THE U.S. fleet of four space shuttles will provide primary access to the incomparable frontier of outer space, offering virtually limitless potential. Technology engendered by the space shuttle has far-reaching implications for bolstering our troubled domestic economy (Greene and Miesing 1984) and for securing worldwide U.S. prominence in high technology space commercialization. But along with arduous technicalities of successfully launching and landing shuttle craft, NASA must grapple with a multifaceted marketing question: What market exchange mechanisms are needed to allocate optimally the economic and social benefits derived from shuttle operations? This article identifies the key marketing issues of ownership and control over allocation of shuttle resources, pricing, and other procedures affecting that allocation, and adequate promotion (or lack thereof) required to provide widespread appreciation of possible benefits to potential users. With such identification as its primary objective, the issues are discussed in the context of their interactive nature, including why they require explicit, sagacious examination to at least maintain our present posture in an increasingly competitive world marketplace and to ensure equitable and optimal allocation of benefits (social, economic, and security/defense) from shuttle operations. Without effective decisions by government, the full realization of the shuttles’ potential will be significantly diminished.

Figure 1 provides examples in specific industries of socially and economically beneficial uses of technology, supported or actualized by space shuttles. In agriculture, for instance, information from satellites economically launched by a shuttle craft can serve to increase food productivity. That increase will help to alleviate worldwide food shortages, as well as increase the efficiency within that industry and enhance the international competitive position of U.S. agriculture. As an example of economically and socially beneficial outer space research already begun, McDonnell Douglas Corporation and the Ortho Pharmaceuticals Division of Johnson and Johnson have experimented jointly in space to determine if medicines, such as interferon, can be produced much more efficiently than on earth. Certainly military tactical and defense operations can benefit tremendously from less
FIGURE 1
Examples of Space Shuttle Applications*

Agriculture—Sensor systems in space can help solve world food problems. Sensors can identify crops in each field, tell the vigor and probable yield of those crops, and determine plant diseases of insect infestation.

Communications—Communications satellites have made intercontinental television possible and are reducing the costs of transoceanic telephone calls. Costs are decreasing again as the reusable shuttles take new improved satellites into orbit.

Environment—Satellites can send weather information to Earth, survey land use patterns, track air pollution and identify its source, monitor air quality, and locate oil slicks. What would take years to monitor by air can be monitored from space in a few days.

Mineral Resources—Potentially large mineral deposits have been identified in many parts of the world as a result of Skylab photographs. Advanced satellites launched from space shuttles are expected to make more valuable mineral discoveries.

Oceanography—By mapping ocean surface temperatures, Earth resources satellites will help oceanographers understand current patterns. This, in turn, will enable experts to predict the movements of schools of fish. Ice movements in the ocean can also be tracked from space.

Petroleum Resources—Photographs of the Earth taken from space have already supported explorations of oil and natural gas around the world. The improved satellites of the space shuttle era will be able to locate new sources of fossil fuels.

Scientific Studies—The shuttle is capable of taking into Earth orbit completely equipped scientific laboratories manned by scientists and technicians. In the weightless environment of space, researchers can perform tasks that cannot be accomplished within Earth’s gravitational field.

Timber—Shuttle launched satellites can help conserve forest resources, especially in remote areas, by discovering fires, by detecting tree diseases and infestations of pests, and by providing accurate inventories of timberlands.

*for additional information and detail, see Space: A Resource for Earth (1977).

Background

Essentially we view our federal government as a regulator of marketing activities. Its role is one of sens-

ing the need for intervention into the marketplace, developing and enacting legislation designed to enhance society’s well-being, managing the economy through monetary and fiscal policies, enforcing and interpreting laws and regulations, and—in a more abstract sense—encouraging a climate conducive to social responsibility. However, situations arise in which the government places itself in a very different role in its relationship to marketing activities. NASA’s space shuttle exemplifies one significant divergence from the federal government’s usual role; rather than being a regulator of market activities or a purchaser of goods and services, it has become a seller and promoter of technology and innovation.¹

This expanded role goes beyond simply offering assistance with technology and innovation. From a global marketing perspective, our government is cast into the role of stimulating domestic industry in order to fare well against international competition. Government must be more than purely a regulator through adjustment of trade barriers, especially because the mores of other countries permit subsidies and other inducements to domestic enterprises to enhance their countries’ international competitive positions. A brief overview of technological policies of four countries follows, providing perspective on the necessity for a more concerted and well-conceived U.S. government policy of aggressive stimulation of technology.

J. Herbert Hollomon and members of the Center for Policy Alternatives at M.I.T. (1979) stress:

Governments in all modern industrialized countries work to promote and shape technological development. Each has apparently concluded that the free action of the market is not sufficient to achieve the desired long-term goals of technological strength and independence (p. 30).

While many of our federal government programs affect technological innovation, most are not specifically designed to do so and have been developed independently of one another. As a result of this independent development, many programs reflect conflicting societal goals and a lack of coordinated encouragement of technological development. Based on analyses of U.S. government programs affecting innovation, prepared at the request of the Congressional Office of Technology Assessment, the Center for Policy Alternatives concluded “there is no major, across-the-board support for basic civilian technology” (Hollomon et al. 1979, p. 32).

Examination of technology policies from other industrialized countries of the world can furnish perspectives and ideas to emulate or to avoid. The Appendix offers specific examples from Japan, Great

¹See Hertzfeld (1980) for a discussion of some of NASA’s objectives.
Britain, France, and West Germany. Based on Hollman's work, discussion of the general nature of those policies in each country follows.

Japanese government policy supports the development and use of technology that has economic and industrial growth potential. Inefficient, low technology industries perceived as ineffective in international competition are not protected and are allowed to fade away. This applies to both large and small enterprises, with strong policy support of technology and business infrastructure for the latter.

Commercialization of technology has been the aspect of technological support receiving primary emphasis from Japanese public policy. The Japanese government has provided relatively little direct funding of research and development, but instead attempts to establish an environment that is especially conducive to industry's own commercial development of technology. Government tolerance and even encouragement of immense Japanese trading companies, such as the Sogo Shosha, attest to an environment markedly different from our own.

British government policy primarily supports basic research and development, with noteworthy contributions in areas of defense, space, and nuclear energy. Such technological support occurs essentially on the supply side, with the government making most key decisions about which technologies will be developed. Market demand for the products of research and problems of commercialization receive little attention.

With poor labor force relations, low worker mobility, and strong worker resistance to change, the British have not followed a strong human resources policy of preparing technical personnel for particular industrial needs or for technological change. However, the British government has applied its own resources and those of universities to expand the country's supply of basic scientific and technical manpower. Consistent with its supply-side emphasis on non-industry-specific, basic research, private sector technological support by government has been restricted essentially to fostering industry-wide associations, which have tended to encourage only incremental improvements in mature industries.

Strong, centralized governmental direction and control in France primarily supports civilian technology, such as nuclear energy, computers, and aircraft. To gain industrial and technological independence for France, the government provides vast subsidies—often to competitively weak industries—in order to ensure a domestic supplier in every important industry. However, stimulation of innovation has had mixed results from that policy, probably due to the political goal of domestic independence rather than receiving motivation from the civilian market.

More so than Great Britain, French technological policy considers economic growth potential. Building more internationally competitive, powerful firms through encouragement of company mergers, French policy also includes upgrading its technological base to support that competitiveness. Furthermore, the French stress participation by industry in human resource technological training.

Somewhat like Japan's stalwart industry-government-banking partnership, West Germany enjoys a great degree of cooperation among industry, government, and universities to cultivate innovation. Unlike France, however, Germany concentrates on using market forces to stimulate technological research. The German government typically offers aid only if market success seems likely, as opposed to France's criterion of gaining technological independence through heavy government regulation and control.

Minimizing research and development costs to private enterprises and encouraging large, technically based corporations characterize German policy toward technology. In the sense that such a policy influences the environment for technological innovation, it can be compared to Japanese policy. Future international research might focus on and compare the extent to which different governments' assistance to technological research is consumer-oriented and the degree of its relationship to the countries' economic trends and business stability.

The common thread of a marketing orientation, in the sense of strong attention to consumer/market wants and needs, pervades most of those government policies toward technology, notably those of West Germany and Japan. Specific policies attend to the price of technological research through special loans, grants, and tax incentives. Consumer research is actually undertaken by some governments and is strongly encouraged by others through support of only those technologies which indicate likely market success, especially in the international arena. Furthermore, promotion is employed by most governments to actively advance technological innovation, directly through government-sponsored programs, and indirectly through support of university and industry technological training.

Compared to the United States, the rise in international industrial and marketing prominence of Japan, Germany, and other countries has not been an overnight occurrence. Our nation's expenditures for research and development as a percent of gross national product declined to 2.2% in 1978 from 3% in 1964 (Time 1979). The United States' rate of increased productivity has steadily dwindled from an average of 3.2% increase per year during 1947–1966, to 2.1% average annual increase during 1966–1973, and finally to 0.8% during 1973–1979 (Bowen 1979). Such alarming trends bespeak the necessity for in-
novation and improved technology in the U.S.
Risk aversion associated with the perceived risk of R&D investment with unpredictable pay-offs has been exacerbated by the current economic downturn. That condition, coupled with the particularly innovative nature of R&D activities in outer space, attests to the need for strong encouragement from government of such activities by the private sector. If the societal benefits deriving from the resources and technology of space are to be realized in an expeditious manner, and the U.S. is to regain its industrial and marketing momentum internationally, our government must take bold and effective action in marketing space-shuttle opportunities.

Specific Marketing Related Decisions
To the excitement of people throughout the world, in April 1981 NASA successfully launched its first space shuttle to an altitude of 173 miles above the earth, maneuvered the craft through a series of 36 upside down orbits at 17,500 miles per hour, and flawlessly landed it at a speed of 200 miles per hour two and one-quarter days later. The space agency’s plans call for four shuttle orbiters making 44 flights through September 1985, averaging two payloads per flight. But 31 of those payloads will place communications satellites for 10 commercial customers. With the military also extensively using shuttle craft for defense purposes, precious few flights will be devoted to development and commercialization of technological breakthroughs.

Charged with administering shuttle operations, NASA’s Office of Space Transportation Systems Utilization engages in developing user policies, pricing flights, negotiating launch agreements, and scheduling payloads. A marketing orientation appears necessary for that office’s deliberations in light of the many marketing related issues involved. More specifically, since demand for shuttle usage is expected to exceed scheduled flight capacity, a “demarketing” (Kotler and Levy 1971) approach, designed to discourage some potential usage, may be appropriate. But another approach emerges as necessary for fundamental decisions involving massive commitments of public funds and pervasive effects on competition, our economy, and society in general. The approach is called equimarketing.

Equimarketing is an orientation or a philosophy of ensuring an equitable opportunity for all potential users to avail themselves of basic, desired goods and services. The entire spectrum of marketing activities should reflect a fair allocation method for time, place, form, and possession utilities deriving from basic, need-satisfying goods and services. Equimarketing includes the recognition that marketing is not appropriate as a charitable or philanthropic function. Operating within an essentially competitive environment, marketing could not serve long run organizational interests if charity were a precept.

But like businesses in general, marketing exists because of society. Marketing’s dependence upon and interaction with society result in an obligation to operate within bounds considered fair by that society. Simply putting a sugar coating on marketing’s social responsibility opens the field to censorship and to intervention by government. Providing access to goods and services that is equitable (but not necessarily equal) to all of society, especially for basic goods and services that directly developed from public funds, emerges as a fair and necessary social responsibility.

Various specific marketing decisions affect equity of access to need-satisfying goods and services. One such decision, pricing, exemplifies for some organizations an equimarketing orientation. Certain “necessities,” such as utility companies offering “life-line” rates for base-level heating or communication needs, pharmacies with senior citizen discounts, and medical services on a what-you-can-afford basis, demonstrate flexible pricing in light of unequal income distribution. In contrast to such necessities, quantity discounts for heavy users, transportation expenses paid by a manufacturer to attract distant customers, and reduced prices for children to appeal to families, represent price adjustments based on sound marketing principles, not charity to the “disadvantaged” customers involved. The federal government, too, engages in equimarketing through its program of Small Business Administration loans designed to permit small enterprises, especially disadvantaged minorities, access to needed capital for investment.

Flexible pricing, which can permit more equitable access to resources, has precedents in many diverse circumstances, not just for basic necessities. Accordingly, even though few would consider space-shuttle resources to be necessities, potentially great societal benefits to be derived from those resources, coupled with recognition that public funds supported the shuttle’s development, argue for flexible pricing that is equitable for all who have underwritten it. Further, as developed below, other marketing decisions in addi-
tion to pricing should reflect an equimarketing approach.

Certainly military usage as it affects the public interest must receive equitable consideration, too. This paper provides no complete solution to attaining consensus among the many special interest groups who represent potential users. However, numerous significant perspectives and alternatives, including a board of governors representing divergent value bases, are discussed.

In order to optimize societal (social psychological, economic, and military/security benefits, pricing, and other marketing related shuttle decisions must encourage all possible organizations to embrace space shuttle opportunities. Rather than omitting certain parties through their lack of appreciation of outer space potentials (elimination by omission) or through other barriers to access, allocation decisions about limited shuttle resources should be overt and equitable.

Social Audits

Determining an optimal allocation method for equitably gaining access to space-shuttle resources involves some of the same challenges facing businesses attempting social audits of their operations, but on a grander scale. A social audit is basically a systematic study and evaluation of an organization’s social performance, used for planning and for reporting to its managers and its stockholders. Kreps and Wright (1940) first forwarded the notion of a social audit, later elaborated upon by Bowen (1953). However, it did not become popular until more recent social demands were made on corporations (Bauer and Fenn 1972).

The very nature of societal (economic as well as social psychological) impacts of space technology point toward social auditing as a useful but as yet incompletely developed tool. Halal (1980) distinguishes between various current approaches to corporate social reporting on the basis of a dichotomy between quantitative versus qualitative types of information and on the basis of increasingly sophisticated states of development in information systems. While prescribing that social reporting should proceed in the direction of both qualitative and quantitative information, Halal points out that state-of-the-art quantitative types of information systems are inadequate for rigorous, total system, social accounting. Many issues confronting corporate management attempting to assess societal impact from its operations, especially techniques for quantifying into common units of measurement various social costs, benefits, resources, and other intangible factors, become even more perplexing when applied to alternative allocation methods for the pervasive benefits of space technology. But because of their universal impact and the need for an equimarketing approach, those many intangible factors warrant the perspective of an extensive social audit.

A detailed examination of possible techniques for measuring those factors related to space technology should be the subject of further research. Under the topics of shuttle service ownership and pricing below, we consider the more fundamental issues of what the basic goal for space technology should be, and who has proper knowledge and perspective to best define, rank, and operationalize specific goals. Those issues are likely to generate heated debate before final decisions are made. Guidance from a social auditing procedure, including appreciation of challenges to its use and of the different values which decision makers may hold, will ensure a more comprehensive and thereby more equitable consideration of space technology impacts on society.

The American Institute of Certified Public Accountants’ Committee on Social Measurement points out a number of challenges when applying social audits to the public sector, several of which have direct bearing on marketing the space shuttle. For one, specifics of government programs tend to be left unclear deliberately for political reasons, thus inhibiting accurate measurement and prediction of social benefits. Second, some programs are derived by multiple influences and affect multiple audiences which rarely agree on the purpose or intent of the programs, again causing measurement and prediction problems when goals and direction are not clear. Finally, public sector managers trained in financial control simply do not have the requisite skills to measure the impact of these programs on society. In short, “there will always be important technical, economic, ethical, and political problems that limit what can be achieved” (Committee on Social Measurement 1977, p. 178).

Those technical, economical, ethical, and political problems stem from their respective value bases, which in turn are germane to the marketing of space technology. For instance, individuals possessing technical values deal with facts, science, and logic. NASA is comprised primarily of scientists and engineers who tend to prefer such a rational decision-making approach over more intuitive styles. Therefore, these technocrats seem ill-suited to judge alone the abstract social benefits arising from shuttle usage. A social audit would at least encourage NASA decision makers to consider broad public impacts of space technology. Furthermore, if others who possess different values.

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4A selected bibliography of books dealing with social accounting can be found in Preston (1980, p. 241).

5For a discussion of managerial skills essential to different “modes” of technological innovation, see Horwitch and Prahalad (1976).
participate in the audit and decision making, a more balanced, equitable result will ensue.

_Economic values_ attempt to evaluate trade-offs of alternative decisions by measuring their costs and benefits. However, quantifying the social worth of goods and services is extremely difficult. Also, efficient market exchange mechanisms theoretically can allocate economic benefits in an optimal manner, but the sum total of economic benefits may not add up to a desirable _social_ policy which strives to achieve social equity.

_Ethical/social values_ attempt to satisfy group or organizational needs by considering what is morally right or just in terms of ethical, societal principles. Besides the aforementioned barriers to considering and measuring social, psychological, or aesthetic needs, organizations typically do not reward or otherwise reinforce such types of behavior. A social audit might help remedy this deficiency by assessing leadership in nonfinancial or nonquantitative terms, so that quality-of-life issues can be considered. Furthermore, having representatives from diverse segments of society involved in the audit and ultimate shuttle usage allocation decision will increase the likelihood of an optimal and equitable method.

_Political values_ allow for consideration of general welfare needs within the rules of social systems. NASA’s predicament is that, on one hand, it perceives its responsibilities akin to those of a public utility that must fully utilize the space shuttle capacity. Yet, the agency also wishes to remain faithful to its original charter (and constituents) by retaining its role as strictly a space based scientific researcher. Since one of the most difficult tasks is to identify and rank constituents’ concerns, expectations, and benefits, a social audit would help ensure accountability to NASA’s many stakeholders. It seems irresponsible not to utilize progress that research into social audits has produced for addressing the pronounced, long-term, and pervasive effects of space technology commercialization.

Unlike many other nonprofit organizations where declining demand has stimulated concern over building and matching demand to supply capabilities,6 NASA faces the task of determining who from among many interested parties will be selected for each shuttle voyage. That general question can be broken down into three major issues presented in Figure 2. Examination of each major issue follows, with allocation being directly discussed under _Pricing_, but with aspects of ownership and promotion discourses also pertaining to allocation. Policies emanating from decisions concerning those complex interactive issues will shape significantly the direction of our marketing environment as it inevitably will be affected by outer space technology and resources.

**Shuttle Service Ownership**

Should NASA’s space shuttle program remain a government controlled monopoly over a scarce, desirable resource with no direct substitutes? An analogy with the frequently reprehended U.S. Postal Service, presumably exemplifying ineffective government intrusion into the marketplace, opposes the alternative of government ownership. But a compelling reason favoring that alternative is to provide the possibility of recovering public funds, estimated at over $13 billion, invested in research and development of shuttle craft. Through pricing, promotional, and other operating policies, public ownership could ensure against unwarranted exclusion of any certain category of potential shuttle customers. However, that scenario appears unlikely, since current NASA plans call for that agency to abandon operations after several years of mass shuttle launchings (Covault 1978; Grey 1979, p. 160). Facing current budget cutbacks, NASA officials have indicated that they desire to return to the business of science as soon as possible.

Another alternative includes selling or leasing shuttle operations to a single contractor or a joint venture. Inciting interest among private companies in managing shuttle operations as a profitable venture should represent no problem now that main developmental costs have been incurred; Boeing has al-

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6For a recent discussion of marketing by nonprofit organizations, see Kotler (1979).
ready expressed such interest (Covault 1978). Advantages of this option include NASA’s opportunity to separate itself from operations, and American industry’s benefit from what some postulate as a more efficient space shuttle system. But beyond the obvious problem of determining equitable financial arrangements for the sale or lease, other disadvantages also exist.

Mainly, opponents feel reluctant about allowing one enterprise to become sole heir to this publicly-sponsored, high technology innovation. Our government, through taxpayers, has paid for shuttle craft development and has assumed all risks. But the public may never directly reap full financial rewards from taking such risks if the government sells or leases this potentially profitable venture. Another problem is deciding which federal agencies should have jurisdiction over shuttle operations (e.g., the FAA, Commerce, etc.), and what purview of policy decisions the operator would hold. While a single company or joint venture may simplify government regulation, permitting ownership of shuttle craft by several, independent enterprises or by various consortia might offer advantages through competition and a greater number of flights.

Establishment of a government corporation to direct shuttle operations represents a third alternative. Ideally, within several years that corporation would achieve financial self-sufficiency and show a positive return on investment, thereby alleviating the drain on taxpayers’ dollars. A board of governors for the corporation, representing different value bases and consisting of representatives from private industry, academia, NASA, and other government agencies, would lease space on shuttle craft. Technological advances developed by NASA would continue to be free to the public. Discoveries by a private user would remain that lessee’s property, while the government corporation would control spacecraft operations. The public who originally assumed shuttle development risks, directly receives this alternative’s principal advantage through immediate return on their investment from lessee fees. The primary disadvantage lies in putting government in business, albeit a noncompetitive industry.\(^5\)

\(^5\) While cost estimates vary, NASA recently calculated the total cost of its Space Transportation System at $13.591 billion in fiscal 1980 dollars (U.S. Congress 1980).

\(^6\) On a topic analogous to space technology transfer, Weber (1980) warns that medical research in biotechnology may be evolving into a competitive marketing environment in which the competition among profit motivated businesses inhibits free exchange of new medical discoveries and technology.

\(^7\) Although to date the authors know of no other efforts toward building a reusable spacecraft, some indirect competition exists from the European Space Agency’s Ariane rocket delivery system (Wall Street Journal 1980, p. 56, and 1981, p. 20) and possibly from the private sector (Business Week 1981). At $25–30 million per satellite launched, the European Space Agency hopes to capture one-fourth of the commercial satellite market (Time 1982a, p. 63). Time (1982b) reported the successful launch by Space Services Inc. of America which expects to place satellites into orbit for $5 million each.

A proposal allied to the third alternative creates a Space Industrialization Corporation (U.S. Congress 1979). In essence, that bill would establish a government owned bank designed to offer venture capital financing for commercial operations in space. Since money from conventional sources is available to only a few enterprises because of amounts and risks involved, the government could accept responsibility for further financial involvement to broaden access to the auspicious technology that outer space offers. However, the Space Industrialization Act of 1979 does not directly resolve issues of shuttle ownership and control, which themselves affect pricing and promotional policies of shuttle usage.

**Pricing of Shuttle Services**

What is the optimal allocation mechanism for a resource developed at public expense and offering such tremendous promise for so many facets of life? A gravity free environment presents previously unheard of opportunities in the fields of medicine, manufacturing, energy, and communications, to name a few specific areas of industry which can be affected. The price structure for shuttle usage, such as that of Figure 3, will play a major role in determining accessibility to the technological potential of outer space.

Compelling industrial research and production opportunities for space shuttle users, and an expected wide range of inelastic demand despite some possible competition, suggest a relatively high price. Additionally, a high price might provide quicker recovery of public funds used to finance shuttle development. But a single price policy may not be optimal nor will it equitably allocate this scarce resource.

In his discussion of price and distribution theory, Maxwell (1970) states:

> The fact that resources are scarce gives rise to the income received by the owners of resources, and this same scarcity means that only some of the consumer’s wants can be satisfied. Which wants will be satisfied depends upon the priority assigned to those wants by the consumer and upon the consumer’s income . . . (p. 19).

Because access to scarce resources necessitates not only consumer priority but also availability of sufficient funds, unequal funds distribution among consumers results in an unequal distribution of satisfaction; some consumers with high priority wants remain unsatisfied. This is especially acute when the desired re-
source has high and uniform pricing to all potential consumers. Some businesses with high priority needs for space shuttle usage and claiming possible great, societal benefits derived therefrom may have those needs remain unsatisfied due to high, uniform pricing.

Certain government interferences with free market equilibrium pricing characterize equity theory, designed to assist some deserving group or organizations considered disadvantaged relative to others who are “amply well-off” (Samuelson 1973). Those interferences result in economic and social psychological consequences. Balancing of trade-offs between those two sets of consequences should include long run considerations of effects on the overall economic system as well as more immediate effects on parties directly affected. This perspective inherently involves values. But such interferences should not simply reflect charity, as noted earlier concerning equimarketing in the private sector. Instead, they should regard what is in society’s best interest.

Because of the innovative and complex nature of outer space technology, it will be difficult to predict even short run economic and social psychological effects. For instance, smaller or relatively new businesses might become significantly more involved in research and technological development if permitted access to the space shuttle through flexible pricing. While NASA (or another government regulatory agency that may eventually be responsible for pricing shuttle usage) will recognize that extreme differentials in available funds exist among prospective users, and consequently may feel that equity demands a flexible or multiple price policy, standards for basing price differentials challenge their establishment. Theoretically, chosen standards would reflect a goal of maximizing society’s welfare. But in implementing specific standards no crystal ball exists—especially for a revolutionary technological facilitator like the shuttle—to predict which fields of research and production will benefit mankind the most. The field of health care might be expected logically to contribute most to the quality of life. But in numerous instances, research in other fields has contributed directly or indirectly through spinoffs toward satisfying societal needs (NASA 1981). Hence the question of who should determine the standards and bases for shuttle usage price differentials becomes crucial.

One example of how NASA officials dealt with the difficult issue of standards concerns the policy toward “nonscientific” users such as artists, poets, musicians, and moviemakers. After lengthy deliberation within the agency, NASA’s Public Affairs Office issued a press release stating that they had no plans to accommodate paying passengers (Garrett 1980). In this instance, technocrats were forced into making value decisions for which they were ill-prepared and indirectly they determined the nature of public benefits. Communications satellites were deemed to be of greater social importance than aesthetics (Miesing 1980).

**Shuttle Promotion**

Rather than being a government agency purchasing from a vendor, NASA has positioned itself as a seller. In such a role, marketing scholars may generally support promotion by governmental agencies, for information dissemination purposes and for building or modifying demand. Examples of the former purpose include Social Security and the Veteran’s Administration. The Postal Service, Amtrak, military services, and certain utilities exemplify the latter purposes for governmental promotion. Critics, on the other hand, can quickly point out that government should not engage in selling something for which no inherent

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**FIGURE 3**

**Expected Space Shuttle Price Schedule (1980 dollar values)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Price*</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small self-contained payload</td>
<td>$5–15,000</td>
<td>Incentive to fly</td>
</tr>
<tr>
<td>Exceptional program</td>
<td>$17 million</td>
<td>Marginal costs</td>
</tr>
<tr>
<td>Department of Defense</td>
<td>$12 million (reduced from $18 million)</td>
<td>National interest/defense and sharing of common facilities</td>
</tr>
<tr>
<td>U.S. government</td>
<td>$26 million</td>
<td>Average variable costs</td>
</tr>
<tr>
<td>Commercial</td>
<td>$31 million</td>
<td>Average total costs</td>
</tr>
</tbody>
</table>

*These estimated prices for full use of a flight were adapted from Smith, Krampf, and Jacobson (1978) and from NASA, OFM (1981). With the exception of the small self-contained payload, each individual user would actually pay a pro rata share of the capacity utilized. A NASA official recently stated that by 1985 “full operating costs” will be charged, estimating that commercial users would pay $90 million for full use of the cargo bay (Large 1982a). Experiments contained within 200-pound canisters will cost $10,000 per container (Wall Street Journal 1981a, p. 21), with small “getaway special” projects costing a minimum of $3,000 by sharing such a container (Large 1982b).
need exists, obviating the necessity for promotion other than simple press releases.

Notwithstanding such critical arguments, potential benefits derived from the space shuttle subsist in no obvious or preceded way, though indeed they appear to satisfy many societal needs. Thus, promotion beyond simple press releases appears essential. Technological breakthroughs made possible by a gravity-free environment or by extraterrestrial travel may never have been considered by organizations in numerous fields. Dr. Robert A. Frosh, former Administrator at NASA stated:

One fact that has become evident, throughout NASA's endeavors, is the necessity for positive innovative action on the agency's part to create awareness of the possibility of utilizing space technology and [to bring] the space flight opportunities available to the attention of industrial customers (U.S. Congress 1979, p. 60).

Effective informational tools are indispensable for providing equality of opportunity to organizations who never previously contemplated the type of technology made possible by the shuttle, but who might greatly augment the quality of human life.

With growing concern for our economy, evidence suggests technology's significant contribution to its health. Of related concern, however, looms the aforementioned national trend of reduced research and development expenditures, while government itself in some ways inhibits those expenditures (Chemical and Engineering News 1978, Gerstenfeld 1979). Toward its essential goal of enhancing society's well-being, government's responsibility entails stimulating innovation and attracting industrial development of applied science designed to achieve societal goals. Those responsibilities compel government to actively promote technological opportunities made possible by the space shuttle. The optimal extent of active promotional effort and what specific forms that effort should take, however, remain problematic.

While many government executives apparently appreciate to varying degrees the informational value of increasing awareness and of stimulating interest through advertising, as evidenced by mass media promotion of numerous governmental services, public officials surmise limited utility from personal selling of those services, other than military recruitment. However, shuttle services differ from other governmental services in the extent and singularity of applied science involved. For example, in the technologically advanced computer industry, mass promotion techniques cannot adequately inform potential users of specific applications of automatic data processing equipment to their organizations. Individual attention through personal selling to prospects with potential for benefiting from computer usage remains common-place and efficient in stimulating its effective use. For the further advanced and innovative technology of outer space, personal selling to individual organizations and to entire industries offering potential for achieving societal goals, emerges as a mandate for government to ensure optimal and equitable opportunity for that technology.

Critics claiming NASA suboptimally promotes itself and shuttle services (other than to Congress) suggest inducements such as tax incentives, loan guarantees, space patent and licensing laws, and general "encouragement" of major corporations to participate in space shuttle opportunities. Several departments within NASA currently engage in developing such incentives, including the Office of External Affairs, the Space Transportation Systems Utilization Office, and the Office of Space and Terrestrial Applications. Those departments consist chiefly of individuals possessing technical or legal backgrounds but having minimal marketing orientations. Although the departments enhance the attraction of exploring outer space technology, vigorous promotional strategies would provide the impetus to surmount selective information processing barriers applicable to industrial settings as well as to individual consumers.

Only if organizations consider extraterrestrial projects and perceive them as commercially feasible can they be expected to invest in the research and development of exploring space shuttle opportunities. Systems already exist within NASA, such as "Tech Briefs," Space Centers, a shared scholar program, seminars, and workshops, for disseminating information. Through aggressive promotion with an equi-marketing orientation, those systems and others can effectively communicate commercially feasible plans developed through collaboration of government and the scientific and business communities for utilizing space shuttle technology. Organizations that are not high technology based but might benefit greatly from a gravity-free environment could then assess the economic practicality of those or related plans.11

Along with effective communications, government, as a seller of shuttle services and with responsibility for stimulating technological innovation, must assist in the critical function of needs assessment. While industry can be expected to determine what customers want and what is commercially feasible, only through active investigation of commercial needs by our na-

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10For discussions of perceptual processes and of information processing, see, respectively, Berelson and Steiner (1964, p. 88) and Engel, Blackwell, and Kollat (1978, p. 25).

11Products such as wall coverings, enhanced pig production/pregnancies, food packaging, ski goggles, and guitars that are not generically thought of as involving high technology, demonstrate areas benefiting significantly from aerospace research and technology (NASA 1978).
tional space agency can the opportunities afforded by space travel be optimally and equitably available to all who could potentially benefit from it.

Because NASA currently lacks a vigorous commercial orientation, it has difficulty focusing upon and fully appreciating potential markets for space technology. In the short run, NASA-industry liaisons could fill this void. Aerospace companies already possessing a vested interest in the shuttle's success represent prime candidates for that role, though some conflict of interest might emerge. Along with investigating and personally selling applications of outer space technology to industries and organizations previously unaware of such possibilities for their own endeavors, joint ventures between the aerospace liaison's company and none aerospace firms could be encouraged. In the longer term, NASA must develop its own marketing expertise and promotional capabilities, a development consonant with government's responsibility for attracting industrial research and development of technology designed to realize societal goals. Accomplishing that necessitates a restructuring of NASA to assure coordinated marketing effort throughout the agency and an elevation of needs assessment to a sufficient level of priority.

Summary and Conclusions

Through NASA and its space shuttle program, our government has enabled technological opportunities of outer space to be commercially utilized. In so doing, government is discharging its responsibility for encouraging advancement of applied sciences for society's benefit. But a further obligation is entailed, that of ensuring equitable access to those opportunities for all who might benefit mankind through effective applications of that innovative technology.

To fulfill that additional responsibility, it is incumbent upon our national space agency to adopt a marketing orientation. Space travel policies and procedures which incorporate an equimarketing approach will provide fair allocation of that resource among potential users. Specific decisions pertaining to (1) ownership and control of the publicly-sponsored space shuttle, (2) regulation of space travel, (3) allocation method for access to shuttle resources, and (4) effectiveness of commercial needs assessment and of promotional information dissemination will extensively influence national and worldwide marketing systems, and in turn will profoundly affect U.S. international posture and many facets of all our lives.

Research findings from the field of social audits may help direct those bearing responsibility for these weighty decisions. But further research demands the development of (1) a comprehensive set of relevant factors which then must be individually weighted as to their effects on achieving societal goals; (2) methods of measuring qualitative and quantitative information pertaining to those societal effects; and (3) a procedure whereby responsible public officials can apply that information to optimize societal benefits from space travel opportunities.

The potential is immense, but so is the responsibility for ensuring equitable allocation of space shuttle resources.

Appendix

Specific Technology Policies and Programs of Various Governments

Japan

- strong support of technical education, providing highly skilled human resources for industry.
- provident direction of the industrial base, providing protection only to technologically advanced firms and industries prepared to effectively compete internationally, thereby furthering export trade.
- exclusion from support of technologically weak companies.
- primary emphasis on consumer oriented technologies, rather than support of basic research and development, "big science," and national prestige projects.
- mandatory licensing of technologies attaining dominant market positions, thereby precluding technology monopolies by Japanese firms.
- direct government supports for industry, e.g., analyses of export markets and of available foreign technologies, tax credits and deductions for industrial R&D, and accelerated depreciation for research, development, and pilot plant facilities.

Great Britain

- moderate partnership with industry in the National Research and Development Corporation, a relatively successful public corporation supporting innovation by paying development costs of promising innovations, by licensing public sector technologies, and by entering into joint ventures with private companies.

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12Information in this appendix was adapted from Holloman et al. (1979).
support primarily of government designated projects through the Launching Aid Program, attempting to reduce commercial risk facing manufacturers of new products and processes by offering interest free loans to a developer.

- encouragement of industry to utilize advanced manufacturing equipment, by government purchasing equipment from manufacturers and lending it to selected industrial users who have an option to buy it after a trial period.

**France**

- objective of at least one domestic supplier in every important industry, often requiring large government subsidies to weak industries.
- encouragement of company mergers into stronger national entities to compete more effectively internationally.
- support for critical area “concerted action programs,” with committees for coordinating research.
- backing of “thematic action programs,” coordinating interdisciplinary applied research among laboratories typically involved with basic research.
- assistance to research organizations for pre-developmental investigation of new technologies.

- support of the National Agency for the Valorization of Research to help researchers, inventors, and small firms develop innovations.
- loans to meet development costs of private firms.
- direct tax incentives, e.g., income tax deductions for all R&D operating expenses, accelerated depreciation of R&D facilities, tax deductions by new organizations for R&D facilities, and payroll tax for worker retraining programs.

**West Germany**

- major support of an extensive network of research institutes, ranging from basic to applied industry oriented research.
- heavy emphasis on “big science” and “key technology” programs with the latter focused on industrial innovation and offering government cost sharing with industry.
- interest free, forgivable loans covering 50% of the cost of commercial development of promising new technologies; if the effort fails, the loan is cancelled.
- guarantees to an independent consortium of banks supplying venture capital, with the consortium buying equity shares in new companies undertaking innovative projects.

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