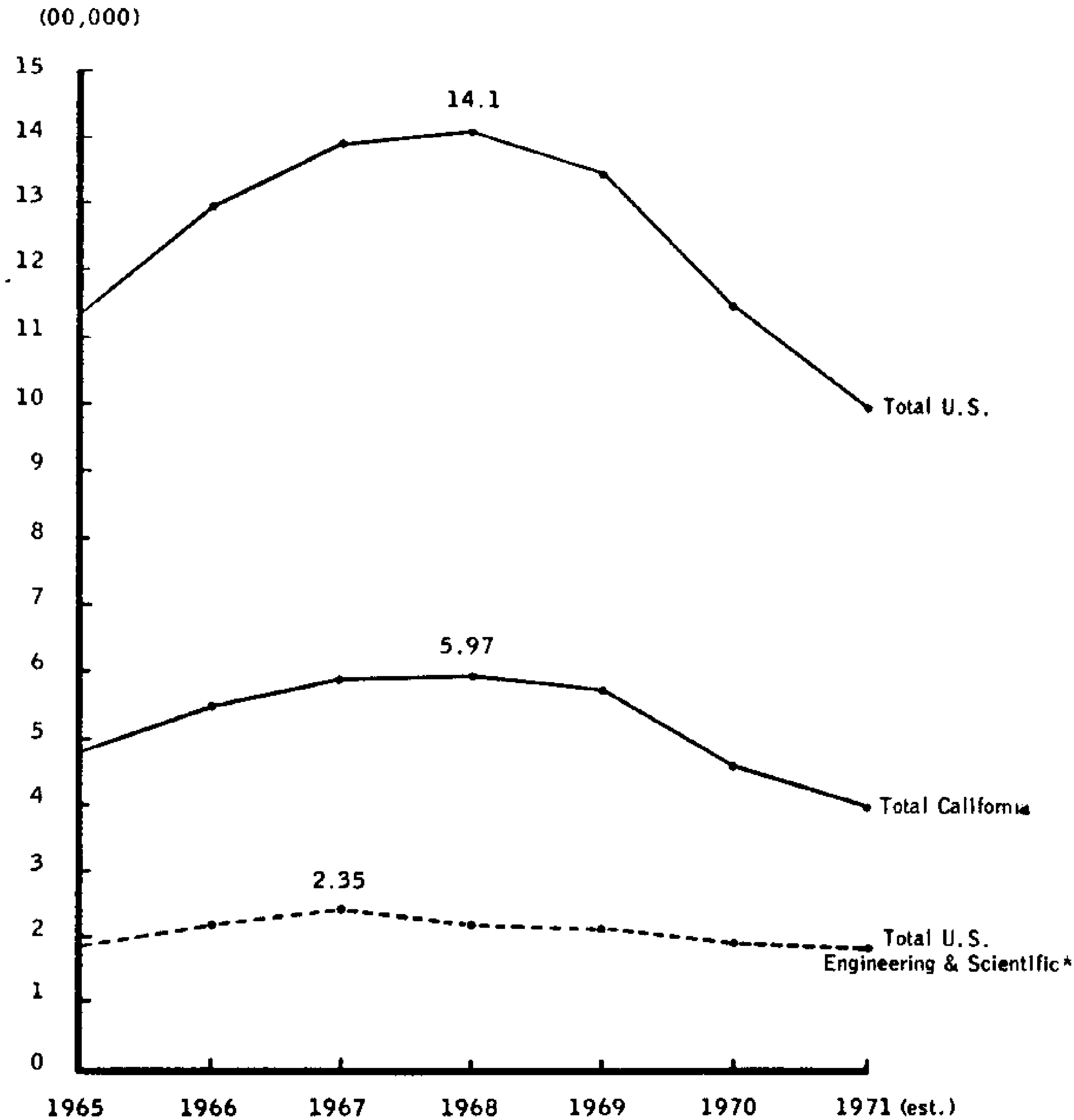
These ratios have remained constant throughout the decline, since the lay-off axe has sliced proportionately through the employment sectors.

Figures again do not express the significance of this unemployment, for the significance lies in the waste of human resources. It is not only the unemployment of individuals, but also the unemployment of great human resources: former producers now sit unproductive.

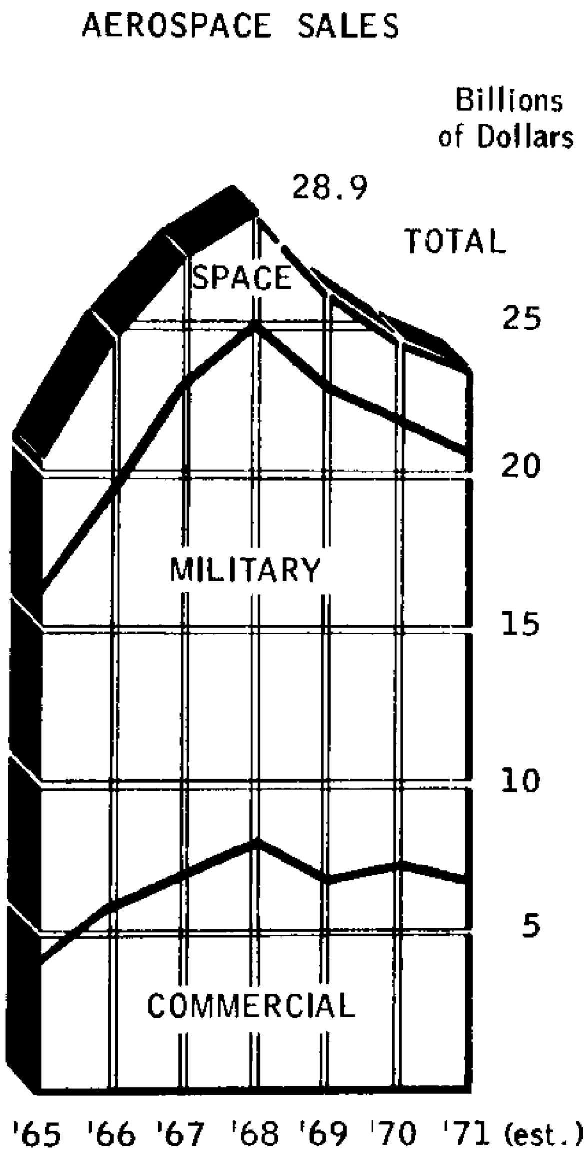
The aerospace industry also asserts a significant role in the national economy. The following data show that the importance of aerospace to the national economy is not easily replaceable or transferable. [5]

2.9% of the Gross National Product
8.4% of the U. S. exports
74.0% of the manufactured World Civil Airlines
$14.2 billion payroll

AEROSPACE EMPLOYMENT



If the nation were to lose part of its largest export industry, a significant contributor to the GNP would be debased. As a result, the nation would lose the dominant world position of its aerospace products and payroll.



The decline in aerospace sales is a simplistic answer to the cause of this recession in aerospace, but the reasons why tell the real story. All three constituents of aerospace sales are plummeting as presented in the graph on the preceeding page. [6] (Figure 1)

The drop in commercial sales is due to the current dilemma of the airlines. Stuart Tipton, president of the Air Transport Association, estimates that the U. S. air carriers will show losses of $123 million in 1970, $192 million in 1971, and $279 million in 1972. The four major reasons for losses include: [7]

1. The productivity benefit of replacing propeller aircraft with jet aircraft was essentially completed in 1967.

2. Since 1967, the rapid rise in inflation in the national economy struck the airlines particularly hard and in 1969 inflation in the airline industry was almost double the U. S. rate.

3. The depressed national economic performance has completely eliminated domestic traffic growth in the airline industry in the face of rising capacity.

4. The pricing system in the airline industry has lagged well behind the impact of productivity runout and heavy inflation.

The drop in military sales is largely a result of the cessation of the Viet Nam War. The decline in space funding is due to the lack of new federal funds towards another space program now that the Apollo program is nearing completion.

The scuttling of the SST by Congress came at a time in the SST's life when it would have required the greatest employment, for it was at the stage of proto-type and production. Had this next generation of aircraft been funded, production workers, technicians, and engineers would have been employed.

The final circumstance responsible for the aerospace dilemma is the low profit margin of the industry. [8]

Net Profits After Taxes
as a Percentage of Sales, 1969

All Manufacturing	4.8%
Non-Durable Goods	5.0%
Durable Goods	4.6%
Aerospace	3.0%

In summation, the following quotation concerning the aerospace industry would best express its economic environment. [9]

Of all major professions, ours seems to be by far the most intimately tied to major shifts and fluctuations of a political or economic nature, sometimes leading and sometimes following, but always affected.

RE-EMPLOYMENT DIFFICULTIES

With such a massive aerospace unemployment force, no single industry can absorb their ranks; furthermore, prejudices exist towards the former aerospace employees. Prior to the re-employment of aerospace workers, these prejudices against them must be eliminated by the facts. On the basis of the following information, I have divided the factors inhibiting re-employment into three sections; unjustified opposition, partially justified opposition, and personal reasons.

Unjustified opposition

1. The Aerospace stigma
2. Over-qualified
3. Overaged

Partially justified opposition

1. Overpaid
2. The deadwood concept
3. Over-specialized
4. Preference for Aerospace
5. Aerospace man selling himself
6. Unfamiliarity to the industry
7. Present Supply of E&S within the industry
8. Cost-conscious thesis

Personal Factors

1. Mobility
2. Residence

Unjustified Opposition

<u>The Aerospace Stigma</u>

This first opposition is a pure bias against the aerospace industry rather than the individuals. It stems from a domination of federal funds since other industries have come to question the marginal social costs vs. the marginal social benefits of the aerospace industry. The domination of trained manpower has also created this bias. During the 1960's when aerospace was in its buildup, aerospace recruiters could attract engineers and scientists to share in some of man's greatest dreams while a durable goods manufacturer could not present such a romantic and stimulating career. To this day, the domination of the engineers and scientists is still partially resented.

Over-Qualified

The idea that the aerospace workers possess a lengthy and specialized education plus considerable working experience inhibits employers from hiring them since an over-qualified man will leave when a more attractive opportunity arises. It is difficult to discuss this opposition due to the lack of an accurate description of the aerospace worker, for there exists the full spectrum of varied qualifications. The following statistics describe these unemployed aerospace workers, not the currently employed. The focus of this study is to determine the transferability of aerospace manpower to oceanography, and since the unemployed are the most available for transfer, their qualifications need to be examined. The following sources are from three surveys conducted recently concerning characteristics of the *unemployed* aerospace engineer and scientist. The first source was conducted by this author (sample size of 355), [10] the second by the Orange County Human Resources Development [11] (sample size unknown), and the third by Experience Unlimited, San Diego (sample size of 152) [12].

Degree Attainment
of Unemployed Aerospace

	Author's Survey	O.C. HRD	S.D. E.U.
No Degree	27.0%	52.4%	43%
Bachelor's Degree	55.2%	31.1%	45%
Master's Degree	13.8%	16.5%	12%
PhD Degree	.8%	0.0%	0%

These three surveys show that an amazingly large number of engineers and scientists do not possess a Bachelor's degree. I suspect that in the Orange and San Diego County's surveys technicians were included in the sample size; however, my survey excluded technicians, thus lowering the percentage of non-degreed people. Nevertheless, a 27% non-degreed figure remains high, especially when the aerospace industry encourages advanced degree work. 37% of surveyed aerospace E & S's received "much" encouragement, 56% received "some" encouragement, while only 7% received "none" [13]. To conclude that the aerospace workers are under-qualified would be just as erroneous as it would be to conclude that they are over-qualified. The 55% with Bachelor's degree bears this out. The myth could have been originated from the complexity and accomplishments of the aerospace industry, or from the over-zealous publicity for the re-employment of workers, i.e., PhD's driving taxi-cabs.

The following quotation which both confirms and explains the high number of non-degreed employees is from William Hoyt's speech, "Demand for Engineers; Past, Present, & Future." [14]

> In 1951, there was a shortage in recruiting requirements of 11%, but for the period 1952-1957 the yearly shortages were in the 15%-25% range. In 1958 there was a rather severe but short lived economic slowdown, and that year demand exceeded supply by only 6%. In 1959, the figure had risen to 8.6% and held at about that level until 1963 when the conomy turned down again, resulting in a shortage of only 1.5%. By 1966-1967, when the NASA effort was at its peak, the demand had again built up, producing a shortage of 16% which was the high point for the '60's. This has since diminished to the present condition, of which you are all well aware.
>
> Incidentally, one might wonder where all those new engineers came from, to swell the ranks of the profession at such a rapid rate. Of course the colleges and universities contributed their share, but the pressures of the times and the attraction of high salaries caused many non-graduates and graduates of non-engineering curricula to find their way into engineering type jobs. Of the total number reported by the Dept. of Labor as "employed as engineers" about 43% had less than a Bachelor's degree as of 1962, and I do not think the situation will show much change when the 1970 census data are released. The implications of the influx of non-graduates are, of course, comething that could be speculated upon at considerable length.

Overaged

The myth that the aerospace employee is too old also inhibits re-employment, since an older person might be more dogmatic in his working habits, and his years to retirement would be less. The age of an employee seeking new employment works both for him and against him. Although the preceeding statements are valid, a more experienced person brings with him a formative knowledge of operations and techniques.

Using the same surveys, I note the following age distributions:

	Author's Survey	O.C. HRD	S.D. E.U.
22 - 27	3.1%	-	-
28 - 32	7.3%	-	-
33 - 38	13.0%	-	-
39 - 44	21.1%	-	-
45 - 50	26.8%	-	-
50 +	27.3%	-	-
Medians	45 - 50	40-49	46

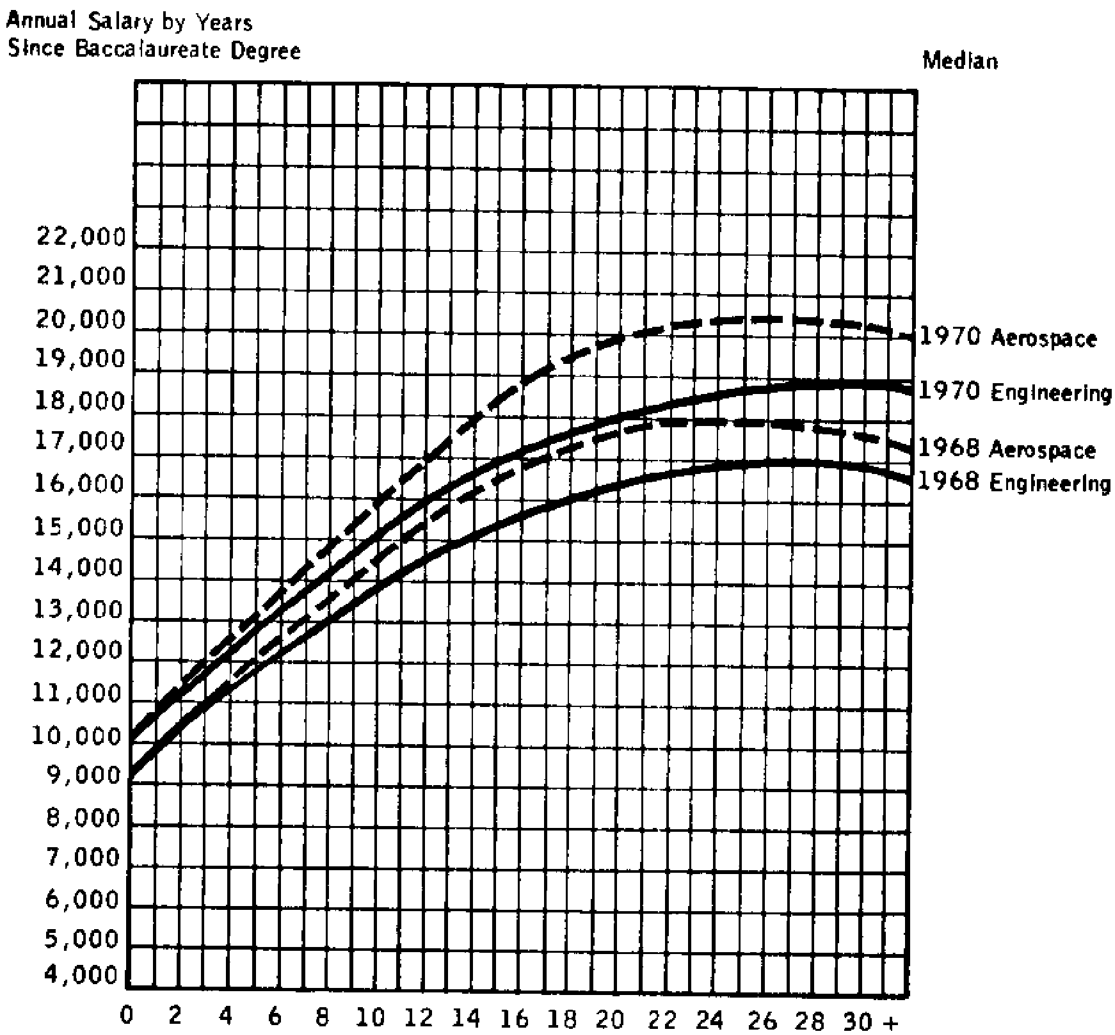
In all three surveys the median age was about 45 years old. Assuming that his desired retirement age was 65, the aerospace workers remaining employment time would be approximately 20 years. These 20 years might also be his most productive years. Regardless, 23% are 38 years old or less and thus well within the employment range.

Partially Justified Opposition

Overpaid

As illustrated in the following graph, the aerospace engineer's salary was higher than the engineering median salaries for both the years of comparison, 1968 and 1970. [15]

INDUSTRY AND AEROSPACE MEDIAN SALARIES FOR ENGINEERS



A valid point made was that a salary should be commensurate with the duties and responsibilities of the employee. In the case of the aerospace employees, these individuals assumed demanding responsibilities and were delegated authority. Lack of benefits and employment stability could also merit this higher salary by the aggregate aerospace employees.

Salaries of Unemployed Aerospace

	Author's Survey	O.C. HRD	S.D. E.U.
Less than $10,000	5.9%	6.8%	-
$10,000 - $15,000	39.7%	57.3%	-
$15,000 - $20,000	36.3%	35.9%	-
$20,000 - $25,000	15.2%	-	-
$25,000 - $30,000	1.0%	-	-
Medians	$15-$20,000	$10-15,999	$14,400

The feasibility of this report is dependent upon voluntary salary reductions by the ex-aerospace manpower. From my survey the following voluntary salary reductions "to meet the competitive salaries of another industry" were expressed as follows:

Voluntary Salary Reductions
of Unemployed Aerospace

Percent Reductions	Responses
None	12.7%
5%	7.0%
10%	27.3%
15%	9.3%
20%	17.5%
25%	13.2%
30%	4.5%

Thus, by aerospace functional responsibilities standards, the aerospace workers were not necessarily overpaid; however, the preceeding figures show the willingness of these workers to realistically compete for employment in the commercial sector. The effect of these voluntary salary reductions upon various salaries will be presented in Chapter V.

Over-Specialized

The fear that a particular aerospace worker has concentrated his efforts towards one specific concept inhibits an employee's re-employment since he might have lost his ability for general applications. These technical specialists might still have transferability to the non-aerospace sector if their skills can adapt to the particular functional responsibilities. If not, a conversion from the applied to the basic engineering principles would be necessary. Some E & S had enough job diversification to maintain the basic engineering principles while others did not. Again, each individual's transferability would be dependent upon either the need of his specific technical skill in a non-aerospace industry, or his maintenance of the basic engineering principles.

> William Hoyt summarizes the situation well when he says, Engineers are educated as generalists within a major discipline, and the current trend in engineering education is putting increasing emphasis on this. However, as soon as an engineer enters industry he begins to specialize. Nevertheless, I am sure that the problem of many of the men who are currently seeking employment is over specialization. Whereas the hallmark of a good engineer is usually his ability to solve a variety of problems, some who started out with that ability have permitted themselves, as a result of a thoughtless or pressured management, or have elected on their own accord for any one of several reasons, to develop such a narrow knowledge that they are of little value when the need for their specialty is removed. I would submit, therefore, that there is much to be gained for engineers as individuals and for the future health of the engineering profession by a reversal of the trend of over specialization.

This fact will conflict with the educational and working qualifications for oceanographic employment as presented later in Chapter IV.

The Deadwood Concept

At the beginning of the aerospace cutbacks in employment those aerospace employees who were deadwood, i.e., non-producers, poor workers, and parasites on the industry, were usually the first to be laid off. Unfortunately, in seeking new employment at a time when openings existed, they became ambassadors of aerospace to the other industries. If it is the man who makes the position, then this ex-aerospace man usually failed to prove his worth again; the result was a black eye for the aerospace manpower due to the deadwood ambassador.

Inability of an Aerospace Man to Sell Himself

The following four situations act as strikes against an aerospace worker seeking employment in the non-aerospace sector. As seen by Experience Unlimited officials, they are:

1. Inability to use correct or successful form letters, resumes, or vitas for solicited or unsolicited employment opportunities.

2. Answering job applications, e.g., salary? Commensurate with duties and responsibilities rather than $15,000 set !!

3. Conduct during interviews.

4. Obvious frustration and despair due to past rejections.

The remedy of these difficulties has been achieved by employment workshops conducted by Experience Unlimited Offices and aerospace firms.

Unfamiliarity to a Non-Aerospace Industry

Naturally an aerospace worker would not be familiar with the jargon, concepts, and technology of another industry. The smoothness of his transition was discussed in the "over-specialized" section. The amount of opposition to this neophyte would be a function of adaption time and cost. However this adaption time and cost would be comparable to that of hiring a new graduate.

Supply of Engineers and Scientists Within a Particular Non-Aerospace Industry

Two questions an employer might ask when considering an aerospace employee's application might be: What about the E & S's in the field looking for a job? What about the new college graduates who have directed their education towards this goal? If a surplus of E & S's occurs in either of these two groups, an employer might tend towards their employment rather than that of an aerospace employee.

Cost Conscious Thesis

Dr. Smith of UCLA suggested that technology gaps exist among the various managerial and E & S sectors. [17] The management technology gap exists due to the differing optimizing objectives. The commercial segments optimizes profits to costs while the defense segments are more time-cost oriented.

The E & S gaps exists since a supplementation of technology is needed prior to a transfer, and that transfer would be towards civil service and other industries. The final gap would occur due to the transferring from a large firm to a small firm and/or industry.

Preference for Aerospace

The final opposition could be the most essential question, "Will this employee return to aerospace once there is another build-up?" To predict what a former aerospace employee would to during a build-up, whether he was employed at the time or not, is most difficult. In my survey (sample size 355) the response to the question was as follows:

"Do you still desire to return to aerospace industry?"

Yes	41.1%
No	50.4%
No answer given	8.7%

To the question, "Would you prefer another job in your respective field, but in another industry?", the following responses were made:

Yes	83.4%
No	7.6%
No answer given	8.7%

It could be concluded, then, that half of the unemployed E & S are opposed to returning to the aerospace due to personal reasons while 41% would not oppose returning to aerospace. The facts reveal that an overwhelming 83% would prefer another industry. This indicates that their preference does not lie with aerospace.

Economic and Personal Factors

If a man owns his home, if his children are established in school, and if he is socially established with friends and relatives nearby, his mobility is inhibited. If he were to find a job elsewhere, it would be in an area unaffected by aerospace lay-offs, since that job would probably be filled locally. Thus, the following situation could occur.

1. He moves from an affected aerospace area to take a job elsewhere, and he puts his house for sale in a market that has a new and plentiful supply due to similar actions by his peers. Thus, a loss on the sale of his house would occur.

2. He moves to an area relatively unaffected by aerospace. If a normal market of today exists there, then demand is greater than supply. Thus a financial loss on a purchase would occur.

Conclusions

The aerospace industry has suffered a serious decline in sales resulting in massive unemployment during the past three years. The problem is now bottoming out, i.e., the situation is getting worse less rapidly. The resultant unemployed workers have taken to the streets to seek new employment only to be met by a poor employment market, and in some cases, employment prejudices. The fact that these proven performers sit unproductive is a waste of human resources. The aerospace industry is obviously ailing and not showing any signs of immediate improvement; and thus, no re-employment potential for its layed-off workers.

The prejudices that these unemployed aerospace workers have experienced and those that this chapter has either elucidated or disproved included:

1. A stigma from an association with the aerospace industry.

2. A false conception that the aerospace workers were over-qualified; however, many of those employed in engineering and technical jobs were not degree holders and many of those only had a B.S. degree.

3. That they were too old, but 23% were under 38 years of age, and the median were only half way through their employable lifetime.

4. The fact that they were overpaid, since the aerospace workers did have higher median salaries; however their voluntary salary reductions would bring aerospace into line with other areas.

5. That the aerospace job seekers were deadwood discarded by the industry, but this is not necessarily true.

6. That they were over-specialized, but this also is not necessarily true.

7. That the ex-aerospace worker would return to aerospace but the majority expressed a preference against returning to aerospace.

Employment of these unemployed aerospace workers in another industry requires not only finding room, but also the eradicating or qualifying of the prejudices towards these workers. This has been the intent of this chapter.

Chapter II

THE AGGREGATE ECONOMIC PROGRESSION OF OCEANOGRAPHY

With recent economic and technological encouragement, oceanography may be entering a new age; the Age of Marine Utilization & Protection. This age would bring an utilization of the natural resources from the oceans while protecting and maintaining the oceanic environments. This age is preceded by three other distinct periods. The Age of Ocean Exploration was initiated with the voyages of the "S.S. Challenger" (1872-1876) with Sir John Murray, and the "S.S. Hirondelle" with Prince Albert I of Monaco. The Age of Classical Oceanography was centered around the Scandinavian scientists: Bjerknes, Sandstrom, Helland-Hansen, Ekman, and Nansen with the voyages of the "S.S. Meteor" (1925-1927). The Age of Marine Investigation began in the post World War II days, not only government inspired for defense purposes, but also oriented towards scientific use. This Age of Marine Investigation continued at the turn of the decade in 1970 and was expected to continue because of the enormous scientific knowledge still un-investigated or un-documented. The scientific knowledge already obtained draws closer the day of utilization of the ocean resources; this, coupled with federal intentions and private investments, created this optimistic prediction.

The recent economic history of the oceanography industry has not been completely smooth or sustained. The following progression, first by the aggregate economic history and then by sectors, illustrates both the slow and successful periods of 1968-1971.

The Year of the Wide Participation - 1968

Government encouragement and glamour contributed to 1968's being a year of widespread industrial participation. This governmental encouragement led to the creation of several submersibles by large and reputable firms. The glamour of oceanography was centered around over-zealous publicity: "a panacea for the world with its vast natural resources." Furthermore, oceanography was a market (not an industry) for technological transfer and spinoff. True to the Age of Marine Investigation, the purpose of "operational oceanography" was application for meeting specific military needs and practical benefits. Record gross sales occured for most oceanographic firms, largely due to the boom in offshore oil drilling. The one real inhibiting factor was a reduction in federal spending, which mostly affected research. Thus, with the high growth rate predicted for this glamorous market at a time of acquisition craze, oceanography ballooned into a real industry with government encouragements and potential returns.

The Year of the Economic Setback-1969

In 1969, the causes that so adversely affected the oceanography industry were: the aggregate economic conditions, government re-alignment of its oceanographic intentions, Maritime impediments to progress, and the Santa Barbara blowout. Viet Nam, the Middle East Crisis, inflation, low output by the automobile industry, tight money, and campus unrest all contributed to a lack of support and interest in the economy as well as in oceanography.

Industrial sentiments might be expressed by an editorial in Under Sea Technology.[18]

> The businessmen in this community (oceanography) have, in our view, done their part. They have made enormous capital investments and proven their abilities to handle complex ocean-oriented tasks.
>
> Industry now wonders if those who decide on national priorities are at least prepared to make their commitments---to say specifically how much of the country's resources, time, and energy will be devoted to oceanic exploration and development.

The answer to this editorial and the sentiments of the federal government in 1969 would best be stated by Dr. Edward Wenk, Jr., then the Executive Secretary, Marine Science Council.[19]

> Since 1966, federal funding in Marine Science affairs has grown from $330 million annually to over $500 million. More growth can be expected, but at a time when fighting inflation must be the President's as well as the nations priority concern, funds will not be available for all of the channels of interest, no matter how attractive. The test for increased support must thus be relevance to national goals and urgency. The size of the budget during these times of fiscal discipline will consequently not be the primary barometer of federal interest. Rather, the quality of federal management and the quest for fostering interest, participation and financial support by industry as well as government will serve to indicate the intensity with which the government is pursuing the nation's oceanic goals.

The immediate future of oceanography thus shifted from fiscal support to federal management. However, oceanography was not to be indefinitely drydocked in federal bureaucracy, for a five-area agenda evolved as to the assessed priorities of the government.[20]

1. Coastal Zone Management
2. Establishing laboratories for understanding ecology
3. Lake pollution
4. International Decade of Ocean Exploration
5. Artic Environment Research

These priorities would provide for: the development of aquaculture; legal questions; international relations; navigational regulations; education; data transfer; and weather prediction.

In the same year, NOAA, the National Oceanic & Atmospheric Agency, was conceived after being recommended in Our Nation and the Sea. NOAA (HR 13247) was to consolidate and coordinate the federal marine efforts into a single agency. On October 3, 1970, NOAA was approved by Congress, thereby marking a beginning of "quality federal management". The actual organization and function of NOAA will appear later in this study.

During 1969 the Santa Barbara blowout occurred, which led to a moratorium on lease sales of offshore oil rigs.

> After the Santa Barbara blowout, all federal offshore sales were suspended pending revision of OCS (Outer Continental Shelf) regulations. As a result, the industry spent only $93 million for federal and state offshore acreage during the first eleven months of 1969. This is down drastically from the $1,362 million spent on bonuses in 1968 and $563 million in 1967.
>
> For four years it (offshore industry) had climbed steadily at a rate approaching 28% per year, reached annual total of 414 million barrels in 1968. First half 1969 figures show a yearly rate of increase of only 11%. Daily offshore production is in the range of 1.25 million barrels of oil, representing 14% of the domestic total. [21]

The effects of this lessened activity were widespread. A large portion of the oceanographic industry was dependent upon the oil industry since petroleum was one of the few areas that, at the time, was profitably extracting a resource wealth; consequently, the oceanographic industry was severely set back by the moratorium. As mentioned, the state and federal government also depended heavily on revenue from these leased sites.

Due to a paucity of immediate economic incentives, technology, and legal framework, the offshore mineral industry was impeded from progress.[22] All three problems needed to be resolved prior to any real progress in tapping the offshore mineral resources.

Thus, the wind was taken out of oceanography's sails and a dismal year of economic setbacks occurred. But the storm had just begun: the weathering of 1970 had become the essential chore; for 1970 was to be a more severe year than 1969.

1970 - The Year of the Economic Cutback

In 1970 the "quality federal management" continued their soul searching while negating any increases in the Federal Budget. For Fiscal Year 1971 (which began July 1, 1970) the estimated expenditures were $518.5 million, a 1% increase over FY 1970 when inflation was at 6%. Again the pleas of industry echoed a need for government commitment: "The fundamental pre-requisite for the attraction of private capital to unproven oceanic areas is a commitment by the government. Even if funding is not forthcoming, the government must take a stand if it wants to encourage private interest to invest." [23] Other valid criticisms arose since that which is academically attractive to the coming decades is relatively unmoving in terms of political or business economics. Tax payers and stockholders demand and deserve justification for a use of their money. [24] Thus, a standstill: Why should industry invest without the support of the government, and why should the government invest taxpayer's money in a high risk area?

In the Marine Science Affairs 1970, a reason for public and private development of ocean resources evolved as a major challenge for the Seventies.

> In no area of marine science are the benefits from--indeed the necessity for--a public--private partnership more apparent than in the development of mineral resources. The exploitation of these resources will continue to be conducted by private industry. At the same time, the minerals are on public lands and must be managed in accordance with overall national priorities and objectives, including considerations of foreign policy. In view of the mineral potential of the oceans and the complex issues confronting their continued exploitation, it is imperative that the Federal and State Government and private industry work together to develop policies which take into account the economic incentives that motivate industry to move seaward, the rapidly evolving technology for doing so, the growing public demand for adequate environmental protection, and the implications for these policies for our broader international objectives. [25]

The preceeding statement certainly provided the desired intentions of private industry; however, no real agency of the government existed to implement these intentions. Private industry had previously reacted favorably to governmental intentions and encouragements, but this time industry waited for these intentions and encouragements to take the form of commitments.

On October 3, 1970, President Nixon enacted Executive Reorganization Plan 4. "Drawing ocean activities together into NOAA will make possible a balanced federal program to improve our understanding of the sea, and permit their development and use while guarding against the sort of thoughtless exploitation that in the past laid waste to so many of our precious natural resources." [26] Thus, the National Oceanic and Atmospheric Administration became a function of the Department of Commerce to coordinate and advance the oceanic and environmental efforts. This consolidation brought the following agencies under the aegis of NOAA. [27]

From the Department of Commerce:

Weather Bureau
Coast and Geodetic Survey
National Environmental Satellite Center
Environmental Data Service
Research Laboratories

From the Department of the Interior:

Bureau of Commercial Fisheries
Marine Game Fish Research Program
Marine Minerals Technology Center

From the U.S. Navy:

National Oceanographic Data Center
National Oceanographic Instrumentation Center

From the U.S. Transportation Department's Coast Guard:

National Buoy Development Project

From the Army Corps of Engineers:

U.S. Lake Survey

From the National Science Foundation:

Sea Grant Program

The Environmental Science Services Administration (ESSA)

Certainly NOAA could be considered a means for transforming federal intentions into federal commitments; however, federal funding still had to reinforce this gesture. "Quality federal management" had begun to prove itself, but the oceanographic industry awaited the necessary funding for F.Y. '72.

Meanwhile, the petroleum industry was still in the moratorium on offshore lease sales and stringent controls. The effect of this two year moratorium is expressed by Frank Ikard, who writes, "In the four years prior to 1969, production had climbed steadily at a rate of over

25 percent a year. In 1969, offshore production increased only 12 percent, and for the first half of 1970, the rate of increase was slightly below 7 percent."[28] Again the importance of the petroleum industry needs to be stressed, since a number of oceanographic companies are dependent upon this industry. The lift of the moratorium in December, 1970 came as a relief, but this news was only to be met with rising average costs of drilling offshore, $559,309 per site.[29]

In summary, 1970 began the decade by witnessing a federal re-alignment and coordination of federal efforts. Both promising and depressing factors influenced the industry, but the temporary cut-backs needed to be ameloriated before any real industrial progress could be produced.

The Year of the Recovery - 1971

The one indicator from the federal government that private industry wanted to see evolved in February, 1971. The Presidential Budget for 1972 sought $609.1 million for oceanography, a 17.6% increase from the previous year. A new faith within the industry created anticipation and enthusiasm towards the second half of 1971. The "quality federal management" had proven itself, but its chores were far from complete, for an even more essential problem needed to be considered: the management of the coastal zone. The definition of the coastal zone and its importance could best be described as follows:[30]

> This area---the band of water and land that surrounds the continent---is for most of our citizens their major point of contact with the oceans. It extends offshore to the outer edge of the continental shelf and inland at least to the reaches of the tides. Bays, estuaries, lagoons, wetlands, and beaches that fringe this irregular and often mobile boundary are necessarily included, as are the Great Lakes.
>
> Source: Marine Science Affairs, 1971

Chapter III

WHAT AND WHERE IS THE MARKET FOR OCEANOGRAPHIC EMPLOYMENT?

An examination of past employment distributions is necessary in order to answer the question "Where is the market for oceanographic employment?" The following table presents the most recent and complete study concerning the personnel distribution: 31

Table XI.2—Employers and Professional Specialties of Oceanographic Personnel in the U.S., 1964 and 1967

Type of Employer	Oceanographer		Fisheries Scientist		Oceanographic Engineer		Ocean Fisheries Technician		Non-Oceanographic Technician and Eng.		Marine Intern		Total	
	1964	1967	1964	1967	1964	1967	1964	1967	1964	1967	1964	1967	1964	1967
Federal	184	316	74	85	47	324	125	614	284	1,039	180	315	894	2,693
State & Local	49	35	72	104	2	4	4	82	30	20	71	37	228	282
University	320	556	17	37	37	126	34	140	201	221	128	155	737	1,235
Industry	17	60	1	3	35	168	3	32	111	209	14	88	181	560
Non-Profit	47	81	1	1	5	12	9	33	19	36	26	22	107	185
Others	14	11	6	8	1	3	1	2	12	3	4	---	38	27
Total [1]	631	1,059	171	238	127	637	176	903	657	1,528	423	617	2,185	4,982

[1] Students have been excluded. In 1964, there were 464 students who fit the criteria for inclusion; in 1967, 783 students qualified as oceanographic personnel.

Note In 1964, there were 3693 questionnaires returned of which 2649 qualified for the categories. The 1967 survey produced 7500 total responses with 5765 meeting the criteria for inclusion.

Source. A Study as to the Numbers and Characteristics of Oceanographic Personnel in the United States, 1964, NSF Contract—C331. A Study as to the Numbers and Characteristics of Oceanographic Personnel in the United States, 1967, NSF Contract—C469, both by the International Oceanographic Foundation

An analysis of the 1964 and 1967 figures as a percentage of the total further illustrates the shifting patterns in employment opportunities:

	1964	1967
Federal	41%	54%
State & Local	10%	5%
University	33%	25%
Industry	8%	11%
Non-Profit	4%	3%
Other	1%	1%

Obviously, the federal government is becoming the largest employer, with the universities second. However, in a 1971 survey of the 21 universities with ocean engineering programs, 15 of them reported the following employment patterns for their graduates in ocean engineering. 32

Employers of
Ocean Engineering Graduates

1.	Federal	31%
2.	State & Local	3%
3.	University	11%
4.	Industry	51%
5.	Non-Profit	4%

The pattern of the recent graduates seems to be towards the industrial sector rather than the federal or university sectors. An explanation for this will follow in the Determinates of Demand section.

A final statistic concerning the size of the employers and their number should be mentioned. A survey on Ocean Engineering by Dr. John Herbich of Texas A&M sought the total number of employees involved in ocean engineering activities in their respective organizations. 33 The results were as follows:

Number of Employees	Number of Organizations	
1-10	77	(45%)
11-20	27	(16%)
21-40	15	(9%)
41-60	14	(8%)
over 60	37	(22%)

Dr. Herbich then concluded, "the firms involved in ocean engineering are rather small and employ 1-10 employees or very large, employing over 60 employees. This probably means that the small firms are involved in feasibility studies, research and development, and consulting, while the large firms are involved in petroleum exploration, construction, or production."

Determinants of Demand

At the present time, the single most crucial determinant for demand is the federal budget. This is recognized in the preceeding chapter. AS the federal budget fluctuated, the entire oceanographic community directly and immediately followed. Furthermore, the federal government remains the largest employer of ocean-related scientists and engineers. Therefore, an in-depth study of the federal budget with the knowledge that can be derived from its fluctuations, is essential.

The following table shows the chronological progression of the federal budget for oceanography: 34

	Est. F.Y. 1969	Est. F.Y. 1970	Est. F.Y. 1971 *	Est. F.Y. 1972 *
R&D	265.7	299.5	328.9	385.6
Investment	49.7	63.7	41.4	48.7
Operations	148.0	151.3	148.2	174.8
TOTAL	463.4	514.5	518.5	609.1

As stated previously, the recessionary years of 1969 and 1970 were largely attributed to federal budget cut-backs. However, the 17% increase this fiscal year should aid tremendously in the industry's recovery.

A micro-analysis of this FY 1972 budget will reveal more information concerning particular areas of growth. By descending order, the programs with the greatest federal funding would be: Oceanographic research (21%), National Security (19%), Exploration, Mapping & Charting and Geodescy (13%), Transportation (10.1%), Fishery Development & Seafood Technology (8.5%), Environmental Observation (8.5%), and all others (18.9%). As an indicator, this places demand for employment in those areas receiving large sums, especially those with R&D dollars.

This information brings forth a possible formula for determining the demand for employment in all sectors by using the Federal R&D funding level. By combining several previous studies, the following formula can be derived:

1. Implicit performer cost-ratios; i.e., deriving the cost of employing one oceanographic employee per year in R&D. This amount would include salary, overhead, technical support personnel, and some operating costs such as research. This method was prescribed in Federal Spending and Scientist and Engineer Employment, a Study Measurement. [35] From a survey of 43 oceanographic firms in California, this average cost was $46,200 which fell below the $53,854 by the previously mentioned government's statistic for industrial average (excluding AEC). Andreas Rechnitzer did a study entitled Marine Sciences in California Institutions of Higher Education in which ue used $50,000 as the approximate figure. [36] I chose to use the same $50,000 figure in order to maintain continuity in the comparison between Dr. Rechnitzer's findings anc that of my own; 44% of my respondents agreed with this figure.

2. Determine the total R&D federal dollar and its distribution to the following sectors on a "with total funds" or "without total funds" basis. "With total funds" indicate that the total amount for research was given while "without total funds" means that only a portion of the total amount to be spent was given. The sectors would be: Federal, University, Industry, Non-Profit, State, and Petroleum. The source would be the Smithsonian Science Exchange. [37]

* Estimated on the basis of percentage. R&D = 63.3%, Investments = 8.0%, and Operations = 28.6%.

3. Derive the cost-sharing contributions to federal grants received "without total funds" by each of the different sectors. The cost sharing average contributions are as follows: [38]

	Matching Average	Multiplier effect*
Industry	45%	2.22
Petroleum	85%	6.66
University	33%	1.50
State & Local		
Non-Profit		

*The multiplier effect is that number times the total funding dollar to derive the total R&D spent by a sector.

This process will give a total R&D dollar figure since it notes both the federal contribution and the individual sector's matching contribution. The above multiplier effect times the federal "without total funds" contribution would give the total $ R&D by the different sectors.

4. Assuming that the Federal organization would always receive grants with total funds, the following formula would thus be developed.

For "with total funds":

$$\frac{(\$Federal + \$University + \$Industry + \$Non\text{-}Profit + \$State + \$Petroleum)}{\$50{,}000}$$

For "without total funds":

$$\frac{1.50\ (\$University) + 2.22\ (\$Industry) + 6.66\ (\$Petroleum)\ +\ .\ (\$Non\text{-}Profit)\ +}{\$50{,}000}$$

$$\frac{.\ (\$State)}{\$50{,}000}$$

5. R&D Scientist and Engineers represent about 75% of the Total S&E employment.

This should give the most accurate demand for employment prediction provided the following:

1. The Federal $ R&D is known.
2. The contributing ratios are known.
3. The implicit performer cost-ratios are known.

Dr. Rechnitzer made the effor of dividing $50,000 into the total federal dollar, but "only 5% of non R&D employment is directly affected by federal dollars". [39] This would assert that the approximately 40% of the federal budget provided for non R&D would create employment equal to that of R&D funding. This effor could explain Dr. Rechnitzer's extreme optimism concerning employment predictions.

FUNCTIONAL RESPONSIBILITIES

Functional responsibilities are the working obligations and duties of a particular position within a firm. There are 5 sub-groups:

Management
Research
Development
Design and Production
Teaching

Each employer determines the difficulty and uniqueness of a position's functional responsibilities and then determines the educational and working qualifications needed to accomplish these tasks. A thorough presentation of oceanography's functional responsibilities and the educational and working qualifications needed follows in the next chapter. The point to be made here is that the functional responsibilities that will arise in an industry will be an important determinant of demand.

Private Industry's Operations

An analysis of the private industry's operations in manufacturing, extraction, and research will present some of the functional responsibilities that will be occuring in oceanography.

Manufacturing

Manufacturing of oceanographic instruments and tools exists as the essential market of the private industry due to the new demand for such equipment. This new demand has been stimulated by the federal programs in which the development and production of oceanographic equipment is needed for the largest areas of federal endeavor: Oceanographic Research (21%); National Security (19%); Exploration, Mapping, and Charting and Geodesy (13%); and Environmental Operations (8.5%). The prediction for the oceanographic market of major systems is expected to increase from the current total of $10 million to $70 million. The major systems needed in 1980 and their values are predicted to be: [40]

Ship systems	$10-$15 million
Buoy systems	$20-$50 million
Satellite systems	$ 2-$ 5 million

The National Oceanographic Instrumentation Center conducted the following survey concerning essential instruments needed; their sample size of 1,038 consisted of: 50% industry, 24% government; and 26% academia. [41]

N.O.I.C.S. Top Twenty

1. Current meters
2. Navigational aids
3. Biological Samplers
4. STD's
5. Echo Sounders
6. Temperature Sensors

7. Hydrophones
8. Tide and wave gauges
9. Oxygen meters
10. Corers
11. Pressure sensors
12. Wire rope
13. Salinometers
14. Velocimeters
15. Magnetometers
16. Camera/lights
17. Optical
18. Release devices
19. Tape recorders
20. Gravimeters

From the N.O.I.C.S. Survey, an idea of the future markets and the resulting functional responsibilities can be determined. Prior to the manufacturing of these products, they will need to be researched and developed and then designed, tested, produced, and sold. All of these will call upon both scientific and engineering knowledge and skills.

Extraction

The extraction of resources from the oceans acts as a primary stimulus for oceanographic exploration. The oceans will never be the panacea for the world's diminishing natural resources, but they will be a new place to which man can turn (and return) for his natural resources if sound technology and management prevail. The major factor inhibiting the exploitation of the ocean's resources today is the lack of technology to tap the oceans and compete economically with land-extracted resources. Two events could provide a feasible oceanographic venture: Technological advancements and increasing demand due to diminishing supply. The latter is not immediate but the former will prove to be the means to potentiality.

The 1969 statistics for the U.S. extraction of mineral resources as a percentage of world total were: 42

36.8% of the materials from seawater
32.9% of the minerals from beneath the seafloor
31.1% of the materials from beaches and the seafloor

"While the net value of petroleum, natural gas, and sulphur derived from the U.S. outer continental shelf has increased fivefold since 1960, minerals mined from the adjacent sea floor have barely maintained level production during this time. 43 However, this might not be the case in the future, since one manganese high production rig (one to two million tons a year) and an efficient processing plant could supply 25% of the current U.S. manganese needs, 10% of the nickel, 1% of the copper production, and 40% of the cobalt requirements. 44

In addition to this, it has been estimated that the world demand for oil is increasing at about 1 billion barrels per year. This means that the oil industry must find a new Saudi Arabia or two new Irans every year simply to keep pace. The U.S. Department of Interior projects a demand of 80 billion barrels of crude and natural gas liquids between now and 1980. Of the good onshore sites, 90% have already been drilled, leaving oilmen only one last frontier---the sea. Less than 10% of the prospective drilling sites in the ocean have been explored. 45

Thus, the major functional responsibilities for extraction of natural resources from the oceans is development of the necessary technology. There also exists another essential task for economic exploitation of the oceans, particularly in the petroleum industry. The protection and maintenance of the environment must be a top priority if man is to continue to turn to the oceans for natural resources. The following statement presents a rational solution:

> The large revenues that municipalities, states, and countries receive from leases, as well as production on offshore areas within their cognizance, are a major portion of existing and projected budgets. To terminate or even reduce such needed assistance to burgeoning countries, as well as harassed taxpayers, is inconceivable. Certainly a technology capable of operating elaborate space and undersea programs will be able to achieve safer and more efficient operation in this area and an effective means of combating the undesirable effects of mishaps. 46

Research: Applied vs Basic

Research by the private industry is done for an application to a marketable development rather than for pure scientific knowledge. This is understandable since the private industry is involved in oceanography for profit, leaving the pursuit of scientific investigation to the universities and the federal government.

FEDERAL PROGRAMS

An analysis of the federal government's "in house" operations will present the functional responsibilities and employment opportunities that will be occurring in the future. The U.S. Navy plays the major role in federal ocean engineering because "The major thrust of the Navy's ocean engineering is toward the development of a technology base which will advance and provide options for military systems." 47 The major areas of this technology base would include:

Previous Projects

Deep Quest
"Dry make" connectors
A chemical overlay system
Experimental 10 horsepower engine
Underwater welding of thick titanium plate
Optical absorption metering
A construction assistance vehicle
The Transparent submersible NEMO

Current Projects

Power Sources
Materials for underwater application
Underwater construction equipment and techniques
Buoyancy materials
Mechanical and conductor cables

Future Projects

Spread footing and pile foundations
2nd generation vibratory anchors
Lift systems
Concrete pressure - resistant structures
Capability of seafloor construction
Remote unmanned work systems

Thus, the technologies needed to accomplish these federal projects and the private industry's ends would determine the demand for functional responsibilities in oceanography.

SALARY

Salary acts as a determinant of demand since it must be weighed against the budget and the needed qualifications of a worker, i.e., an employer might need a PhD but can only afford an employee with a Bachelor's degree. The media salaries of the various scientific and engineering groups are presented below:

	PhD	MS	BS
Earth & Marine Sciences [a49]	$15,600	$14,000	$15,000
Engineering R&D 50	$20,500	$17,950	$15,950
Petroleum Engineering 51	$20,950	$16,800	$17,900

a The reason for the higher salary in BS than MS is that the MS is the teaching salary less consulting.

This obviously shows a higher salary distribution amongst the engineers, perhaps due to substantial annual salary increases.

Although 1971 pay scales for federally employed oceanographers are not available, Harris B. Stewart, Jr., stated in a speech on federal marine careers that the government pay scales were very competitive and attractive. To this he added that the demand was great and the opportunities were among the best. 52

SUPPLY

The supply of oceanographic students needs to be considered, now that the demand for oceanographic manpower has been examined. There exist two standards by which this evaluation can be made: the real supply and the potential supply. The real supply accounts for only those students pursuing their disciplines with a direct application to a marine science, and who would probably seek oceanographic employment upon graduation. The potential supply includes the real supply plus those students studying basic disciplines that can be considered marine-related (i.e., biology, botany, civil engineering), and who would not necessarily seek employment in oceanography. Thus the potential supply represents those also obtaining an education conducive to oceanographic employment.

To estimate the real supply two surveys will be used; one covering only the scientific students; the other covering the engineering students. The first evaluation of scientific supply comes from Oceanology International, which conducted a survey of 63 of the nation's four-year public institutions offering marine science. 53 Their findings appear on the next page.

Oceanography Students

	Graduates	Enrollment
BS	200	1,664
MS	212	822
PhD	115	759
Unclassified	-	248
	527	3,493

To determine the real supply from the total of 527 graduates, one must also deduct those BS and MS students who would not enter the labor market but would continue toward an advanced degree. Another consideration is that those 115 PhD's will probably enter the teaching profession or federal research labs rather than private industry. Thus, the 527 figure is somewhat greater than the real supply of graduates entering the labor market (particularly into private industry). Thus, a more realistic supply.

I conducted a survey of the 21 institutions with ocean engineering programs; with a sample size of 14, the real supply of ocean engineers was estimated. The demand for ocean engineers was evident by the 25% increase in graduates during the past four years. Since the sample size represents only two-thirds, it is necessary to multiply these figures by 1.5 to estimate the actual totals.

Ocean Engineering Graduates

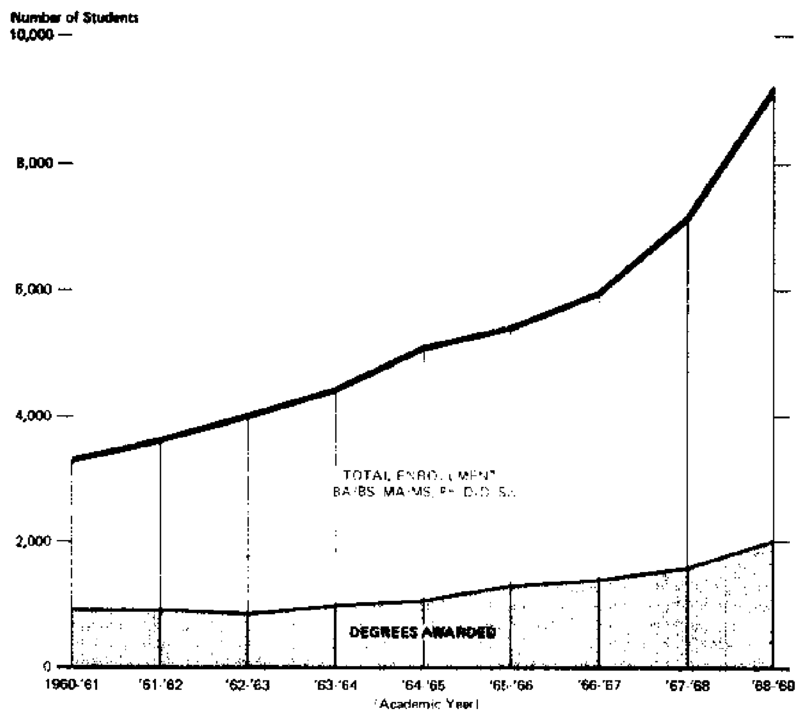
	1971	1970	1969	1968
Undergraduate	48	25	31	19
Graduate	125	101	75	46
Total	173	126	106	65

Ocean Engineering Enrollment

	1971	1970	1969	1968
Undergraduate	200	191	173	130
Graduate	460	370	237	165
Total	660	561	410	295

To determine the real supply of ocean engineers, both the graduate school retention rate and the years required to obtain a MS must be considered. The schools noted that approximately 15% of their MS students pursued a PhD. The majority of schools expressed that it took 1 1/2 years to complete Master's degree.

Figure XI-5—Degrees Awarded in Marine Sciences



*SOURCE: "AN ANALYSIS OF ENROLLMENTS AND DEGREES AWARDED IN THE MARINE SCIENCES AND RELATED FIELDS, ACADEMIC YEARS 1960-69," BY MARINE SCIENCES AFFAIRS STAFF, OFFICE OF THE OCEANOGRAPHER OF THE NAVY, DECEMBER 1969

The preceeding potential supply figures were contributed by the Marine Science Affairs Staff, December, 1969, and as stated earlier, their inclusion covered both marine sciences and marine-related basic disciplines. 54 To properly evaluate the potential supply, the sub-groups must be presented.

Enrollment at all levela in Oceanography and related marine science fields	3,000
Ocean Engineering and marine related basic engineering	1,104
Naval Architecture	887
Marine food & fisheries science	770
Marine operations and marine technology	1,910
Marine related basic sciences	1,860
TOTAL ENROLLMENT	9,521
TOTAL GRADUATES	2,000

Compared to the real supply the first two figures (oceanography and ocean engineering) were nearly identical while the differences occurred in the remaining four categories.

Conclusions

The demand for ocean engineers lies with the federal government and universities; however, private industry seems to be the area of employment growth. The functional responsibilities of the private industry show a potential high activity in manufacturing and extracting, while the federal "in house" projects will be towards the development of a technology base for military systems.

The actual number of Marine Science majors entering the labor market represents a fraction of the Marine Science enrollment. Furthermore, those students and graduates with basic science disciplines represent a potential supply of manpower in oceanography. No real shortage of manpower would exist if a sudden build-up in oceanography occurred due to this potential supply. Meanwhile, the Net Real Supply of Marine Scientist sufficiently supplies the current labor market.

Chapter IV

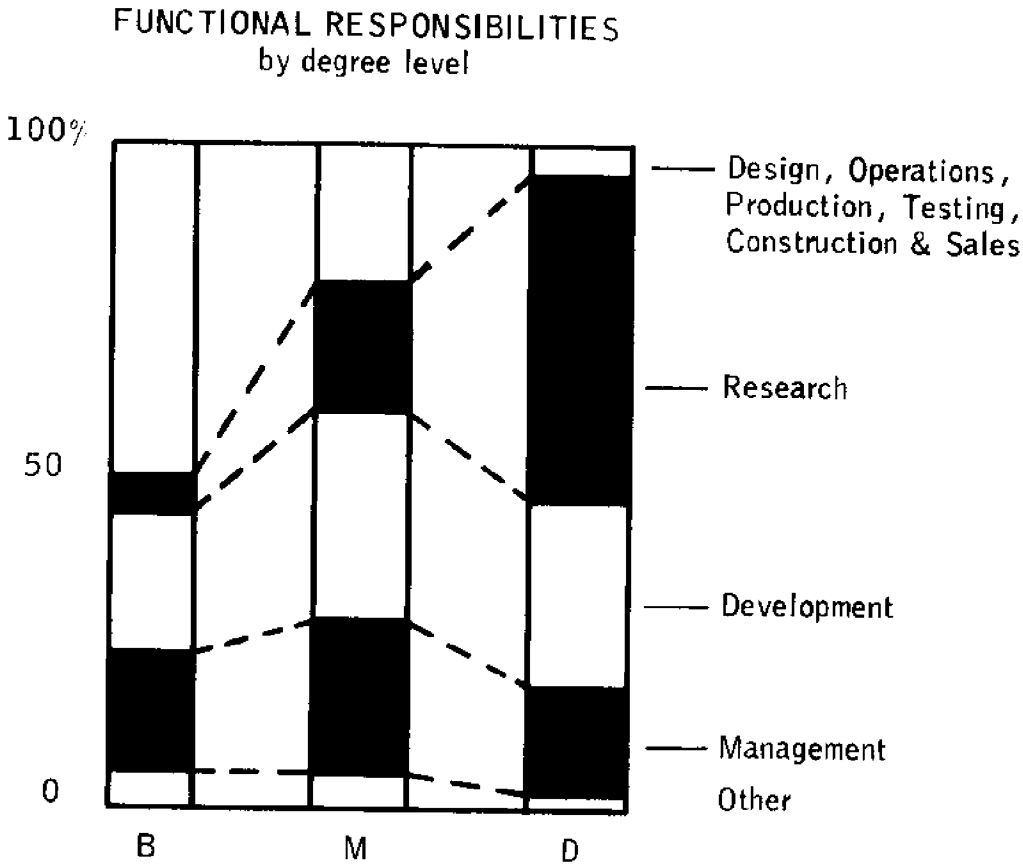
WHAT ARE THE EDUCATIONAL AND WORKING QUALIFICATIONS FOR EMPLOYMENT IN OCEANOGRAPHY?

What is an oceanographer? Semantics of the word "oceanographer" inhibits a definition per se. However, the delineating of working responsibilities and duties, plus the qualifications needed, permits an elucidation of the word "oceanographer". This approach is more inclusive of the situation than is the method of classifying persons by degree and major and then stating their working abilities. The classification system might establish criteria for membership in scientific societies or analytical statistics, but it does not totally answer an employer who asks, "Who can accomplish the jobs and responsibilities which need to be performed?" The answer to this particular question is the purpose of this chapter.

There exist four functional responsibilities in the scientific and engineering community, and a possible fifth for the education sector. As mentioned in the determinants of demand section, they are:

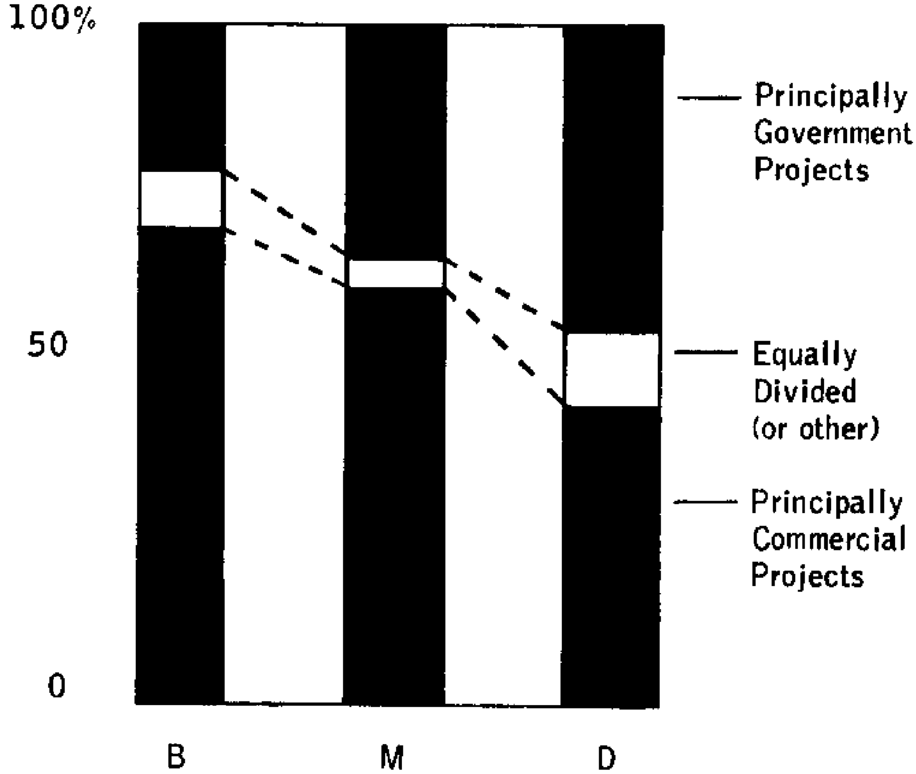
Management
Research
Development
Design, operations, production, testing,
construction and sales
Teaching (for educational institutions)

The difficulty and uniqueness of the functional responsibilities determine the educational and working qualifications needed to accomplish the tasks. By approaching the situation in this matter, it establishes the job and the type of employee needed. Thus, this prevents the under-employment of a stringently classified oceanographer, or the preclusion of an able worker. This theory is simply managerial decision making, and only each management can assess their functional responsibilities and then determine the caliber of their employees. An example of a management's assessment graph might be as follows: 55



Another criterion for decision-making might be the type of project, since, for example, government projects might call for more qualified employees. The assessment graph for this criterion might be as follows: 56

TYPE OF PROJECT
IN PRIVATE INDUSTRY
by degree level



Thus, with the functional responsibilities and type of project used as the determinents of demands, guidelines can be set for determining the criteria of employment in oceanography.

Research & Development Scientist:

The disciplines of physics, geology, chemistry, biology, meteorology, or mathematics are the foundations of R&D Scientists. The further study of these disciplines in relation and application to marine science determines their qualifications for both applied and independent R&D. 57 Those not having this advanced education or application to marine science would serve two vital roles. The first role would be that of a specialist in the basic disciplines with possible technology applications from other industries. The second role would be that of advanced technical support of those conducting the Research and Development. Thus, those not possessing an advanced degree in relation to marine science would be employed more often in dependent or team R&D under the direction of one possessing such an education.

Working experience would also serve as part of the criteria for assessing employment capabilities. Greater working experience, particularly in the marine sciences would merit greater functional responsibilities. Thus, a man's qualifications in both educational and working experience could determine quite accurately his capabilities and his potential.

Research & Development Engineer:

An article entitled: "Qualifications Ocean Engineers Need" by Allyn C. Vine of Woods Hole, most descriptively presents the ocean engineering career. The following comments are excerpts from this article: 58

> ...in ocean engineering, many jobs have yet to be conjured up at the drawing board or encountered head on in the field...ocean engineering involves a multiplicity of disciplines, and the general nature of many problems has yet to be defined. As a result, the mold for ocean engineers is still in a fluid state.
>
> For emphasis and convenience I shall divide ocean engineers into two essential classes called hard core and peripheral.
>
> The full-time hard core ocean engineer is the one who wholly commits himself to oceanic problems. In this endeavor he may need a good dose of missionary zeal along with a sound technical background. Included in this category are the generalists who can visualize and control large and complex jobs or systems and know enough to avoid the numerous failing errors into which narrow specialists are so prone to fall. His professional breadth must be acquired through both education and experience.
>
> The part time peripheral engineer will work on ocean problems only that fraction of time that his normal professional interests cross over into ocean problems. He is apt to be a specialist in some other field and hence one of his great values will be that he will refresh ocean engineering with devices, techniques, philosophy, money and friends from other fields. However, because of his limited exposure to oceanography, the peripheral engineer must acquire most of his oceanographic breadth through reading, through association with hard core engineers, and through continuing educational courses.

The hard core ocean engineer is apt to be interdisciplinary in outlook and his educational opportunities should strengthen such interdisciplinary outlook. The ocean engineer must bring the ocean down to a workable size in his area of specialization.

I would suggest that in many cases a student would be well advised to consider ocean engineering a marvelous minor but a questionable major.

The ratio of Indians to Chiefs or Bachelors to PhD's will probably be greater in ocean engineering than in ocean science. This is an historical trend and seems to be justified because the percentage of routine work in engineering is greater than in science.

Thus, ocean engineering seems similar to ocean sciences: in both, ocean-oriented professionals exist who conduct the applied research and development. In both, also, professionals from basic disciplines exist who augment the work of "hard core" professionals. <u>In ocean engineering, more than in ocean sciences, these professionals from basic disciplines are needed to perform the more routine, but equally needed, functional responsibilities.</u>

<u>Technicians and Assistants</u>:

The shipboard operator with competency in instrument operations and repair, research analysis, and computational assistance have an essential role in oceanic operations. Associate of Arts, working experience, or technical training qualifies one for these functional responsibilities.

<u>Design Operations, Production, Testing, Construction & Sales</u>:

The scientists and engineers involved in these operations have the functional responsibilities of either providing for R&D or utilizing the knowledge gained from R&D. Their operations require an education and working experience capable of perceiving the needs for R&D and comprehending the accomplishments of the R&D.

<u>Management</u>

The functional responsibilities of management in any oceanographic operation can be as varied as the science disciplines involved. On the elementary level, an oceanic operation is no different than other scientific endeavor of business practices and policies, and persons with educations in business administration, particularly in management and accounting, are needed. Managers are needed with interdisciplinary education and experience. Furthermore, experienced engineers and scientists are needed in the top line management for technical advisement and institutional prestige. (reaping the reputation).

Equally important in management is the availability of legal and political consultation. Due to the infancy of the science and the dependancy upon the federal government, the most precious employees could be those who are able to interpret and influence the latest developments in these two areas.

Employment Criteria

Now that the employment theories of functional responsibilities have been presented, a practical description can be made of employment criteria of both California's industry and of the federal government. The minimum qualifications as an 'oceanographer' in the federal government are established by the Civil Service Commission. These requirements are: 59

Category A

1. A Bachelor's degree in oceanography, meterology, geophysics, physics, mathematics, or chemistry.
2. At least 24 semester hours in the physical sciences.
3. Mathematics at least through integral calculus.

Category B

1. A Bachelor's degree or equivalent progressive professional experience in oceanographic work (experience may be substituted on the basis of one year of professional experience for one academic year of college).
2. At least 24 semester hours in the physical sciences.
3. Mathematics at least through integral calculus.

Category C

1. A Bachelor's degree in geological, biological, or engineering sciences.
2. Formal training and/or work experience in oceanography.
3. At least 24 hours in the physical sciences.
4. Mathematics at least through integral calculus.

Basically, the requirement for category A is a Bachelor's degree with a certain area of emphasis and intensity. Category B requires a Bachelor's or equivalent working experience with a certain area of emphasis and intensity of education. The strictest, Category C, requires both a Bachelor's degree and working experience along with the area of emphasis and intensity of education. The competition for federal employment is keen, but the volume of employment is also the greatest amongst the sectors of oceanography.

California Oceanographic Comparies'

Employment Standards

	Education		Years Experience	
	Preferred	Conditional	Preferred	Conditional
Oceanographer				
Biology	BS	MS	1 - 3	4 - 6
Chemistry	MS	--	1 - 3	-
Physics	MS	BS	1 - 3	4 - 6
Geology	MS	BS	4 - 6	1 - 3
Geophysics	MS	BS	4 - 6	1 - 3
Fisheries Scientist				
Marine Biology	BS	--	1 - 3	-
Zoology	BS	--	1 - 3	-
Ocean Engineer				
Electrical	BS	MS	4 - 6	1 - 3
Mechanical	BS	MS	4 - 6	1 - 3
Chemical	BS	--	4 - 6	-
Sanitary	BS	--	-	-
Environmental	MS	--	4 - 6	1 - 3
Industrial	MS	BS	4 - 6	-
Civil	BS	MS	1 - 3	4 - 6
Ocean Specialist	MS	BS	4 - 6	-

In a survey of 43 of California's oceanographic companies the following employment preferences were revealed. The 'preferred' standards listed represent the mode of answers while the 'conditional' represents the second mode. (see next page)

In magnitude of stringency the following occupations are ranked on the basis of this survey:

1. Geology, Geophysics, Ocean Specialist, and Environmental and Industrial Engineering. Masters degree and 4-6 years of experience preferred.
2. Chemistry & Physics. Masters degree and 1-3 years experience preferred.
3. Electrical, Mechanical, and Chemical Engineering. Bachelors degree with 4-6 years experience preferred.
4. Biology, Marine Biology, Zoology, and Sanitary and Civil Engineering. Bachelor's degree and 1-3 years experience preferred.

There are several conclusions that might be drawn from this survey. The lower standards for marine biologists and zoologists might explain the current over-supply in these fields. More of these people are out seeking jobs rather than continuing their educations, since the functional responsibilities in these fields do not necessitate advanced degrees. PhD's are seldom employed by the industries, except in cases of ownership and advanced R&D. Those with Doctorates, as a general rule, are employed by the educational institutions and federal government.

One last requirement opinion appeared in Occupational Outlook 1970-1971, 60; the following excerpts reiterate the previous findings.

> The minimum educational requirement for beginning professional positions in oceanography is the Bachelor's degree with a major in oceanography, biology, a geoscience, one of the other basic sciences, mathematics, or engineering. For professional positions in research and teaching and for advancement to high-level positions in most types of work, graduate training in oceanography or one of the basic sciences usually is required.
>
> Since oceanography is an interdisciplinary field, training in the related basic sciences, when coupled with a strong interest in oceanography, is adequate preparation for most beginning positions in the field or for entry into graduate school.

> Thus, the new graduate who has a degree in a basic science rather than in oceanography usually can be provided enough understanding of oceanographic principles to enable him to preform adequately in this field
>
> Well trained persons with Bachelor's degrees in related sciences will find opportunities mainly in research assistants in routine analytical positions.
>
> The academic work of the graduate student in oceanography consists primarily of extensive training in a basic science combined with further training in oceanography.

In using these three sources, this study has attempted to show that the skills needed to accomplish various functional responsibilities are not completely covered by former classifications of "oceanographers'. The thesis is that for employment, functional responsiblities and type of projects must be coupled with educational and working qualifications of an employee. For it is as wasteful of human resources to under-employ a scientist or engineer as not to employ a qualified person at all.

For the benefit of statistical clarification, definitions in oceanographic employment are needed to evaluate the manpower. Such definitions were established in 1967 by the International Oceanographic Foundation study. Their delineations of ocean-oriented employees were as follows. 61

OCEANOGRAPHER: (biological, chemical, physical, geological, geophysical) - training or experience equivalent to a Master's degree or higher.

OCEAN ENGINEER: (electrical, mechanical, chemical, sanitary, civil, environmental, or industrial) - training or experience in applied research equivalent to a Master's degree or higher.

OCEAN SPECIALIST: Training or experience in science or engineering equivalent to a Bachelor's degree.

OCEAN TECHNICIAN: Training or experience equal to an Associate of Arts degree of two years of post high school training.

MARINE CRAFTSMAN: Formal education through high school. Competency in a marine oriented skill.

UNSKILLED MARINE AIDE: No formal educational requirements. Competency to serve aboard vessels.

COMMON LABORER:	Engaged in shore based cperations.
NON-SCIENCE PROFESSIONAL:	Training in the social sciences or humanities aspects of oceanography beyond the Bachelor's degree.
STUDENT OR INTERN:	

Conclusions

The difficulty and uniqueness of the functional responsibilities determine the educational and working qualifications needed to accomplish the various tasks. The graphs used showed that "Research and Development" demanded those with a more advanced degree while "Design and Operations" needed basically Bachelor degree holders. For R&D Scientist, the important education in a Marine Science criteria determined whether a worker would be involved in independent or team R&D. The R&D Engineer has less relevance to a Marine Science degree since, more so than in ocean sciences, professionals from basic disciplines are needed.

The educational and working qualifications needed in private industry that were derived by this study were as follows:

1. Geology, Geophysics, Ocean Specialist, and Environmental and Industrial Engineering. Masters degree and 4-6 years of experience preferred.
2. Chemistry & Physics. Masters degree and 1-3 years experience preferred.
3. Electrical, Mechanical, and Chemical Engineering. Bachelor's degree with 4-6 years experience preferred.
4. Biology, Marine Biology, Zoology, and Sanitary and Civil Engineering. Bachelor's degree and 1-3 years experience preferred.

Oceanography is an interdisciplinary science. Some disciplines require an application to Marine Science at the Master's level while others require only a Bachelor's degree with no formal application to a Marine Science.

Chapter V

CAN AEROSPACE MANPOWER SATISFY THESE REQUIREMENTS?

To determine the transferability of aerospace manpower to oceanography, their relationship to the prescribed functional responsibilities and types of projects needs to be examined. The educational qualifications have been established as the most important criteria for employment. It is important not only in the subjects studied, but also at the level studied, for if aerospace manpower is to be able to transfer to oceanography, a high correlation of their educational qualifications is essential.

Degree Correlation

It has been shown that the degree level of an individual helps determine his functional responsibilities and type of projects. The comparison to be made now will analyze the aerospace manpower through the employment criteria in oceanography.

	Degree Comparison of Unemployed Aerospace		
	Ocean Eng.[62]	Earth & Marine [63]	Author's Survey
No degree	-	1.1%	27.0%
Bachelor's degree	46%	42.0%	55.2%
Master's degree	36%	33.9%	13.8%
PhD degree	18%	23.5%	0.8%

The correlation of degrees earned by oceanography versus aerospace manpower presents a greater percentage of people with advanced degrees in oceanography; this fact was previously established in the requirements for oceanographic employment. The consequences to the lesser trained aerospace manpower on the basis of educational degrees only would be as follows:

1. Those not possessing a Bachelor's degree (27%) would have little or no employment opportunities in oceanography, except as technicians or assistants.

2. Those possessing a Bachelor's degree (55%) would be qualified for the previously discussed 'peripheral' engineering, and independent or team employment.

3. Those possessing a Master's degree (13.8%) or a PhD (0.8%) would be qualified for peripheral and team employment, however, a real usefulness for these people could be found in the areas of augmenting the engineering and scientific efforts with knowledge transfer from another industry.

Disciplines Studied in Oceanography & Aerospace

	Ocean Engineers	Aerospace
Civil Engineering	35.8%	1.7%
Mechanical Engineering	10.6%	24.2%
Ocean Engineering	8.2%	-
Structural Engineering	7.0%	-
Naval Architecture	4.0%	-
Hydraulic Engineering	3.5%	-
Petroleum Engineering	3.5%	-
Electrical Engineering (& Electronics)	5.8%	27.0%
Oceanography	2.9%	-
Physical Oceanography	2.9%	-
Other	15.8%	-
Chemical Engineering	-	2.5%
Environmental Engineering	-	.6%
Industrial Engineering	-	8.5%
Aeronautical Engineering	-	7.9%
Systems Engineering	-	.6%
Physics & Math	-	8.5%

Dr. Vine of Woodshole and editor of Marine Technology Society Journal, created an optimism for that aerospace manpower who possessed a Bachelor's degree in a basic engineering discipline since, "The ratio of Indians to Chiefs or Bachelor's to PhD's will probably be greater in ocean engineering than ocean science . . . because of the percentage of routine work." 64 The fact that the aerospace manpower would not have any previous application to oceanography would debase them to peripheral and routine (but still essential) employment. Those aerospace scientists (only a few in number) would be required to possess an advanced degree to qualify for this same class of employment.

The Master's and PhD's involved from aerospace could also qualify for more technical and possibly even more applied employment in oceanography. They would best serve to technically augment both R&D and production.

By this particular standard, those without degrees would not realize any employment opportunities in oceanography. It might best be described as the security of a degree, for employers in a technical field will view this minimum standard as just that -- essential and securing. In seeking employment in a different industry, the degree presents a capability and possession of skill and knowledge while an Associate of Arts degree or proficiency license does not have this intra-industry creditability. However, these lesser credentials would satisfy requirements as technicians and assistants who need a competency in instrument operation and repair, research analysis, and computational assistance.

Discipline Comparison

A poor comparison exists concerning the available aerospace manpower versus the engineering professions employed in oceanography. (See following page.) A further analysis of these comparisons shows that the greatest aerospace manpower available (electrical engineers at 27%) only accounts for 2.9% of the engineers employed in oceanography (another (2.9% in 'electronics' giving the total of 5.8); while the greatest oceanographic manpower employment (civil engineers at 35.8%) only account for 1.7% of the available aerospace manpower. A reminder should be made that two vastly different magnitudes of manpower exist for aerospace numbers far exceed that of oceanography. This depresses the situation even more for those professions with an unfavorable correlation. Thus, those engineering professions with both the greatest demand in oceanography and the least supply from aerospace would be the most capable of transfer. Those included in this group would be civil and mechanical engineers. The employment of 7% 'structual' engineers and 3.5 hydraulic engineers creates a problem of semantics, since these professions could be considered civil engineering or possibly mechanical engineering. If these were to be considered as one of these basic disciplines, it would open more opportunities to the available aerospace manpower.

Physics & Math aerospace manpower (8.5%), although not correlated above, would find employment opportunities in oceanography due to a heavy use in scientific operations.

Working Experience

The available aerospace manpower overwhelmingly satisfies oceanography's working experience requirements for employment, but the experience is usually either in aerospace or a basic discipline rather than an application to oceanography. The working experience responses were:

Working Experience
of Unemployed Aerospace

1 - 3 years	4.5%
4 - 6 years	7.3%
7 -10 years	14.6%
10 -15 years	20.0%
16 +	50.4%

The criterion established by the 43 oceanographic companies was basically 1 - 3 years or 4 - 6 years working experience. Thus, the available aerospace manpower satisfies the working experience requirement.

Having presented the educational and working qualifications, conclusions concerning the functional responsibilities, type of projects, and type of employers can be established.

The manpower with a Bachelor's degree would be employed for peripheral or routine work; this would include mostly the sector of 'Design, Operations, Production, Testing, Construction & Sales' and possibly Development. (see page). Due to the status of a Bachelor's degree it is likely that the type of projects for these employees would be commercial rather than governmental. Finally, the employer would be the large firms involved in petroleum exploration, construction or production. From Dr. Herbich's survey the type of organizations that employ 40 or more engineers account for 30% of the total, or 51 organizations. This class of 'design and construction' engineers constitutes 49.8% of the ocean engineering work force, an encouraging fact that this type of engineer is needed in oceanography.

Those with a Master's or Ph.D. would be capable of both the previous class of 'design and construction' and the class of R&D ocean engineers. Thus, their abilities to satisfy both the classes of functional responsibilities would enhance their employment opportunities. Furthermore, their advanced degrees would qualify them to work on a larger percentage of government as well as commercial projects. If Dr. Herbich's conclusion is correct, the smaller 104 firms (61%) employing 1-20 persons would be the likely employers for those involved in feasibility studies, R&D, and consulting. The fact that 30.5% of the ocean engineers are employed in conceptual or feasibility studies confirms that this class of ocean engineers is also needed.

The Deadwood Concept Considerations

In keeping with the question "Can Aerospace Manpower Satisfy These Skills?", discussion of the Deadwood Concept is needed. As stated in Chapter I, it was hypothesized the 'deadwood' employees were the first to be laid off, to find new jobs in another industry, but again failed to prove their worth resulting in a black eye for the aerospace reputation. This is not meant to conclude that all those unemployed a year or more ago are deadwood manpower, nor does it imply that all those laid off less than a year ago are not deadwood. It does, however, imply that the most recent unemployed might be more qualified, and that they were only laid off as a result of extreme economic hardship. The following statistics concerning last employment show the majority of aerospace manpower recently unemployed at 1-6 months.

Last Employment
of Aerospace Unemployed

	Author's Survey	O.C. HRD
1-6 months	48.2%	68.0%
7-12 months	28.2%	32.0%
1-2 years	13.2%	-
3-4 years	2.3%	-
5 + years	5.1%	

Technology Transfers from Aerospace

Continuing the evaluation of aerospace manpower's fulfilling the skills needed, a further examination of their technological capabilities is needed.

> If a major national ocean program with high employment develops, how can we gear up quickly? Present programs can be expanded---they were planned with such expansion in mind. But it would be two years before the first augmented block of graduates emerged from the pipeline. In the interim,

vacancies would be filled by transferees from other related specialities such as aerospace. 65

The basic disciplines' successful transferability has previously been discussed, but there also exist specialities and technology that are particular to aerospace but applicable to oceanography. The premiere application is the 'Oceanography from Space Program'. By basically infra-red photography and technical analysis of the photographs, aerospace scientists and engineers have provided oceanographers with data about the oceans from a broad view. Examples of such data include sea surface temperature and currents, sea states, marine biology indicators, sea ice, navigational positioning, and pollution. 66 Aerospace people would find possible openings.

Available literature on this technology transfer has been published by the Office of Technology Utilization, National Aeronautical and Space Administration, Washington, D.C. and the Stanford's Research Institute publication, A Preliminary Analysis of Inter-Specialty Mobility of Technical Professional Manpower Resources. Such publications are useful in utilizing the technologies developed by aerospace and beneficial to oceanography.

Conclusions

By analyzing the unemployed aerospace manpower by five criterions, their ability to satisfy particular manpower requirements in oceanography could be determined. Those who satisfy the employment requirements in oceanography would be employed as follows:

A. Bachelor's with Civil or Mechanical Engineering Degrees
   1. For "Design, Operations, Production, Testing, Construction, and Sales" segment which employs 49.8% of the ocean engineering work force.
   2. Predominantly commercial operations.
   3. The larger 30% of the oceanographic firms.

B. Master's or Ph.D.'s with Civil or Mechanical Engineering Degrees.
   1. Predominantly "Research and Development" segment which employs 30.5% of the ocean engineering work force.
   2. Government projects as well as commercial.
   3. The smaller firms (61%) that are involved in feasibility studies, R&D, and consulting.

C. Degree holders of other disciplines
   1. Opportunities of limited amount based on the oceanographic need for either peripheral engineers or technical augmenters.
   2. Commercial projects or governmental.

Chapter VI

WHAT ARE THE EMPLOYMENT DESIRES OF THE AEROSPACE MANPOWER?

Although it has been shown that employment opportunities do exist for the aerospace manpower, their employment preferences also need to be considered. Do they seek interim or long term employment, do they desire to return to aerospace, what will their salary demands be, and when will they want to retire? The answers to these questions will clarify their employment preferences.

Employment Desires

The determining of the unemployed's preference for returning to aerospace would best show their willingness to transfer to another industry. To reiterate the aerospace statistics presented in Chapter I to the question, Do you still desire to return to aerospace industry?"

Yes	41.1%
No	50.4%
No answer given	8.7%

To the question, "Would you prefer another job in your respective field, but in another industry?", the following responses were made:

Yes	83.4%
No	7.6%
No answer given	8.7%

These statistics concerning the preference to aerospace might best be rationalized as a reflection of the employee's ego. It is well-known that government contract and aerospace work do not guarantee job stability, but in being laid-off, two blows were dealt: The employees' professional pride was hurt when they felt that their skills were no longer needed, and their personal pride was debased before their family and friends. A return to this same industry that struck these blows would subject them to the same liabilities.

The 50.4% who declared no desire to return to aerospace reflected this resentful man. The 41.1% who declared a desire to return to aerospace could be labelled the aerospace enthusiasts, men with heavy responsibilities in need of a job, or those not resentful.

The next question breaks these prefererces down even more. The 83.4% that desired another industry, represert not only the 50.4% that had no desire to return (from the above question) but also 33% that would return to aerospace but preferred a non-aerospace job. The following conclusions could be made to show the preference or lack of, to aerospace:

50.4% Will not return, and desire another industry
33.0% Will return, but would prefer another industry
7.6% Want to return, and would not prefer another industry
8.7% No answer given

Thus, the unemployed aerospace workers indicate a strong willingness to transfer to another industry rather than returning to aerospace.

Salary Demands

The salaries earned by the unemployed aerospace workers were listed as follows.

	Salaries Earned of Unemployed Aerospace
Under $10,000	5.9%
$10 - $15,000	39.7%
$15 - $20,000	36.3%
$20 - $25,000	15.2%
$25 - $30,000	1.0%

76% of the respondents were earning $10,000 - $20,000 per year; with this knowledge, an analysis of their v-luntary salary reductions can be made. The responces plus the effect upon the median $15,000 salary would be as follows:

Voluntary Salary Reductions
of Unemployed Aerospace

% Reductions	Responses	New Salary
None	12.7%	$15,000
5%	7.0%	$14,250
10%	27.3%	$13,500
15%	9.3%	$12,750
20%	17.5%	$12,000
25%	13.2%	$11,250
30%	4.5%	$10,500

The mode (27.3%) in this case were willing to accept a 10% reduction in salary, while the median were willing to accept 15%. These ratios remained constant for those not requesting to return to aerospace and those not employed only in the past six months. In comparison to oceanography, these new salaries would be comparable or below the median salaries in oceanogrphy as presented in Chapter III. This fact would provide a competitive advantage for the unemployed aerospace manpower in seeking employment in oceanography.

Age to Retirement

75.4% of the respondents were 39 + years of age, and their responses concerning their desired retirement age were as follows:

Preferred Retirement Age
of Unemployed Aerospace

Age	Responses
50 - 55	3.7%
56 - 60	9.0%
61 - 65	37.5%
66 - 70	28.2%
70 +	19.7%

Both the median and the mode was 61 - 65 years of age. If such statistics are representative of the total industry, this would mean these aerospace workers desire a considerable number of years until retirement; thus, many years remaining of a useful life in their profession.

Location and Mobility

In California, the distribution of unemployed aerospace workers would be dependent upon the locations of the various aerspace companies. As a reference to these companies, the following table presents the geographical distributions. 67

Concentrated Aerospace Areas

	Aerospace Employment (000)	% of U.S. Total
Los Angeles	140.8	10.8%
San Jose	71.5	5.5%
San Diego	36.6	2.8%
Anaheim-Santa Ana-Garden Grove	15.6	1.2%

Thus, there exists a heavy concentration of aerospace employment in the Southern California area, 14.8% of the national total.

Of the surveyed aerospace E&S's, 66.8% owned their residence while 31.3% rented their residence. Those owning homes would have less mobility, especially out of concentratec areas such as Los Angeles or San Jose, if an exodus of aerospace workers occurred in the pursuit of new employment. Those renting their residence would have considerably greater mobility.

The intangible statistics concerning the personal factors inhibiting mobility are not available. Such factors would include uprooting children from schools and friends/relatives. The mobility of an individual could easily be dependent upon these personal factors.

Conclusions

The unemployed aerospace workers indicate a strong willingness to transfer to another industry rather than returning to aerospace. Their willingness of voluntary salary reductions would bring them well within range of oceanographic salaries. They seek long term employment, but they have somewhat limited mobility out of concentrated aerospace areas.

Chapter VII

THE RECEPTIVITY OF THE OCEANOGRAPHIC EMPLOYERS TOWARDS THE UNEMPLOYED AEROSPACE MANPOWER

The final question to be considered evaluates the oceanographic employer's receptivity to the unemployed aerospace manpower. This section should not be interpreted as a conclusion to the paper, for this section's purpose is to determine the oceanographic employer's opinions towards the re-employment difficulties that the aerospace manpower is experiencing. From my survey of 43 oceanographic firms in California, the following responses were made to the question, "In your opinion, how receptive would your company be to employing aerospace manpower in oceanography operations?"

Oceanographic Receptivity
to Unemployed Aerospace

Very Receptive	9.3%
Receptive	32.6%
Undecided	20.9%
Not Receptive	23.3%
Definitely Not Receptive	2.3%
No Answer Given	11.6%

There are many conclusions that could be drawn from these responses.

1. The encouraging 41.9% that were either "Receptive" or "Very Receptive" represented those who are aware of the aerospace manpower's transferability.

2. These same 41.9% did not agree with the bias involved in the re-employment difficulties of the aerospace manpower.

3. Those that replied "Undecided" (20.9%), "Not Receptive" (23.3%), or "No Answer Given" (11.6%) might have stated this because of an unawareness of the aerospace manpower's transferability or because they agreed with some of the bias against the aerospace manpower.

4. The only "Definitely Not Receptive" was from a skin diving equipment manufacturing firm with no need of an engineer or scientist.

A final encouraging note from this survey is that, of the scientific personnel employed, only 60% had a formal advanced degree in a Marine Science. This means that 40% of the private industry's scientific and engineering personnel do not possess a formal Marine Science degree.

Conclusions

The aerospace industry, the largest employer in the nation, has had a serious decline in sales which has created a massive unemployment force for the past three years. To best describe the decline of aerospace employment, one must investigate the individuals involved. To give the startling magnitude of the situation, these individuals must be expressed in terms of thousands. While considering these thousands of individuals, one must remember that each individual represents a proven human resource currently idle from any productivity.

With no real opportunities for re-employment by the aerospace firms, these workers have sought employment in other industries. No one industry or national goal can assume their ranks; furthermore, their search comes at a period of trying economic times causing few job openings. To compound the situation, prejudices exist towards the ex-aerospace worker as far as employment in non-aerospace industries. Chapter I presented these prejudices and showed that they were either totally unjustified or only partially justified. Thus, the employment of these unemployed aerospace workers in another industry requires not only finding room, but also the eradicating or qualifying of the prejudices towards these workers.

Oceanography represents a developing science and industry with a seemingly similar demand for technical manpower. Currently in an infant stage, oceanography represents a source of man's food and mineral resources, transportation, military use, and recreation. Although retarded from growth because of various reasons, oceanography with an encouragement from the federal government and attraction by private industry appears to be headed for development and potentiality. This study has attempted to analyze the manpower situation in oceanography and the feasibility of introducing aerospace manpower to aid in oceanography's development.

The rationale of this paper sought to answer five basic questions in order to determine the feasibility of employing aerospace manpower in oceanography. The answer to the question, "What and where is the market for oceanographic employment?" stated that the current supply adequately satisfied the demand for manpower. Furthermore, a potential supply from the basic disciplines were available. Although private industry represented a third ranking 11% of the manpower demand, it also represented the largest area for growth. Thus, in terms of numbers, no real surplus of jobs currently exist in oceanography, but this fact does not necessarily preclude aerospace manpower from oceanographic employment.

To the question, "What are the educational and working qualifications for employment in oceanography?", the answer revealed that oceanography was an interdisciplinary field and that each discipline has its own standards for employment. In all disciplines involved, degree level and Marine Science application were the two criterion established to determine the functional responsibilities that an individual could handle. Whether or not a scientist or engineer had an application to marine science determined his role as an independent or team worker. His degree level determined the functional responsibilities that he would work on. The exact requirements for each discipline were presented on page 38. The answer to this question pointed out that engineers from the basic disciplines, of both bachelor's and higher levels, were needed in oceanography.

The heart of this feasibility study was in the answer to, "Can aerospace manpower satisfy these requirements?". Those that would best satisfy these requirements on the basis of degree level, discipline studied, and working experience would be the Civil and Mechanical engineers with a Bachelor's, Master's or Ph.D. degree. What about the rest? Those with a Bachelor's degree or higher and of another discipline would have limited opportunities as peripheral engineers or technical augmenters depending upon the need by oceanography. For those 27% without a minimum of a Bachelor's degree, their opportunities would exist as research assistants and technicians.

To the question, "What are the employment desires of the aerospace manpower?", the answer presented no complications to transferring. The unemployed aerospace manpower expressed a preference to transfer to another industry and a willingness to voluntary salary reductions to meet competitive standards.

Finally, the oceanographic industry expressed a definite receptivity to this unemployed aerospace manpower. Although 25.6%

stated an oposition, a presentation of the foregoing facts might reduce this percentage considerably.

Although the preceeding conclusions are not as encouraging and inclusive as I might have hoped, this study has accomplished two important tasks. One, it has delineated the requirements for manpower in oceanography. Second, it has presented meaningful data for the re-employment of aerospace workers to not only oceanography, but also other industries. I feel that the knowledge presented will not only aid in the development of oceanography, but also aid in the utilization again of this human resource and technology.

FOOTNOTES

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INDUSTRY MANPOWER STUDY

This questionnaire has been prepared to assess the educational and working qualification of oceanographic manpower in comparison with the educational and working qualification of aerospace manpower. This survey is to be used in my Directed Research Study (University of Southern California, School of Business Administration) entitled "The Feasibility of Employing Aerospace Manpower in Oceanography."
I would appreciate its return as soon as possible in order to give time to computer program this survey.

In appreciation of your co-operation in filling out this questionnaire, and in an effort to see this study be more than just another academic study, I would like to offer a free copy of this study when it is completed in June, 1971. If you wish a copy please check below.
( ) Yes ( ) No

Once again, thank you very much. Byron Washom
2668 Magnolia St.
Los Angeles, California 90007
(213) 749-9528
(213) 746-2668

1. Name of Company: ______________________
   Person completing this questionnaire: ______________________
   Position with the firm: ______________________

2. Types of ocean oriented activities your firm is engaged in: Please Check

TECHNICAL
( ) Boat & ship repair
( ) Data Processing
( ) Offshore Mining
( ) Underwater Photography
( ) Underwater Surveys
( ) Service (sales) Industry

PROFESSIONAL SERVICES
( ) Computer Programming
( ) Math Models
( ) Ocean Engineering Consultants
( ) Ocean Engineering & Design
( ) Oceanographic Consultants
( ) Oceanographic Studies

PRODUCTION
( ) Acoustic Instruments
( ) Buoys
( ) Cables & Connectors
( ) Desalinization
( ) Food Products
( ) Navigational Positioning
( ) Oceanographic Instrumentation
( ) Radio Communications
( ) Ships & Boats
( ) Survival Equipment
( ) U/W Communications Eqiup.
( ) U/W Photography
( ) U/W Power Supplies

3. Number of oceanographic employees: ________________.
   Of this number, what is the approximate percentage engaged in each of the following activities?

Administrative	________%
Clerical	________
Scientific	
Oceanographer	________
Fisheries Scientist	________
Ocean Engineer	________
Ocean Specialist	________
Technical	
Ocean Technican	________
Marine Aide	________

4. Of your scientific personnel, approximately what percentage have a formal advance degree in a Marine Science? ________%

5. What are your company's qualification requirements to the following:
   Please Circle

	Education	Education	Education	Yrs. Experience	Yrs. Experience	Yrs. Experience
a. Oceanographer						
Biology	BS	MS	PhD	0	1-3	4-6
Chemistry	BS	MS	PhD	0	1-3	4-6
Physics	BS	MS	PhD	0	1-3	4-6
Geology	BS	MS	PhD	0	1-3	4-6
Geophysics	BS	MS	PhD	0	1-3	4-6
Fisheries Scientist						
Marine Biology	BS	MS	PhD	0	1-3	4-6
Zoology	BS	MS	PhD	0	1-3	4-6
Ocean Engineer						
Electrical	BS	MS	PhD	0	1-3	4-6
Mechanical	BS	MS	PhD	0	1-3	4-6
Chemical	BS	MS	PhD	0	1-3	4-6
Sanitary	BS	MS	PhD	0	1-3	4-6
Enviromental	BS	MS	PhD	0	1-3	4-6
Industrial	BS	MS	PhD	0	1-3	4-6
Civil	BS	MS	PhD	0	1-3	4-6
Ocean Specialist	BS	MS	PhD	0	1-3	4-6

6. What is the size of your company in terms of Sales Volume for 1970? $________

7. Approximately, what percent of this is derieved from oceanic operations? ______%

8. What has been your growth factor for oceanographic operations for the past three years? ________% What is your projected growth factor for the next three years? ________%

9. What percentage of your funds are derieved from:

The Federal Government

Dept. of Defense	______%
Dept. of Interior	______%
N.S.F.	______%
Dept. of Commerce	______%
Dept. of Transportation	______%
Dept. of State	______%
A.E.C.	______%
H.E.W.	______%
Agency for International Development	______%
Smithsonian Institute	______%
N.A.S.A.	______%
State Govt.	______%
County Govt.	______%
City Govt.	______%
Petroleum Industry	______%
Construction & Engineering Industry	______%
Public Utilities	______%
Loans	______%
Corporate	
Stock	______%
Retained Earnings	______%
Bonds	______%

10. How available are funds to you?
( ) Easily Available ( ) Available ( ) Not Sure ( ) Difficult ( ) Very Difficult

11. Would you be in favor of an agency designed to secure funds for your company and California Institutions?
( ) Definitely ( ) Probably ( ) Not Sure ( ) Probably Not ( ) Definitely Not

12. Do you agree that a "rule of thumb of $50,000 of funds or revenue is needed to support one oceanographic personnel" is accurate? This amount includes salary, overhead, technical support personnel, and some operating costs such as research.
( ) Yes ( ) No If not, what is your estimate? $______.

13. In your opinion, how receptive would your company be to employing retrained aerospace manpower in oceanography operations?
( ) Very receptive ( ) Receptive ( ) Undecided ( ) Not Receptive ( ) Definitely Not receptive.

AEROSPACE MANPOWER SURVEY

This questionnaire has been prepared to assess the number and characteristics of aerospace manpower in California. This survey is to be used in my Directed Research Study (University of Southern California, School of Business Administration) entitled "The Feasibility of Employing Aerospace Manpower in Oceanography." I would appreciate its return as soon as possible in order to give time to computer program this survey.

So that this feasibility study does not become just another academic paper, I plan to distribute copies of its findings to California political leaders, the oceanographic industry, Experience Unlimited, and other interested organizations. Your co-operation in completing this questionnaire is very essential in enabling the sample size to be complete and accurate.

Byron Washom
2668 Magnolia Street
Los Angeles, California 90007

1. What are your personal qualifications?
   Educational major: (Electrical Engineering, Accounting, etc.)
   ______________________ BS MS PhD (Please Circle)
   ______________________ BS MS PhD
   Working Experience in these respective fields: Years Experience
   ______________________ 1-3 4-6 7-10 10-15 16+
   ______________________ 1-3 4-6 7-10 10-15 16+

2. When were you last employed in this field(s) mentioned above? (Please Check)
   ( ) 1-6 mos. ( ) 7-12 mos. ( ) 1-2 yrs. ( ) 3-4 yrs. ( ) 5 + yrs.

3. Do you still desire to return to aerospace industry? ( ) Yes ( ) No. Would you prefer another job in your respective field, but in another industry? ( ) Yes ( ) NO.

4. What is your current age? ( ) 22-27 yrs. ( ) 28-32 yrs. ( ) 33-38 yrs. ( ) 39-44 yrs.
   ( ) 45-50 yrs. ( ) 50 + yrs.

5. At what age in your life do you think that you will retire?
   ( ) 50 -55 yrs. ( ) 56-60 yrs. ( ) 61-65 yrs. ( ) 66-70 yrs. ( ) 70 + yrs.

6. To which one of the following cities do you most closely reside?
   ( ) Oakland ( ) Ventura ( ) Glendora ( ) Van Nuys ( ) Burbank ( ) Los Angeles
   ( ) Long Beach ( ) Anaheim ( ) San Clemente ( ) San Diego

7. Do you currently ( ) own or ( ) rent your home?

8. If you were to find a new job in your respective field in another industry, what salary cut would you be willing to take? Assuming that these cuts were to meet competitive salaries of that industry. ( ) None ( ) 5% ( ) 10% ( ) 15% ( ) 20% ( ) 25%
   ( ) 30% ( ) 35% ( ) 40% ( ) 45% ( ) 50% ( ) + 50%

9. What was your last salary range while employed in aerospace? ( ) Under $10,000
   ( ) $10,000-$15,000 ( ) $15,000-$20,000 ( ) $20,000-$25,000
   ( ) $25,000-$30,000 ( ) + $30,000.

USES OF THE OCEAN'S RESOURCES

Compiled by Stuart Davis

I. Extraction Resource Use

A. Regenerative Resources

1. Living Resources

a. Seafood Fisheries (fin-fish and shell-fish)

1) Pelagic Fisheries (tuna, shrimp)

a) Migratory Fisheries (tuna, albacore)

b) Non-migratory Fisheries (mackerel, anchovy)

i. Seasonal Fisheries (squid)

ii. Non-seasonal Fisheries (mackerel)

2) Demersal Fisheries (bottom-fishes)

a) Seasonal Fisheries (halibut)

b) Non-seasonal Fisheries (lingcod, rockfish)

3) Benthic Fisheries (clams, crabs, lobster)

b. Other Uses for Living Resources

1) Extracted chemicals

a) Shellfish (lime)

b) Algae (kelp)

c) Drugs from the Sea

2) Ornaments, Decorations

B. Non-regenerative Resources

1. Minerals and Chemicals

a. Bedrock Deposits or Vein Deposits (beneath the sediments)

b. Surficial Deposits (sediments and other deposits on bedrock)

1) Placer Deposits

a) Sand

b) Heavy metals

2) Sediments (fossil fuels)

3) Chemical Precipitates

a) Nodules (manganese)

b) Layers (phosphorite)

c) Concretions (corals)

c. Metaliferous Brines and Muds (e.g., Red Sea Hot Brines)

II. Non-extraction Resource Use

a. Maritime Use

1. Navigation

a. Commercial Use of the Sea Lanes

1) Internation Commerce

2) Commerce in Support of the U.S. Government Overseas

3) Intra-national and Coastal Commerce

b. Military Uses

1) Zones Restricted for Military Use

a) Military Reservations

b) Operating Areas

2) Safety Zones

a) Testing Areas

b) Dumping Zones (e.g., ordance, classified material).

c. Private-Boating and Other Uses

1) Private Boating in Sea Lanes

2) Safety or Special Use Zones

a) Skin or SCUBA Diving Parks

b) Restricted Areas for Sailing or Water-Skiing

2. Ports and Marinas

a. Marine Structures (breakwaters, piers, wharves,)

b. Support Facilities

1) Warehousing

2) Transportation Facilities on Land

3) Tourist and Residential Accomodations

B. Recreation

1. Boating, Water-Skiing

2. Sport Fishing

3. Swimming, Surfing

4. Skin and SCUBA Diving

5. Beaches

6. Shoreside Walks and Drives

7. Shoreside and Pier-Warf Improvements

a. Parking

b. Shopping areas

c. Accomodations

C. Public Utilities

1. Power Generation

a. Site Location for Fossil Fuel and Nuclear Fuel Plants

b. Geothermal and Hydrodynamic Power Generation

2. Desalination
    a. Site Location
    b. Nuclear, Flash, or Reverse Osmosis Process Selection
3. Waste Disposal
    a. Municipal Sewage (human and household wastes)
    b. Industrial Wastes
        1) Those in the Sewage System
        2) Bulk Solid Wastes
    c. Agricultural Wastes
    d. Secondary Waste Disposal through Land-Runoff
    e. Thermal Discharge

D. Other Uses

1. Basic Research
    a. Research Vessels and Marine Structures
    b. Zones for Scientific Uses Only
    c. Research Laboratory Location
2. New Exposed Surfaces
    a. Artificial Reefs, Islands, and Landfills
    b. Exposed Structures and Platforms for Industrial, Residential, or Public (e.g., transportation terminus) Use
3. Non-Use
    a. Wilderness Areas
    b. Preserves for Plants and Animals
    c. Preserves as National Reserves of Minerals