CONTRACT R&D: THE EFFECTS OF BUSINESS POLICIES AND MARKETING METHODS ON OBTAINING NEW BUSINESS

by

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ABSTRACT

An investigation was performed to understand the key success factors involved in obtaining new contract R&D business. In particular, 95 R&D proposals written by the managers and technical staff of a large contract R&D organization were investigated to determine (1) how contract R&D is marketed, (2) which factors are crucial to the successful procurement of a contract, and (3) how the characteristics of the resulting contracts vary from one type of customer to another. Contract R&D work with four different types of customers was investigated: government defense customers, government nondefense customers, private industry - defense subcontracting customers, and private industry - directly funded R&D customers.

With respect to contract R&D marketing it was found that in established business areas the initiative for an R&D effort was as likely to be made by the sponsor as by the contract R&D organization, the proposal success rate was independent of which party took the initiative, and follow-on efforts had a slightly higher but statistically insignificant proposal success rate than non-follow-on efforts. It was also found that the two most common methods by which R&D efforts with potential sponsors were identified were through previous work with the sponsor and third party referrals.

The three policy-unrelated factors which were most highly correlated with the success or failure of a contract proposal were found to be: (1) the commitment of the client's management to the project, (2) political factors within the client's organization and (3) competition from other firms. With respect to operating policies it was found that (1) a noncompetitive policy significantly inhibits the contract procurement success of both government defense and nondefense work and (2) a patent policy which states that the contract R&D organization retains all titles to patents developed in the course of an R&D effort significantly inhibits the contract procurement success of industrial contracts.

Finally, with respect to contract characteristics it was found that the program size, program duration, and average annual budget were all larger for government defense work than for private industrial work. Also, no significant differences among the four different types of customers in terms of the percentage of research, development, design, documentation and testing performed could be found. Based upon these findings, strategies for contract R&D organizations are presented to increase their likelihood of obtaining R&D contracts from potential sponsors.

Thesis Supervisor: Dr. Edward B. Roberts
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1.1 Background

An organization that is interested in obtaining the knowledge received from research and development can obtain that knowledge by either performing the R&D internally or contracting the work out to another organization. In the United States alone in 1981 private industry paid approximately $32 billion for R&D [Business Week, 1982] and the federal government paid approximately $44 billion [Budget of the United States Government, 1981]. Of these expenditures the federal government contracted out about 70% of the R&D work that it performed while the remaining 30% was done in-house [Engineering Times, 1983]. For private industry most of the R&D was done in-house and that a smaller fraction of the work performed by industry was contracted out to another organization. Hence in 1981 contract R&D represented a significant U.S. industry with sales in excess of $30 billion.

This study is the result of an interest on the part of the author to understand more clearly the process of contract R&D marketing. To this end an investigation is performed of the R&D marketing experience of
an applied research and development firm. Through the use of the data obtained from the R&D firm, the three objectives of the study are to determine

(1) how contract R&D is marketed,

(2) which factors are crucial to the successful procurement of a contract, and

(3) how the characteristics of the resulting contracts vary from one customer type to another.

It is hoped that the results of this study will prove to be useful to those firms interested in understanding the contract R&D marketing process and formulating strategies for improving the effectiveness of their marketing efforts.

1.2 Description of the Process of R&D Marketing

The marketing of an R&D service is similar to the marketing of a new industrial good, in the sense that (1) the problem to be solved from the perspective of the buyer is new and different from anything which has arisen in the past and (2) the purchaser of the R&D service does not personally pay for and benefit from the R&D performed [Robinson, 1967]. The recognition of a need for an R&D effort may have been created by either an internal stimulus within the client's organization or an environmental factor outside the client's organization. An example of an internal stimulus is the recognition of a need for specialized research and development by an organization as it develops a new product. An example of an environmental factor is the economic disaster at Three Mile
Island which indicated to the Nuclear Regulatory Commission and the nation's utilities that a significant investment in R&D was needed to upgrade all of the U.S. nuclear power plant systems. Hence the marketing objectives of an R&D organization are to identify the need for R&D and to concurrently persuade the buying influences through the proper information that solutions suggested by the marketer represent the best possible alternatives to the problem.

Following the framework of Robinson, Farris, and Wind [Robinson, 1967] for industrial goods, there are eight activities which occur in the contract R&D procurement process:

1. Anticipation or Recognition of a Problem or Need
2. Determination of the Characteristics and Quantity of the Needed R&D
3. Description of the Characteristics and Quantity of the Needed R&D
4. Search for and Qualification of Potential Sources of the R&D Service
5. Acquisition and Analysis of Proposals
6. Evaluation of Offers, Selection of the Contractor, and Negotiation of the Terms of the Contract
7. Execution of the Work Statement
8. Feedback and Evaluation of the R&D Contractor's Performance Activities (1), (2), and (3), which involve the identification of the problem or need and the characterization of the required R&D, represent a crucial hurdle in the R&D marketing effort. As found by the
Project SAPPHO study [Achilladelis, 1971], an accurate understanding of user need was the factor which discriminated most strongly between commercially successful and unsuccessful industrial good innovation projects. Furthermore, as determined by Utterback [Utterback, 1974], approximately three out of four commercially successful industrial good innovation projects are initiated in response to a perception of user need for an innovation, rather than on the basis of a technological opportunity to achieve them. Finally, as von Hippel has pointed out [von Hippel, 1976], it is the user of the technology who most frequently identifies the need. The above observations frequently conflict with the situation desired by the contract R&D organization. In contrast with a "market pull" orientation, a contract R&D organization would rather have a "tech push" orientation. The prime reason for this orientation is that the R&D organization consists of technical personnel with highly specialized skills who are looking for work in a technical or professional area. This attitude has evolved because the technical staff have erected, through education and experience, a barrier to entry into a particular technical area. Hence, there is a strong desire on the part of the organization to try to obtain contract R&D work which utilizes this barrier rather than to obtain contract R&D work based on the identification of a user need. Overcoming this dilemma is a significant challenge to the management of a contract R&D organization because it means that the technical staff must be convinced of the importance of a "market orientation."
The next three activities, listed above, (4), (5), and (6), correspond to the contract procurement process. In this step the objectives of the contract R&D organization are to convince the potential client that (1) it has the technical capability to best solve the problem or need which has been identified and that (2) the terms of the agreement with respect to project cost, project duration, patent rights, and trade secrets are fair and equitable. It has been shown in other work [Pringle, 1965; Roberts, 1964; Berger, 1965; Roberts, 1965] that firms which exert a significant amount of effort prior to the proposal writing stage in trying to understand the needs of the client and convince the potential client that its organization can successfully address the client's problem are more successful than those firms which do no marketing prior to the proposal writing stage. This study tries to extend the results of these previous efforts by (1) presenting the methods by which the contract R&D organization convinces the potential client that it has the requisite technical capabilities and by (2) showing how the standard terms of agreement affect the success of contract procurement.

The final two activities listed above, (7) and (8), are also important to the overall marketing effort. The working relationship developed during the execution of the contract helps to create a rapport with the client. If the work is performed well and if new areas worthy of investigation are discovered, there is a good possibility that a follow-on effort may be contracted out to the R&D organization. This hypothesis is substantiated by others [Roberts, 1967] who have found that
the probability of obtaining a government contract is greater if it is a follow-on effort than if it is a new effort. The results of this study present the performance of the contract R&D firm studied in terms of the effect of previous work with the client on obtaining new work.

1.3 **Thesis Organization**

The order of the subject presentation corresponds to the order of the actual research process. Chapter 2 provides, initially, descriptions of the organization from which the contract R&D marketing data was obtained and the standard contract terms of agreement of the organization. The treatment next turns to a description of the contract proposals which were selected for study and the analytical methods used to analyze the data. Chapter 3 contains the analytical body of the thesis. The three parts of the chapter present, respectively, the study's findings on the commonly used marketing methods, the impact of various factors on contract procurement success, and the characteristics of the received contracts for the various customer types. Based upon the questionnaire results Chapter 4 outlines a strategic plan for improving the success of contract procurement through the appropriate business policies and marketing methods. It also summarizes important aspects of the study, comments on its relevance to various interested parties, and suggests related areas worthy of future investigation. Appendix A contains a listing of the questionnaire and a summary of the responses, and Appendix B summarizes the statistical methods used to analyze the data.
CHAPTER 2

RESEARCH METHODOLOGY

2.1 Description of the Studied Firm

The study investigated 95 R&D proposals which were written by the managers and technical staff of a large contract R&D organization. The proposals studied were chosen from a single organization so as to keep the technical capabilities of the organization constant and therefore to be able to determine the non-technical differences between successful and unsuccessful proposals. It should be noted here that according to the managers of the studied organization the majority of all of the marketing contracts resulted in proposals. Therefore, the sample of proposals chosen for study represented not just the proposal writing effort but the entire marketing effort of the organization.

The organization that was studied, heretofore called the DGS Corporation, is primarily engaged in the research, development, design, fabrication, and testing of prototype systems and instruments for government and industrial sponsors. DGS views itself as an applied R&D organization which serves to interface the basic research and development performed by universities with the production capabilities of private industry. It is a nonprofit corporation which employs over 1000
engineering and technical support people. Of these, about 48% are technical staff, of which more than half have master's degrees or doctorates.

As a nonprofit corporation DGS's operations are run so as to follow the letter and the spirit of the non-profit corporation laws which state that DGS cannot manufacture or sell in quantity. The organization's prime objective as stated in the charter is to "engage in activities that contribute to the support and advancement of scientific research, technology, and development and in educational activities in the sciences and allied subjects." [DGS, 1982] Since DGS does not have a proprietary product line and does no manufacturing, it claims to be able to serve as an unbiased developer of prototype systems because its hardware and software designs will not have an a priori bias. Thus it is claimed that DGS can focus on being objective and innovative in seeking optimal solutions for the client.

As a public service organization DGS has the general objective of transferring technology to the public or making it generally available. This entails the use of patent disclosures, formal reports, memoranda, and written papers to disseminate the technology developed by DGS. Since it is not DGS's function to manufacture in quantity, DGS generally grants limited term exclusive licenses to commercial organizations when such licenses will facilitate the bringing of an invention to the point of commercialization. The manner and timing of the commercialization are rigidly controlled by DGS in accordance with the contractual agreements between DGS and its sponsor organizations. These agreements are meant to
provide the sponsors the necessary control and time in which to implement their plans. Furthermore, in order to assure that an invention which is the result of a sponsored program is brought to the point of commercialization, DGS usually retains the title of the inventions and grants the sponsor a royalty-free license to use the invention. Additionally, at the sponsor's option DGS will grant a limited term limited field of use exclusive license if the sponsor shows to DGS a realistic plan for bringing the invention to the marketplace. The exclusive license usually includes a reasonable royalty payment to DGS with the royalty payment recognizing the sponsor's investment in the research.

With respect to publication DGS usually presents its work at national conferences or publishes the results of the work in refereed journals when the work performed is not classified by the Defense Department. It should be noted that the defense-related work implicitly satisfies the public service requirement laid down for nonprofits by the state in which DGS is incorporated and therefore this work need not be published in the open literature. Since publication is an important activity of DGS, the official publication policy is that in order for DGS to accept work with a potential sponsor that sponsor cannot deny the public access to data or results. Therefore, the only major protective mechanism DGS offers its industrial sponsors is lead time in obtaining know-how about the technology.

The contract R&D services of DGS are made available through unique qualification and directed unique qualification contracts. In essence,
then, DGS does not bid for contracts on a competitive basis nor does it attempt to compete directly with private industry. The contracts are usually written so that the work is paid for on a cost plus fixed fee basis rather than on a fixed price basis. In practice, though, the cost estimates generated in the contract proposal are usually adhered to rigidly and cost overruns occur infrequently. The fixed fee is put into a discretionary fund. This fund pays for (1) internal research and development work in technical areas chosen by the board of directors which appear to be fruitful areas for new business development, (2) new facilities to improve the technical base of the organization, and (3) proposal, planning, and travel efforts required to obtain new work.

2.2 Sample Selection

The initial task faced in this analysis was to develop a list of contract proposals from which to study the effects on procurement of the marketing effort and the corporation's policies. A total of 210 successful and unsuccessful contract proposals written in fiscal year 1982 (July 1, 1981, through June 30, 1982) were chosen for study. The proposals represented procurement efforts in seven technical areas:

- Precision Instruments
- Control Systems Development
- Fault-Tolerant (nonstop) Computing
- Industrial Automation
- Geophysical Science Technology
- Oceanographic Science Technology
- Energy Systems
The mix of proposals were chosen to be representative of both the relative number of proposals and revenue level in the corresponding technical areas.

2.3 **Interview and Questionnaire**

After having chosen the sample of contract proposals to be studied, a questionnaire was formulated to determine

1. The characteristics of the proposed efforts,
2. The marketing methods used to identify the opportunity for a potential contract, and
3. The impact of various factors on the success of the contract procurement and negotiation efforts.

The questions contained in the questionnaire were the result of personal interviews with the top management of DGS as well as its legal, technical, and planning staffs. These interviews helped to identify key issues which the various parties felt were crucial to the success of the contract procurement efforts.

The questionnaire, listed in Appendix A, was distributed to the program managers responsible for marketing the proposed efforts to potential sponsors. Of the 210 contract efforts which were selected for study, 95 were analyzed and returned by the managers. Discussion with DGS's management indicated that these responses were representative of the total sample of 210 proposals for all of the technical areas. The representativeness of the sample was assured during the data retrieval stage by aggressively soliciting responses to the questionnaire when it
became apparent that an insufficient number of responses were coming from a particular technical area.

2.4 Analytical Methods

After the questionnaires were returned, the data were analyzed to determine trends in marketing and success factors. The analysis was performed using the software package EXPRESS [Management Decision Systems, 1982]. A more detailed explanation of the methods used to analyze the data is provided in the following chapter and a summary of the statistical tests used are presented in Appendix B.

The potential customers to whom the proposals were targeted fell into four major categories:

- Government Defense (51 proposals)
- Government Nondefense (18 proposals)
- Private Industry - Government Defense Subcontract (8 proposals)
- Private Industry - Directly Funded R&D (18 proposals)

With this data base on the four different customer types, the differences in the marketing success factors among these customers were determined and are presented in the next chapter. Subsequent to the following chapter, an analysis is presented which suggests marketing strategies and corporate policies which would improve the success of the marketing efforts and minimize the policy conflicts with the potential customers.
CHAPTER 3

RESEARCH FINDINGS

3.1 Overview

Based upon the personal interviews of DGS's top management, the contract proposals were grouped into four categories for analysis: government defense, government nondefense, private industry - government defense subcontract, and private industry - directly funded R&D. These four categories represent customers with different objectives in terms of the payment for and use of research and development. Hence, it was hypothesized at the beginning of the study that one would observe differences in the marketing of R&D services to these four customer types. To provide a framework from which to understand the different markets it is hypothesized that:

(1) The prime objective of the U.S. government defense department in obtaining new knowledge from research and development is to improve the performance of existing weapons systems or to develop advanced concepts for new weapons systems. The limitations to budget allocations are based upon the governmental political process. The defense department is not trying to develop a proprietary product protected by
property rights and hence it liberally allows the organization performing the contract R&D to retain patent rights and to publish the results of unclassified work. Thus the property rights conflicts between the defense department and the particular contract R&D organization studied here are minimal.

(2) The prime objective of a U.S. government nondefense department's purchase of R&D knowledge is to obtain a public good such as pure or applied research knowledge which private industry would not be willing to pay for. Similar to the defense department, the limitations to budget allocations are based upon the governmental political process. As in the defense department work there are few property rights conflicts which occur between the contract R&D organization and the government nondefense department.

(3) The prime objective of a private firm that is performing defense work when it lets a subcontract for R&D is to obtain knowledge that cannot be obtained in-house due to the highly specialized nature of the problem. The firm does not significantly care about patent or publication rights since its contract with the defense department already limits the firm to a government exception on patents and publications. Since the private firm is not paying for the work directly, it is only indirectly concerned about the payment for work performed outside of the organization.
(4) The prime objective of a private firm when it contracts out research and developments efforts to another firm is to capture as much benefit per dollar as possible from that R&D work. The purpose of R&D for the private firm is to develop a product to increase revenues or to improve a process to reduce costs or improve quality. The R&D effort is not performed in-house because the technical capability does not exist and the firm does not wish to hire personnel on a permanent basis with the needed technical capabilities. Since the goal of private industry is to develop and maintain a strong proprietary position in a particular technical area through the expertise obtained from the R&D contract, the desire of the private firm is to obtain all property rights from the R&D firm and to prohibit any technical publications on the R&D effort. Furthermore, since the R&D expenditure is an expense, the goal of the funding organization is to minimize the payment and pass along the technical risk to the R&D firm by putting the proposed work up for bid and paying for the work on a fixed price basis.

Through the use of these four major hypotheses it was assumed that the R&D marketing methods would be the same but that the contract negotiation success factors and contract characteristics would be different for the different customer types. The results of the questionnaire presented below are structured to reflect these assumptions. The results are grouped into four categories. First,
summaries of the interviews with several members of DGS's management are
given to convey management's perception of the process of contract R&D
marketing and to illustrate the impact of various factors on the success
of contract procurement. Second, a summary is given of the findings of
the questionnaire survey on the historically used methods for making a
marketing contact. Third, a presentation is given of the questionnaire
findings on the impact of several factors on obtaining and negotiating a
contract once the marketing contact has been made. Finally, a summary is
given of the resultant contract characteristics and how they differ from
one customer type to another.

3.2 Management Interviews

The marketing and procurement of R&D contracts is not performed
totally independently by individuals but rather within an organizational
context which typically involves several levels of management and other
professional support staff. The responsibilities and contributions of
these people in the R&D contract marketing and procurement processes are
presented below, along with their perception of the factors which improve
the success in these processes. The managers interviewed are all in the
Manufacturing Automation Department of DGS Corporation. Interviews with
managers from this department were chosen primarily because the
department does contract R&D work for all four customer types and hence
the management in this department is best aware of how the contract R&D
marketing process varies among these different customer types.
Interviews with two professional support staff, the Director of Planning
and the Corporate Lawyer, are also presented. These interviews serve to bring to light some of the broader strategic and policy issues involved in R&D contract procurement process. Figure 3.1 illustrates the management structure of DGS Corporation and the organizational position of the interviewed individuals.

Department Head Interview

The department head at DGS Corporation is two levels below the president of the organization. He is responsible for managing a particular technical business area by controlling and reviewing the performance of the department's divisions. The department head's involvement in the marketing effort is primarily aimed at addressing managerial rather than technical issues. Direct contact with the higher nontechnical levels of the clients' management is quite common.

According to the department head, the major method used to obtain new business is through direct personal initiatives to potential clients. The broad needs of these potential clients are identified through articles in trade magazines, papers at conferences, and third party referrals. The managerial level at which the needs are identified was mentioned to be a major factor in the success of contract negotiations. In particular, it was cited that needs have to be identified at the client managerial level at which the fund allocation decisions are made. According to the department head, once the client's needs have been identified, the next step is to "get into the plant and then just be a good listener."
Figure 3.1. Management Structure of DGS Corporation
It was pointed out that being a good listener in the Manufacturing Automation area was especially important because it was claimed that most of the industrial automation clients "do not know what research is all about." This lack of understanding was felt to provide a barrier to the performance of any research and development work during the first contract with a new client. Therefore a tactic used to get a foot in the door with a prospective client was to be initially hired as a consultant to work on problems related to industrial automation software and cost analysis. The marketing of these types of efforts would be tailored towards the accountants and financiers who were expecting the consulting effort to show a rapid return on investment. From the sponsor's perspective the initial work serves to answer a specific set of technical problems while from DGS's perspective the work provides an opportunity to develop an insider's view of the real problems which DGS could address in a much larger and longer term program. One example of the success of such a tactic is a recent program for a large automobile manufacturer which started as a half-man-year project. This effort eventually developed into a long term follow-on contract funded at a level of 9 man-years per year. The reason for the success of this tactic as mentioned by the department head is that it is not uncommon for the clients to be unable to articulate or unaware of the existence of their problems. Hence the personnel of the R&D organization must work within the client's organization on the details of the client's industrial automation system to be able to identify these problems and areas for potential work. In addition to having direct exposure to the client's
problems it was also felt that the continual communication with the client during this initial phase is also instrumental in increasing the possibility of a follow-on effort because of its importance in building DGS's credibility and rapport with the sponsor. Where it was possible the department head encouraged the creation of office space in or near the client's buildings to improve the communication process.

In addition to the direct marketing of the contract R&D work the patent, publication, and non-competitive policies of DGS were also felt by the department head to strongly affect the success of obtaining contracts. The publishing policies were claimed to cause start-up difficulties with private companies. However, in some respects, publishing was felt to be essential to DGS's advertising and its ability to attract and retain staff. The non-competitive posture of DGS was not felt to be a significant problem with private industry provided that DGS truly had the unique capabilities that would make it useless for a potential client to bid a project. With respect to government work, however, it was felt that the non-competitive posture severely affects the ability of DGS to obtain new contracts. Finally, with respect to patent ownership the department head felt that the present policy limited DGS's ability to obtain industrial contract work and that it had no effect on government contracts.

Section Chief Interview

The section chief at DGS is a first-level manager who is in charge of a group within a specialty area of the division. The section chief
commonly writes proposals with members of his section and is responsible for the proper execution of the contract once obtained. During the R&D program the majority of the contacts with the client are made between the section chief and the sponsor's technical leader. It is at this level and below that the specific technical needs are identified when working with the sponsor.

The interview with the section chief centered specifically on how particular R&D efforts were identified by DGS. It is important to note that in DGS's case the need identification process is more difficult because it does not respond to RFPs from either government or industrial sponsors due to its noncompetitive posture. A request for proposal is the most common way in which potential sponsors announce their R&D needs. To illustrate the way in which DGS gets around this problem, three examples were given by the section chief.

The first example described how DGS received its initial contract in industrial automation from the National Science Foundation. In this case the NSF approached DGS Corporation to perform basic research on robotics. DGS was chosen for the study because of its experience in instrumentation and control theory. Thus the Corporation's reputation and experience were very important in the success of the contract procurement effort.

In the second example it was mentioned that DGS had identified a need within a major robot manufacturer through an article published in an industrial automation trade journal. In this case the section chief responsible for the technical area that could address the need of the
manufacturer made a phone call to the president of the company and presented a broad outline of a solution to the particular problem. This "cold call" in conjunction with subsequent discussions resulted in a multiyear research and development contract for DGS.

In the third example DGS's management had identified a major development program that was being funded by one of the armed services. The identification was made through a third party referral to DGS as it was investigating possible work with the armed service in question.

In summary, the section chief stressed that the need identification was made in one of three ways.

(1) impersonal means such as technical papers and trade magazine articles
(2) personal direct contact
(3) third person referrals

A detailed presentation of DGS's marketing experience and the frequency of these means of need identification are presented in the next section.

Director of Planning Interview

In DGS Corporation, the main responsibility of the director of planning is to provide a strategic framework for upper management to aid them in their decisions with respect to entering or exiting a particular business area. The planning director has the authority to allocate discretionary funds for internal research and development, bid and proposal, and planning and travel efforts. The director also serves to
monitor both the financial performance and the contract proposal success rate in each business area. Poor performance in an area is sufficient reason to withhold discretionary funds for further efforts in that area. Conversely, if the board of directors in conjunction with top management decide that a particular area will be fruitful for business opportunities the planning director can increase the allocation so as to build a new business base.

The discussion with the director of planning included both the effect of marketing and nonmarketing factors on obtaining new business. With respect to marketing it was mentioned that in a contract R&D firm the predominantly technical background of the personnel in the firm creates a culture which believes that better technology will sell itself. This "tech-push ideal" which is present in a contract R&D firm raises the question of the strength and effectiveness of the marketing effort. Furthermore, it implies that the technologists may not be the proper people to do the marketing since they may not be in tune with market needs. In addition it was also mentioned that marketing contacts through technical papers, trade journal articles, and conferences are not an effective primary marketing tool, but rather their main purpose is to attract and keep highly qualified technologists at DGS. The most effective marketing method according to the director of planning was one-on-one personal contact with the client where a dynamic interchange of DGS's technical strengths and the client's technical needs could be presented.
The discussion of nonmarketing factors centered on (1) the competition DGS faces from other firms, (2) DGS's business policies, and (3) DGS's standard contractual terms of agreement. The major policies of DGS which cause conflicts with potential clients are the patent rights, publication rights, noncompetitive posture, and nonprofit status policies. It was mentioned by the director of planning that the degree of these conflicts varies widely among the different customer types. In particular, the patent and publication rights policies were not felt to create significant conflicts in government sponsored programs but they were felt to have a tremendous negative impact on private industry-funded programs. Conversely, though, the noncompetitive policy of DGS was felt to be a continual impediment to the procurement of new government work and not very important in industrial work. With respect to other factors, the director of planning was skeptical about the effectiveness of internal research and development (IR&D) efforts on obtaining new business. Rather the IR&D efforts were believed to be frequently used within DGS as a means of keeping technical people gainfully employed between contracts.

**Legal Counsel Interview**

The legal counsel's main responsibility is to work out the terms of the contractual agreements between DGS and the potential clients. The opinions of the legal counsel with respect to contract procurement are important because the continual interaction of the counsel with these possible sponsors provides him with an overview of the key factors which increase the likelihood of a successful contract procurement.
The legal counsel provided brief descriptions of the negotiation efforts for a wide range of contract proposals. In summary, it was felt that the chance of a successful negotiation is high if "you get the right guy to negotiate with." This person is the one "who can say yes, who signs the document, or who gives the okay." Furthermore, it was mentioned that in a successful contract negotiation there "must be a give and take of information between the organizations so that it is clear to all concerned that the bargaining is occurring in good faith." These comments indicate that the legal negotiations can be the linchpin in successful contract procurements. This is especially true for negotiations with industrial sponsors because the negotiated settlement outlines the intellectual property rights of the parties involved. The experience of the legal counsel indicated that it was quite common for property rights to become a more important issue in the negotiation process than the technical needs of the potential sponsor. As one manager of a potential client organization put it: "lawyers can be notorious at protecting yourself out of business." Therefore it is seen that a strong commitment to the R&D project by the potential sponsor is important to overcoming the legal obstacles which may occur during the contract negotiations.

It is reasonable to assume that all industrial sponsors want intellectual property rights; however, this raises the question as to why some negotiations are successful and others are not. The experience of the legal counsel has been that the negotiations which are the roughest are the ones where there is a direct interest on the part of the sponsor
to commercialize the technology. The more successful negotiations were felt to be the ones where the work was either more research oriented or process improvement oriented. In both these instances the possibility of a patentable device is smaller. In addition to patents, most firms are usually interested in limiting publications. According to DGS's lawyer, successful agreements usually contain a clause which specifies that DGS will delay publication for a specified period of time after completion of the project to allow the sponsor time to develop a lead time advantage over the competition. It is seen that the property rights issue creates a unique dilemma for a contract R&D organization when it tries to obtain work from private industry. On the one hand, the work that the organization performs for industrial sponsors must be useful enough so that industry will be willing to pay for the contract R&D effort. On the other hand, it can't be too directly applicable to the marketplace because property rights issues will prevent the organization from reaching a negotiated settlement with a potential client. It was felt by the legal counsel to be unlikely that a contract R&D organization could resolve this dilemma if it insists on having restrictive property rights policies which eliminate the incentive of industrial sponsors to contract out for R&D services.

3.3 Questionnaire Findings on Marketing Methods

This section deals with the findings of the questionnaire on the methods used by DGS to market its R&D services. Hypotheses relevant to the questionnaire data along with statistical tests of the validity of
the hypotheses are given. The following analyses are based upon the 95 responses to the contract proposal questionnaire submitted to the management of DGS Corporation.

Which organization makes the contact

According to recent studies on the innovation in scientific instruments [von Hippel, 1976] it was found that the user was dominant in identifying needs and innovating new developments. Hence the user in this study would be expected to initiate many of the contacts for R&D work with DGS Corporation. As seen in Table 3.1, the potential sponsor was found to make contact with DGS Corporation about potential work as frequently as DGS was found would make the contact with the sponsor. Six of the responses indicated that it was impossible to determine which party took the initiative since DGS and the client were in continual contact throughout a previous effort.

Since a sponsor-initiated contact was most likely the result of a user-identified need, it was hypothesized that those proposal efforts which were initiated by the sponsor would have a greater chance of success. As seen from the $\chi^2$ tests, however, no statistically significant difference was found in the success rate between DGS-initiated proposals and non-DGS-initiated proposals. Thus the location where a need or solution to a need is identified and the probability of proposal success don't seem to be related. This implies that the other hurdles to be overcome such as the definition of the work statement and the legal terms of the agreement override the importance of which party is the contract proposal initiator.
Table 3.1 Question 1: Did DGS contact the sponsor or did the sponsor contact DGS about a possible R&D contract?

<table>
<thead>
<tr>
<th></th>
<th>Response</th>
<th>% of total responses</th>
<th>$\chi^2$</th>
<th>Significance Level</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DGS made the contact</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successful procurement</td>
<td>29</td>
<td>30.5</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Unsuccessful procurement</td>
<td>14</td>
<td>14.7</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Sponsor made the contact</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successful procurement</td>
<td>30</td>
<td>31.6</td>
<td></td>
<td>0.0989</td>
<td>5%</td>
</tr>
<tr>
<td>Unsuccessful procurement</td>
<td>16</td>
<td>16.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unable to tell (write in response)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successful procurement</td>
<td>6</td>
<td>6.3</td>
<td></td>
<td>3.0</td>
<td>5%</td>
</tr>
<tr>
<td>Unsuccessful procurement</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>95</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The relative success rate of follow on contract proposals as compared to initial proposals

According to several studies [Roberts, 1967; Pringle, 1965], proposals for follow-on work are more successful than proposals for the first time work with a sponsor. In essence, a follow on contract is analogous to a straight or modified rebuy. A straight rebuy is the most common in industrial purchasing where the client considers only the same solutions that it considered the last time the requirements arose. The alternatives of the client are considered to be both known and unchanged and hence no new evaluation of the alternative solution is considered necessary. In a modified rebuy a new evaluation is made by the client of the buying alternatives. The modified rebuy does not infer that the client will in fact change the source of the service, it just infers that the alternatives are being reevaluated. In both types of rebuys there is a higher probability that the firm working on the next project or phase of a project will be the same as the firm which worked on the previous effort [Robinson, 1976]. It was hypothesized that proposals which were follow-ons to previous efforts would have a higher success rate than those proposals which were not related to a follow-on effort.

The results, given in Table 3.2, indicate that there is a slight but statistically insignificant increase in the probability that a contract proposal will successfully result in a contract when the proposed effort is a follow-on. Thus it is seen that although the development of a working relationship with a client may enable the R&D organization to identify new problem areas to be investigated for the
Table 3.2. Question 7: Is this contract a follow-on effort to a previous contract?

<table>
<thead>
<tr>
<th>Follow-on effort</th>
<th>Successful procurement</th>
<th>Unsuccessful procurement</th>
<th>Unsuccessful procurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>Success Rate</td>
<td>$x^2$</td>
<td>Significance Level</td>
</tr>
<tr>
<td>Successful</td>
<td>22</td>
<td>22/29 = 75.9%</td>
<td>0.05</td>
</tr>
<tr>
<td>Not a follow-on</td>
<td>7</td>
<td>43/66 = 65.1%</td>
<td></td>
</tr>
<tr>
<td>effort</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
sponsor, the possibility that the sponsor will have money to fund the project, or that the contract negotiation efforts will be successful is approximately the same as it was for the initial contract.

The methods by which R&D marketing is performed

Contract R&D marketing is different from standard industrial product and service marketing in the sense that what is being sold is never the same from one "sale" to the next. In this sense contract R&D is more similar to a consulting business. As in consulting there are three main reasons why clients turn to a contract R&D firm:

- The problem requires expertise or capabilities that don't exist in the client's own organization.
- The problem is very large or of short duration and the client wants to avoid the problem of quickly assembling and then disassembling a project team from within the organization.
- An objective, "outside" perspective is required [Booz, Allen, and Hamilton, 1983].

From the perspective of the R&D firm, its objective, so as to remain in business, is to identify the needs of those firms which are willing to pay for and contract out for R&D services for one of the above three reasons.

The traditional methods used to market industrial goods and services are:

- Sales calls
- Direct mailings
• Brochures
• Samples
• Trade magazine advertising
• Trade shows

Of these, only a modified version of a sales call, brochures, and perhaps trade magazine advertising are relevant to contract R&D marketing. In addition other methods not common to industrial marketing such as:

• professional conferences, and
• journal and magazine articles

are used by contract R&D firms to provide visibility to the organization about its capabilities and expertise. These methods may not necessarily be effective, however, since there is a strong possibility that they will not reach the individuals that have the authority to allocate funds for a research program.

In the formulation of the questionnaire for this study eight channels for marketing which embodied both personal and impersonal means of problem identification were investigated. The impersonal marketing and problem identification methods were:

• Information from an RFP (request for proposal) or RFQ (request for quote)
• Journal or magazine article

and the personal methods were:

• Information from a staff member
• Information from upper management
• Information from a former employee
- Contacts generated at a conference
- Information from previous efforts with a client
- Other means of problem identification
- Information from other clients

Table 3.3 summarizes the results of the questionnaire for the 95 contract proposal replies. Caution should be used when interpreting the results since more than one method may have been used for a particular proposal. It is seen that previous efforts with the client represented the most common means of identifying work with a client. Surprisingly, "other means of identification" is seen to be the next most frequent means of identification. Closer scrutiny of the questionnaires indicated that this most frequently meant a third party referral or formal announcement about the need for an R&D effort. In summary, the most common type of marketing method was through direct or indirect (third party) personal contact. All of the impersonal means of contact, i.e., some form of publication, only accounted for about 8% of the contacts made with potential sponsors.

If only those contract proposals are considered which are not either follow-ons nor are related to any previous efforts with a client, i.e., proposals to a new client, a different picture emerges. As seen in Table 3.4, the dominant means of marketing was through "other means" which in this case means third party referrals. Thus it is seen that to obtain new work which is neither the result of an RFP nor previous work with a client, the contract R&D organization must have a high level of visibility in the technical area that corresponds to the sponsor's need
Table 3.3. Questions 3 and 5: How did DGS find out about potential work with the sponsor; how did the sponsor find out about DGS?

<table>
<thead>
<tr>
<th></th>
<th>DGS made the contact</th>
<th>Sponsor made the contact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Successful proposal</td>
<td>Unsuccessful proposal</td>
</tr>
<tr>
<td>Information from an RFP</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Newspaper, magazine or trade journal article</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>DGS staff member referral</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>DGS top management referral</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Former DGS employee or coop students</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Conferences</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Previous efforts with DGS</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>Name obtained from other DGS clients</td>
<td>Not applicable</td>
<td>3</td>
</tr>
<tr>
<td>Other means of identification</td>
<td>14</td>
<td>11</td>
</tr>
</tbody>
</table>

Note: Frequencies of occurrence measured here are for all 95 contract proposals.
Table 3.4. Frequency of occurrence of various marketing contacts for 36 non-follow-on contract R&D efforts.

<table>
<thead>
<tr>
<th></th>
<th>DGS made the contact</th>
<th>Sponsor made the contact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Successful proposal</td>
<td>Unsuccessful proposal</td>
</tr>
<tr>
<td>Information from an RFP</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Newspaper, magazine or trade journal article</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>DGS staff member referral</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DGS top management referral</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Former DGS employee or coop student</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Conferences</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Name obtained from other DGS clients</td>
<td>Not applicable</td>
<td>1</td>
</tr>
<tr>
<td>Other means of identification</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>
so as to generate third party referrals. This indicates that efforts by a contract R&D organization to enter a new business area may quite likely be unsuccessful because it will not have the rate of third party referrals or sponsor-generated contacts to keep a sufficient amount of R&D work coming into the organization in that technical area.

3.4 Questionnaire Findings on the Effect of Policy-unrelated Factors on Contract Proposal Success

Overview of the Findings

Question 8 of the questionnaire asked the managers of DGS to indicate on a -4 to 4 scale the effect a predetermined list of factors had on the success of the contract marketing and negotiation efforts. It was found that the following four policy-unrelated factors were the most strongly correlated with the successful procurement of a contract:

- The commitment of the client's management to the project (correlation with success = 0.467, better than 1% level of significance)
- Political factors within the client's organization (correlation with success = 0.374, better than 1% level of significance)
- Competition from other firms (correlation with success = 0.308, better than 1% level of significance)
- The competence of the customer's technical person who evaluated the proposal (correlation with success = 0.301, better than 1% level of significance).
Furthermore, the following factors were found to have the largest positive correlations with the size of the average annual budgets:

- Relevance of the project to DGS's business (correlation with the size of the average annual budget = 0.347, better than 1% level of significance)
- Knowledge of the workings of the client's organization (correlation with the size of the average annual budget = 0.299, better than 1% level of significance)
- The commitment of the client's management to the project (correlation with the size of the average annual budget = 0.243, 2% level of significance)
- Personal relationship with the client's employees (correlation with the size of the average annual budget = 0.206, 5% level of significance).

The above correlations, although statistically significant, can not be considered to explain a great deal of the variance in the contract procurement process.

The success factor correlations indicate that if a contract R&D firm can obtain or observes a strong commitment on the part of the sponsor's management to do a particular program the likelihood of obtaining the work is improved significantly. In essence this result can be interpreted to mean that the commitment on the part of the client's management to the project is highly beneficial in overcoming any barriers to the procurement such as patent or publication policy disputes. The other three factors indicate that the success of contract procurement is
commonly determined by factors that are uncontrollable by DGS. Political factors such as competition to DGS from the sponsor's internal R&D personnel is one example where there is little DGS can do to influence the outcome of the contract negotiations. Similarly competition from other firms which undermines the viability of DGS's noncompetitive posture can not be changed directly. Finally, the competence of the person that evaluates the proposal, which corresponds to "finding the right guy," as mentioned by the legal counsel, can not be modified by DGS. Thus it is seen that with respect to marketing only the management commitment can be influenced by DGS. However, attempting to influence the management is difficult because (1) it takes a prolonged effort to exert any influence and (2) exerting influence doesn't make the need for the R&D work any more important from a financial or national defense standpoint.

The average annual budget correlations indicate that the largest programs are those which are most relevant to DGS's traditional business base. It is interesting to note that the other three factors, knowledge of the client's organization, commitment of the client's management, and the personal relationship with the client are all facets of a supplier-customer relationship that are built over an extended time period. These factors can be controlled by DGS Corporation. Therefore a good and continuing relationship with a client represents the best opportunity to obtain large R&D programs.

While the discussion has centered on those factors which increase the chances of success it is equally interesting to discuss those factors
which were determined to be unrelated to contract success.

By referring to Tables 3.5 and 3.6 it is surprising to find that internal research and development efforts, proposal quality, and laboratory facilities are nearly uncorrelated with the success of a proposal. This finding supports the notion that the success of contract R&D procurement is not as strongly influenced by impersonal factors under the control of the R&D organization as it is by personal factors not necessarily influenceable by DGS.

A detailed breakdown of the results of the questionnaire with respect to policy-unrelated factors is given below.

**Detailed Discussion of the Results**

- **Marketing Factor #1: The commitment of the client's management to the project.**

  Contract procurement: \( r = 0.467 \), significance level \( < 1\% \),
  
  95\% confidence interval: \( 0.288 < r < 0.647 \)

  Average annual budget: \( r = 0.243 \), significance level \( \approx 2\% \),
  
  95\% confidence interval: \( 0.046 < r < 0.440 \)

  The commitment of the client's management was studied as a success factor because in most instances the funding for the R&D project is going to come from the manager's budget which can be allocated to only a fixed number of projects. Hence, the commitment measure is an indicator of the position on the priority list of the potential R&D contract. Thus it is hypothesized that when the contract negotiations begin to break down or technical differences begin to emerge the client's management will push
Table 3.5. Average values of the policy-unrelated marketing success factors and their correlation with the success of a contract procurement effort.

<table>
<thead>
<tr>
<th>Marketing Factor</th>
<th>Correlation Rank</th>
<th>Contract Procurement Success Correlation and 95% Confidence Interval</th>
<th>Average Value</th>
<th>t Statistic</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>1.53</td>
<td>-0.50</td>
<td>5.093</td>
</tr>
<tr>
<td>The commitment of the client's management to the project</td>
<td></td>
<td>r = 0.467</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.228 &lt; r &lt; 0.647</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Political factors within the client's organization</td>
<td>2</td>
<td>r = 0.376</td>
<td>0.17</td>
<td>-1.28</td>
<td>3.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.185 &lt; r &lt; 0.562</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competition from other firms</td>
<td>3</td>
<td>r = 0.308</td>
<td>-0.02</td>
<td>-0.76</td>
<td>3.122</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.115 &lt; r &lt; 0.501</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The competence of the client's technical person who evaluated the proposal</td>
<td>4</td>
<td>r = 0.301</td>
<td>1.75</td>
<td>0.41</td>
<td>3.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.107 &lt; r &lt; 0.494</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.5. Average values of the policy-unrelated marketing success factors and their correlation with the success of a contract procurement effort (continued)

<table>
<thead>
<tr>
<th>Marketing Factor</th>
<th>Correlation Rank</th>
<th>Contract Procurement Success Correlation and 95% Confidence Interval</th>
<th>Average Value</th>
<th>t Statistic</th>
<th>Significance Level</th>
</tr>
</thead>
</table>
| Other factors    | 5                | $r = 0.296$  
$0.102 < r < 0.49$ | 0.30 | -0.41 | 2.99 | < 1% |
| Understanding of the customer's requirements and problems | 6 | $r = 0.285$  
$0.090 < r < 0.48$ | 2.73 | 1.69 | 2.86 | < 1% |
| The managerial level of the person through whom the negotiations were conducted | 7 | $r = 0.279$  
$0.084 < r < 0.474$ | 1.86 | 0.79 | 2.80 | 1% |
| Previous work with the customer | 8 | $r = 0.259$  
$0.063 < r < 0.455$ | 2.21 | 1.14 | 2.58 | 2% |
Table 3.5. Average values of the policy-unrelated marketing success factors and their correlation with the success of a contract procurement effort (continued)

<table>
<thead>
<tr>
<th>Marketing Factor</th>
<th>Correlation Rank</th>
<th>Contract Procurement Success Correlation and 95% Confidence Interval</th>
<th>Average Value</th>
<th>t Statistic</th>
<th>Significance Level</th>
</tr>
</thead>
</table>
| Knowledge of the workings of the client's organization | 9                | $r = 0.251$  
$1.054 < r < 0.447$ | 1.46          | 0.52        | 2.50              | 2%                         |
| Financial condition of the client             | 10               | $r = 0.248$  
$0.05 < r < 0.445$ | 0.71          | -0.41       | 2.47              | 2%                         |
| The cost of the proposed effort               | 11               | $r = 0.227$  
$0.029 < r < 0.425$ | -0.02         | -0.83       | 2.25              | 5%                         |
| The technical quality of DGS's work force     | 12               | $r = 0.206$  
$0.007 < r < 0.405$ | 3.03          | 2.45        | 2.03              | 5%                         |
| DGS's general reputation                      | 13               | $r = 0.202$  
$0.003 < r < 0.401$ | 2.27          | 2.0         | 1.99              | 5%                         |
Table 3.5. Average values of the policy-unrelated marketing success factors and their correlation with the success of a contract procurement effort (continued)

<table>
<thead>
<tr>
<th>Marketing Factor</th>
<th>Correlation Rank</th>
<th>Contract Procurement Success Correlation and 95% Confidence Interval</th>
<th>Average Value</th>
<th>t Statistic</th>
<th>Significance Level</th>
</tr>
</thead>
</table>
| The uniqueness of DGS’s technical capability | 14 | $r = 0.197$  
$-0.002 < r < 0.395$ | 2.90 | 2.27 | 1.94 | 10% |
| The proposed duration of the project | 15 | $r = 0.148$  
$-0.053 < r < 0.349$ | 0.38 | -0.03 | 1.44 | 10% |
| Personal relationship with client’s employees | 16 | $r = 0.122$  
$-0.797 < r < 0.324$ | 2.08 | 1.66 | 1.18 | insignificant |
| Previous work and experience in the technical area | 17 | $r = 0.115$  
$-0.987 < r < 0.317$ | 3.24 | 2.79 | 1.12 | insignificant |
Table 3.5. Average values of the policy-unrelated marketing success factors and their correlation with the success of a contract procurement effort (continued)

<table>
<thead>
<tr>
<th>Marketing Factor</th>
<th>Correlation Rank</th>
<th>Contract Procurement Success Correlation and 95% Confidence Interval</th>
<th>Average Value</th>
<th>t Statistic</th>
<th>Significance Level</th>
</tr>
</thead>
</table>
| Previous IR&D efforts in the technical area | 18               | \( r = 0.108 \)  
\(-0.094 < r < 0.310\) | 1.333 | 0.93 | 1.05 insignificant |
| Quality of the technical proposal     | 19               | \( r = 0.095 \)  
\(-0.107 < r < 0.297\) | 1.73 | 1.41 | 0.92 insignificant |
| DGS's facilities and equipment       | 20               | \( r = 0.0253 \)  
\(-0.177 < r < 0.228\) | 1.75 | 1.66 | 0.244 insignificant |
| Relevance of the project to DGS's business | 21              | \( r = -0.018 \)  
\(-0.221 < r < 0.185\) | 0.968 | 1.034 | 0.174 insignificant |
| Geographical proximity to client     | 22               | \( r = -0.103 \)  
\(-0.305 < r < 0.099\) | -0.09 | 0.25 | 0.999 insignificant |
| Number of competitors                | 23               | \( r = -0.113 \)  
\(-0.315 < r < 0.089\) | 1.14 | 1.74 | 1.097 insignificant |
Table 3.6. Correlations of the effects of the marketing success factors with the size of the contract's average annual budget.

<table>
<thead>
<tr>
<th>Marketing Factor</th>
<th>Correlation Rank</th>
<th>Correlation Coefficient</th>
<th>Significance Level</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevance of the project to DCS's business</td>
<td>1</td>
<td>0.347</td>
<td>&lt;1%</td>
<td>0.156 &lt; r &lt; 0.538</td>
</tr>
<tr>
<td>Knowledge of the workings of the client's organization</td>
<td>2</td>
<td>0.299</td>
<td>&lt;1%</td>
<td>0.105 &lt; r &lt; 0.493</td>
</tr>
<tr>
<td>The client's commitment to the project</td>
<td>3</td>
<td>0.243</td>
<td>2%</td>
<td>0.046 &lt; r &lt; 0.440</td>
</tr>
<tr>
<td>The client's management of employees</td>
<td>4</td>
<td>0.206</td>
<td>5%</td>
<td>0.007 &lt; r &lt; 0.405</td>
</tr>
<tr>
<td>Personal relationship with the client</td>
<td>5</td>
<td>0.198</td>
<td>10%</td>
<td>-0.001 &lt; r &lt; 0.397</td>
</tr>
<tr>
<td>Previous work with customer</td>
<td>6</td>
<td>0.195</td>
<td>10%</td>
<td>-0.004 &lt; r &lt; 0.394</td>
</tr>
<tr>
<td>DCS's facilities and equipment</td>
<td>7</td>
<td>0.181</td>
<td>10%</td>
<td>-0.0189 &lt; r &lt; 0.381</td>
</tr>
<tr>
<td>The managerial level of the person through whom the negotiations were conducted</td>
<td>8</td>
<td>0.180</td>
<td>10%</td>
<td>-0.0199 &lt; r &lt; 0.380</td>
</tr>
<tr>
<td>Financial condition of the client</td>
<td>9</td>
<td>0.157</td>
<td>insignificant</td>
<td>-0.0044 &lt; r &lt; 0.358</td>
</tr>
</tbody>
</table>

51
Table 3.6. Correlations of the effects of the marketing success factors with the size of the contract's average annual budget (continued)

<table>
<thead>
<tr>
<th>Marketing Factor</th>
<th>Correlation Rank</th>
<th>Average Annual Budget Correlation</th>
<th>t Statistic</th>
<th>Significance Level</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>The technical quality of DGS's work force</td>
<td>10</td>
<td>0.148</td>
<td>1.44</td>
<td>insignificant</td>
<td>-0.053 &lt; r &lt; 0.349</td>
</tr>
<tr>
<td>DGS's general reputation</td>
<td>11</td>
<td>0.134</td>
<td>1.30</td>
<td>insignificant</td>
<td>-0.067 &lt; r &lt; 0.335</td>
</tr>
<tr>
<td>Political factors within the client's organization</td>
<td>12</td>
<td>0.101</td>
<td>0.979</td>
<td>insignificant</td>
<td>-0.101 &lt; r &lt; 0.303</td>
</tr>
<tr>
<td>DGS's understanding of the customer's requirements and problems</td>
<td>13</td>
<td>0.0996</td>
<td>0.965</td>
<td>insignificant</td>
<td>-0.103 &lt; r &lt; 0.302</td>
</tr>
<tr>
<td>Previous work and experience in the technical area</td>
<td>14</td>
<td>0.0548</td>
<td>0.529</td>
<td>insignificant</td>
<td>-0.148 &lt; r &lt; 0.257</td>
</tr>
<tr>
<td>Other factors</td>
<td>15</td>
<td>0.012</td>
<td>0.1157</td>
<td>insignificant</td>
<td>-0.191 &lt; r &lt; 0.215</td>
</tr>
<tr>
<td>Number of competitors</td>
<td>16</td>
<td>-0.003</td>
<td>0.028</td>
<td>insignificant</td>
<td>-0.206 &lt; r &lt; 0.200</td>
</tr>
<tr>
<td>The cost of the proposed effort</td>
<td>17</td>
<td>-0.0202</td>
<td>0.195</td>
<td>insignificant</td>
<td>-0.22 &lt; r &lt; 0.183</td>
</tr>
</tbody>
</table>
Table 3.6. Correlations of the effects of the marketing success factors with the size of the contract's average annual budget (continued)

<table>
<thead>
<tr>
<th>Marketing Factor</th>
<th>Correlation Rank</th>
<th>Average Annual Budget Correlation</th>
<th>t Statistic</th>
<th>Significance Level</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposed duration of the project</td>
<td>18</td>
<td>-0.0214</td>
<td>0.206</td>
<td>insignificant</td>
<td>-0.22 &lt; r &lt; 0.182</td>
</tr>
<tr>
<td>The competence of the client's technical person who evaluated the proposal</td>
<td>19</td>
<td>-0.067</td>
<td>-0.647</td>
<td>insignificant</td>
<td>-0.27 &lt; r &lt; 0.136</td>
</tr>
<tr>
<td>The uniqueness of DGS's technical capability</td>
<td>20</td>
<td>-0.0703</td>
<td>0.679</td>
<td>insignificant</td>
<td>-0.273 &lt; r &lt; 0.132</td>
</tr>
<tr>
<td>Previous IR&amp;D efforts in the technical area</td>
<td>21</td>
<td>-0.071</td>
<td>0.686</td>
<td>insignificant</td>
<td>-0.274 &lt; r &lt; 0.132</td>
</tr>
<tr>
<td>Competition from other firms</td>
<td>22</td>
<td>-0.072</td>
<td>0.696</td>
<td>insignificant</td>
<td>-0.275 &lt; r &lt; 0.131</td>
</tr>
<tr>
<td>Geographical proximity to client</td>
<td>23</td>
<td>-0.089</td>
<td>0.862</td>
<td>insignificant</td>
<td>-0.291 &lt; r &lt; 0.113</td>
</tr>
</tbody>
</table>
harder for a successful contract agreement on the more important R&D efforts than on the lesser important efforts.

Indeed, the results of the questionnaire found that the management commitment variable was most highly correlated with a successful contract procurement. Furthermore, this variable was found to be correlated with the size of the average annual budget of the project. The causality for this relationship, however, is not clear. It is possible either that the size of the budget reflects the level of management's commitment to the R&D effort or that the large R&D budget means that the managers have a larger stake in the results and therefore they must be committed to the effort. It is felt by the author that the former explanation is more plausible since it implies that the effort is very important to the client and that he is willing to commit a larger level of funding to DGS Corporation to obtain the highest quality product from the effort.

- Marketing Factor #2: Political factors within the client's organization
  
  Contract procurement: \( r = 0.374 \), significance level < 1%,
  
  95% confidence interval: \( 0.185 < r < 0.562 \)

  Average annual budget: \( r = 0.101 \), insignificant,
  
  95% confidence interval: \( -0.101 < r < 0.303 \)

  The strength of the correlation of this factor with the success of the project was a surprise to the author. It had been chosen as a factor for investigation because it represents the interaction within the client's organization among the three key factors in any technology-based
organization: money, people, and technology. Political factors that would impact the successful procurement of a contract include:

- Budgetary disputes among the different parts of the client's organization.
- Expertise overlap or conflict between the inhouse R&D team and the DGS R&D team
- Conflict between the customer's existing or proposed product or process and that which is proposed by DGS.

This factor was seen to have a significant impact on contract procurement success but no impact on the size of the program. This implies that the political factors refer to interpersonal issues like interference of the project with the client's R&D organization or government R&D priority disputes rather than the size of the actual program. Discussions with DGS's management indicated that it was not uncommon for DGS to loose programs for these above-mentioned reasons.

- Marketing Factor #3: Competition from other firms

  Contract procurement: \( r < 0.308 \), significance level \( < 1\% \),
  
  95% confidence interval: \( 0.115 < r < 0.501 \)

  Average annual budget: \( r < -0.072 \), insignificant,
  
  95% confidence interval: \( -0.275 < r < 0.131 \)

  As seen from the average factor values in Table 3.5, successful contract proposals had virtually no competition while unsuccessful proposals did have measurable competition. This indicates that when competition exists the noncompetitive posture of DGS is difficult to
justify to the contracting organization which has an interest in competitively bidding the contract. It is seen from the budget size correlation that the degree of competition to DGS is independent of the budget size.

- Marketing Factor #4: The competence of the client's technical person who evaluated the proposal

  Contract procurement: \( r = 0.301 \), significance level \( \leq 1\% \),
  95\% confidence interval: \( 0.107 < r < 0.494 \)

  Average annaul budget: \( r = -0.067 \), insignificant,
  95\% confidence interval: \( -0.27 < r < 0.136 \)

  It was hypothesized that the greater the technical capability of the client's technical leader, the greater the chance that the client's organization would appreciate the benefit of the proposed R&D program with DGS since it would be more likely that the client would be more strongly persuaded by technical reasoning rather than by political reasoning. It was found that this factor was significantly correlated with procurement success, yet uncorrelated with the average budget of the program. This implies that, independent of the size of the program, one should try to identify within the client's organization a "product champion" who has the technical capability to understand the program and the political wherewithal to push it through the organization.

- Marketing Factor #5: Other factors

  Contract procurement: \( r = 0.296 \), significance level \( \leq 1\% \),
  95\% confidence level: \( 0.102 < r < 0.49 \)
Average annual budget: \( r = 0.012 \), insignificant,

95% confidence interval: \(-0.191 < r < 0.215\)

This factor, although correlated with successful procurements, was not found to be a strong factor. The average values were near zero, although the direction of the trend was correct. It was uncorrelated with the size of the average annual budget.

- Marketing Factor #6: DGS's understanding of the customer's requirements and problems

  Contract procurement: \( r = 0.285 \), significance level \(< 1\%\),
  
  95% confidence interval: \(0.090 < r < 0.48\)

  Average annual budget: \( r = 0.0996 \), insignificant,
  
  95% confidence interval: \(-0.103 < r < 0.302\)

It is interesting to note that the managers of DGS felt that they understood the user needs which their R&D work would address for both successful and unsuccessful procurements. However, this factor was not found to be an important determinant of success nor program size. It appears, then, that an understanding of the client need is a necessary but not a sufficient condition in the contract marketing process. This finding underlines the importance of the political and organizational realities operating in R&D contract procurement. It also stresses the problem brought up by DGS's Director of Planning of the lack of appreciation for these factors by many engineers because they feel that "the technology will sell itself" and that "they know the client's
problems better than the client himself." As this study shows, the persuasion of the client cannot be made on technical merit alone.

- Marketing Factor #7: The managerial level of the person through whom the negotiations were conducted.
  
  Contract procurement: \( r = 0.279 \), significance level \( \sim 1\% \),
  95% confidence interval: \( 0.084 < r < 0.474 \)
  
  Average annual budget: \( r = 0.181 \), significance level \( \sim 10\% \),
  95% confidence interval: \( -0.0199 < r < 0.380 \)

It was hypothesized at the beginning of the study that many contracts were being lost because the marketing contact was made at too low a managerial level. This situation is not uncommon in R&D marketing. For example, if the initial marketing contact is made at a national technical conference or through an article read in a technical journal, it is reasonable to assume that the person contacted is from the technical and not the managerial ranks of the prospective client's organization. Thus the first hurdle in this instance is to convince someone at the managerial level in the client's organization that there is an R&D need which the contract R&D organization can address. It was found here that negotiating at the right level is important and that it is very slightly more important for the larger contracts than the smaller contracts.
Marketing Factor #8: Previous work with the customer

Contract procurement: \( r = 0.259, \) significance level ~\( 2\% \),
95% confidence interval: \( 0.063 < r < 0.455 \)

Average annual budget: \( r = 0.195, \) significance level ~\( 10\% \),
95% confidence interval: \( -0.004 < r < 0.394 \)

Previous work with the customer enables the contract R&D organization to identify user needs for future efforts and to rely on rapport and reputation to convince the potential client that it can best perform the requested R&D. It was found that this factor was strongly correlated with both successful contract procurement and the size of the average annual budget. This indicates that the larger programs are either follow-ons or efforts related to previous work. This finding agrees with the notion that "getting in the door" is important for establishing a working relationship to identify the client's needs and to provide a base for larger R&D efforts in the future.

Marketing Factor #9: Knowledge of the workings of the client's organization

Contract procurement: \( r = 0.251, \) significance level ~\( 2\% \),
95% confidence interval: \( 0.054 < r < 0.447 \)

Average annual budget: \( r = 0.299, \) significance level < \( 1\% \),
95% confidence interval: \( 0.105 < r < 0.493 \)

This factor refers to the importance of understanding how the decision making process occurs within the client's organization so that the contract R&D organization can "work the system to its advantage." It
is seen that this knowledge was correlated with the average annual budget of the contract. This indicates that, as was seen by management, the knowledge of the workings of the client's organization became more important as the program became bigger.

- Marketing Factor #10: Financial condition of the client
  Contract procurement: $r = 0.248$, significance level $\sim 2\%$,
  95% confidence interval: $0.05 < r < 0.445$
  Average annual budget: $r = 0.180$, significance level $\sim 10\%$,
  95% confidence interval: $-0.0199 < r < 0.38$

It is clear that this factor would be hypothesized to have a strong effect on the procurement of an R&D contract since the financial condition of the client dictates the willingness of management to disburse funds to another organization to perform research and development. As seen from the results the client's financial condition had promoted the contract proposal's success in successful procurements but inhibited the success in unsuccessful procurements. There was a significant correlation of this factor with both the success of the procurement and the size of the average annual budget. The latter correlation indicates that the client's financial condition becomes a more important factor as the size of the program becomes larger.

- Marketing Factor #11: The cost of the proposed effort
  Contract procurement: $r = 0.227$, significance level $\sim 5\%$,
  95% confidence interval: $0.029 < r < 0.425$
Average annual budget: \( r = -0.0202 \), insignificant,

95\% confidence interval: \(-0.22 < r < 0.182\)

One would imagine that the cost of the R&D effort would always be an important issue to the client. However, as indicated by the average values of the marketing impact, cost is not a factor in successful procurements but it is a factor in unsuccessful ones. It was also found that the cost issue was uncorrelated with the average annual budget of the program indicating that the cost issue is equally important (or unimportant) for all size programs. It is important for the reader to realize that the contract sample consisted of both defense contracts and industrial contracts. The impact of cost as presented in these results may not be the same for the four different customer types.

- Marketing Factor #12: The technical quality of the work force

  Contract procurement: \( r = 2.06 \), significance level \( \sim 5\% \),

  95\% confidence interval: \( 0.007 < r < 0.405 \)

  Average annual budget: \( r = 0.148 \), insignificant,

  95\% confidence interval: \(-0.053 < r < 0.349\)

This factor was felt to be important towards obtaining a contract for most of the managers. Thus although the average values for both successful and unsuccessful proposals were high it did not have one of the strongest correlations with proposal success. Furthermore, it was found that there was no significant relationship between the work force quality and the size of the budget.
Marketing Factor #13: DGS's general reputation

Contract procurement: \( r = 0.202 \), significance level \( \sim 5\% \),
95% confidence interval: \( 0.003 < r < 0.401 \)

Average annual budget: \( r = 0.134 \), insignificant,
95% confidence interval: \( -0.067 < r < 0.335 \)

Contract R&D organizations, consulting firms, and service firms rely heavily upon their general reputation to market their service. Thus it is seen that the managers responded that DGS's reputation was very important in the marketing effort. However, as important as it might have been for the initial marketing, it was not a strong factor in differentiating successful from unsuccessful negotiations.

Marketing Factor #14: The uniqueness of DGS's technical capability

Contract procurement: \( r = 0.197 \), significance level \( \sim 10\% \),
95% confidence interval: \( -0.002 < r < 0.396 \)

Average annual budget: \( r = -0.0703 \), insignificant,
95% confidence interval: \( -0.273 < r < 0.132 \)

Because DGS does not bid for competitive work it must rely upon its unique technical capabilities as a selling point to its prospective clients. As in the technical quality of the work force it was found that management felt that DGS's technical uniqueness was a very important factor in the marketing effort, yet it was weakly correlated with the success of a procurement and it was completely uncorrelated with the average annual budget. This may indicate either that from the sponsor's
viewpoint the unique capabilities of DGS are not sufficient reason to fund an R&D contract or that DGS capabilities are not unique and that a substitute can be found elsewhere. The implications of this result should be considered very seriously by DGS's management.

- Marketing Factor #15: The proposed duration of the project
  Contract procurement: $r = 0.148$, significance level $\sim 10\%$,
  95% confidence interval: $-0.053 < r < 0.349$
  Average annual budget: $r = -0.0214$, insignificant,
  95% confidence interval: $-0.22 < r < 0.182$

  This factor was studied because it was felt that due to the nature of R&D that prospective clients may have balked in the negotiation process because the contracted work would probably not be performed at a rate which would be fast enough for the sponsor. It was found from the study, however, that for successful contract procurements the proposed duration was actually slightly attractive to the client. In essence, though, this factor was found to be nearly insignificantly related to contract procurement success.

- Marketing Factor #16: Personal relationship with the client's employees
  Contract procurement: $r = 0.122$, insignificant,
  95% confidence interval: $-0.797 < r < 0.324$
  Average annual budget: $r = 0.206$, $\sim 5\%$,
  95% confidence interval: $0.007 < r < 0.405$
Personal relationships with prospective sponsors were not found to aid in obtaining R&D contracts. However, there was a statistically significant relationship between this factor and the average annual budget size. It is felt that this indicates that on the older long term contracts a strong working relationship has developed between DGS and its sponsor. It is not felt that this relationship was the cause of the larger budget.

- **Marketing Factor #17:** Previous work and experience in the technical area

  Contract procurement: \( r = 0.115 \), insignificant,
  
  95% confidence interval: \(-0.087 < r < 0.317\)

  Average annual budget: \( r = 0.0548 \), insignificant,
  
  95% confidence interval: \(-0.148 < r < 0.257\)

Previous work and experience in the technical area had been hypothesized to influence the client through DGS's established credibility. It was found that this factor was felt to be important by DGS management. However, this factor had insignificant correlations with both the success of the procurement and the size of the average annual budget. This may indicate that the previous experience only aids in the initial marketing effort to the potential client. Once the proposal is written, however, other factors, probably nontechnical, come into play in the procurement process.
- **Marketing Factor #18:** Previous IR&D efforts in the technical area

  Contract procurement: \( r = 0.108 \), insignificant,

  95% confidence interval: \(-0.094 < r < 0.310\)

  Average annual budget: \( r = -0.071 \), insignificant,

  95% confidence interval: \(-0.274 < r < 0.132\)

  As mentioned in this section's overview, internal research and development (IR&D) efforts had no significant impact on either proposal success or the size of the budgets. This suggests that money which is currently allocated towards IR&D efforts may be more effectively spent on marketing efforts.

- **Marketing Factor #19:** Quality of the technical proposal

  Contract procurement: \( r = 0.095 \), insignificant,

  95% confidence interval: \(-0.107 < r < 0.297\)

  Average annual budget: \( r = 0.157 \), insignificant,

  95% confidence interval: \(-0.044 < r < 0.358\)

  It is commonly believed by the management of DCS that the quality of the technical proposal has an influence on the potential client. The strength of this belief is indicated by the average value of the factor's score on the questionnaire. The belief assumes that technical reason is a powerful persuader in R&D proposals. However, based upon the correlation analysis the quality of the proposal has no significant impact on the success of the procurement and it is unrelated to the size of the budget. From a managerial perspective, this implies that more time should be spent personally convincing the client's management of the
efficacy of the R&D program and less time writing proposals. This result concurs with the study by Pringle [Pringle, 1965] that in contract bidding the successful bidders had worked more on preproposal marketing and less on proposal writing than successful bidders.

- **Marketing Factor #20**: DGS's facilities and equipment
  
  **Contract procurement**: \( r = 0.0253 \), insignificant,
  
  95\% confidence interval: \(-0.177 < r < 0.228\)
  
  **Average annual budget**: \( r = 0.198 \), ~10\%,
  
  95\% confidence interval: \(-0.001 < r < 0.397\)

  As in the previous factor the facilities and equipment of DGS by themselves do not seem to correlate with the procurement of a contract. However, the perceived importance of the facilities and equipment becomes more important as the size of the contract increases. This latter correlation is probably due to the fact that the larger programs frequently correspond to follow-on efforts. In this instance, DGS has built up unique hardware or software from the previous work which thereby makes DGS the logical choice for the continuation of the effort.

- **Marketing Factor #21**: Relevance of the project to DGS's business
  
  **Contract procurement**: \( r = -0.018 \), insignificant,
  
  95\% confidence interval: \(-0.221 < r < 0.185\)
  
  **Average annual budget**: \( r = 0.347 \), significance level < 1\%,
  
  95\% confidence interval: \( 0.156 < r < 0.538\)
This factor was uncorrelated with the success of a contract proposal yet it was determined to be the most highly correlated factor with the size of the contract. One could interpret this result to mean that since an R&D organization generally has a legitimate technical base from which to try to procure contracts that it will try to obtain the largest possible contract in its field of expertise. This does not imply, though, that in the end the organization will have a higher success rate in its traditional area. One would presume that the success rate would be higher for the more highly related contracts but the results of the study do not seem to bear this hypothesis out.

- Marketing Factor #22: Geographical proximity to the client
  Contract procurement: $r = -0.103$, insignificant,
  95% confidence interval: $-0.305 < r < 0.099$

  Average annual budget: $r = -0.089$, insignificant,
  95% confidence interval: $-0.291 < r < 0.113$

The geographical proximity of the client was suggested as a factor which would promote the success of a contract proposal because of the improved communication with the potential client. It was found, however, that there was no significant relationship between procurement success and geographical proximity. Furthermore, the effect of proximity on contract success was felt to be small by DSG's management. This result is not unreasonable when one considers the nature of DGS's business. The technical work traditionally performed by DGS is the development of prototype hardware or software. Frequently the work does not involve
working within a client's plant or facility. The above scenario is particularly true for defense work. In industrial work the situation is somewhat different in that the work is more commonly performed onsite with the client. Yet as mentioned, geographical proximity had little effect on most of the R&D contract proposals.

- Marketing Factor #23: Number of competitors
  
  Contract procurement: $r = -0.113$, insignificant,
  
  95% confidence interval: $-0.315 < r < 0.089$
  
  Average annual budget: $r = -0.003$, insignificant,
  
  95% confidence interval: $-0.206 < r < 0.200$
  
  The noncompetitive posture of DGS does not preclude the existence of competition from other organizations. If DGS has unique capabilities then there will be fewer potential competitors and hence the success rate of the proposals will increase. It was found that there was no significant relationship between the number of competitors and the proposal success rate. Hence competition, if it existed, was not as strong a factor as might have been expected.

3.5 Questionnaire Findings on the Effect of Policy-Related Factors on Contract Proposal Success

The four major policies of DGS which were viewed by management to have the greatest impact on the success of proposals were DGS's patent rights, publication rights, noncompetitive posture, and nonprofit status policies. The discussion of the impact of these policies on contract
procurement success is organized by customer type so as to illustrate the way in which DGS's present policies affect its different business bases. The results of the investigation are summarized in Table 3.7 and described below.

**Government Defense Contracts**

It was found from an analysis of the questionnaire responses that the noncompetitive posture of DGS was the only policy which had a statistically significant impact on the procurement of a defense contract. As seen in Table 3.7, noncompetitive policy was judged by management to have no impact on successful proposals and a strongly negative impact on unsuccessful proposals. The source of this problem originates with the Armed Services Act of 1956 which states that all government defense contracts must be secured through competitive bidding if possible. The regulations of this act continually force DGS into continually proving to the federal government that it has unique capabilities. This is easiest to prove in those business areas where DGS clearly has the technical lead or unique expertise. This lead is most evident in the more mature business areas of DGS where DGS made its original technological reputation. This lead, however, is not as evident in DGS's newer business areas where that reputation is yet to be established. In the newer areas any lead which exists is most likely to be small in terms of both technology and experience and therefore the justification of an award for new work to DGS Corporation on a noncompetitive basis is very difficult.
Table 3.7. Average values of the policy-related marketing success factors and their correlation with the success of a contract procurement effort

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Policy</th>
<th>Contract Procurement Success Correlation and 95% Confidence Interval</th>
<th>Average Value</th>
<th>t Statistic</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Successful</td>
<td>Unsuccessful</td>
<td></td>
</tr>
<tr>
<td>Government Defense</td>
<td>Patent</td>
<td>+0.16</td>
<td>0.15</td>
<td>-0.07</td>
<td>1.13</td>
</tr>
<tr>
<td>(51 proposals)</td>
<td></td>
<td>-0.116 &lt; r &lt; 0.436</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Publication</td>
<td>+0.19</td>
<td>0.29</td>
<td>0.0</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.0849 &lt; r &lt; 0.465</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-competitive</td>
<td>+0.47</td>
<td>-0.15</td>
<td>-2.3</td>
<td>3.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.223 &lt; r &lt; 0.717</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nonprofit Status</td>
<td>+0.16</td>
<td>0.62</td>
<td>0.27</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.116 &lt; r &lt; 0.436</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government Nondefense</td>
<td>Patent</td>
<td>-0.09</td>
<td>-0.25</td>
<td>0.0</td>
<td>0.36</td>
</tr>
<tr>
<td>(18 proposals)</td>
<td></td>
<td>-0.578 &lt; r &lt; 0.139</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Publication</td>
<td>-0.09</td>
<td>-0.27</td>
<td>0.0</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.578 &lt; r &lt; 0.398</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-competitive</td>
<td>+0.68</td>
<td>0.0</td>
<td>-1.0</td>
<td>3.71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.321 &lt; r &lt; 1.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nonprofit Status</td>
<td>+0.11</td>
<td>0.33</td>
<td>0.0</td>
<td>0.443</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.377 &lt; r &lt; 0.597</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.7. Average values of the policy-related marketing success factors and their correlation with the success of a contract procurement effort (continued)

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Policy</th>
<th>Contract Procurement Success Correlation and 95% Confidence Interval</th>
<th>Average Value</th>
<th>t Statistic</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patent</td>
<td>-0.49 ( -1.18 &lt; r &lt; 0.20 )</td>
<td>-0.66</td>
<td>0.0</td>
<td>1.38  insignificant</td>
</tr>
<tr>
<td>Private</td>
<td>Publication</td>
<td>0.0 ( -0.80 &lt; r &lt; 0.80 )</td>
<td>0.0</td>
<td>0.0</td>
<td>0     insignificant</td>
</tr>
<tr>
<td>Industry-Government</td>
<td>Non-competitive</td>
<td>+0.21 ( -0.572 &lt; r &lt; 0.99 )</td>
<td>0.33</td>
<td>0.0</td>
<td>0.526 insignificant</td>
</tr>
<tr>
<td>Defense</td>
<td>Nonprofit Status</td>
<td>+0.42 ( -0.306 &lt; r &lt; 1.146 )</td>
<td>0.0</td>
<td>-1.20</td>
<td>1.13  insignificant</td>
</tr>
<tr>
<td>Subcontract</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8 proposals)</td>
<td>Patent</td>
<td>+0.61 ( 0.222 &lt; r &lt; 0.998 )</td>
<td>-1.36</td>
<td>-3.4</td>
<td>3.08  &lt; 1%</td>
</tr>
<tr>
<td>Private</td>
<td>Publication</td>
<td>+0.01 ( -0.48 &lt; r &lt; 0.49 )</td>
<td>-1.09</td>
<td>-1.14</td>
<td>0.0040 insignificant</td>
</tr>
<tr>
<td>Industry-Directly</td>
<td>Non-competitive</td>
<td>+0.19 ( -0.29 &lt; r &lt; 0.67 )</td>
<td>-0.18</td>
<td>-0.71</td>
<td>0.774 insignificant</td>
</tr>
<tr>
<td>Funded R&amp;D</td>
<td>Nonprofit Status</td>
<td>-0.11 ( -0.59 &lt; r &lt; 0.377 )</td>
<td>-0.45</td>
<td>-0.29</td>
<td>0.442 insignificant</td>
</tr>
<tr>
<td>(18 proposals)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The other three policies were felt by the managers to not be nearly as important as the noncompetitive policy in determining whether a contract was obtained. The nonprofit status was felt to promote slightly the marketing effort since DGS would be able to be objective in performing the work. However, the statistical correlation of this factor with proposal success was insignificant. In addition, it was found that the patent and publication policies of DGS had little impact on the procurement success even though these policies were felt by the interviewed managers to slightly promote the success of the procurement because it was argued that DGS could serve as a technology transfer agent of unclassified DoD technology to the public sector.

**Government Nondefense Contracts**

As in defense contracts the only significantly correlated policy factor for this customer type was DGS's noncompetitive posture. The impact of this factor was mildly negative or not an issue on successful procurements but strongly negative on unsuccessful procurements. Thus it appears that the desire for competitive bidding is also strong in other government agencies such as the Department of Energy, Department of Commerce, and Department of Transportation.

Similar to the government defense contracts it is seen that the patent, publication, and nonprofit status policies were all insignificantly correlated with proposal success. These results confirm the basic hypotheses about the characteristics of government nondefense contracts presented at the beginning of this chapter.
Private Industry - Government Defense Subcontracts

Due to the small sample size for this customer type it was not possible to determine any statistically significant correlations between proposal success and DGS policies.

Private Industry - Directly Funded R&D

According to the results of the questionnaire, only the patent policy was determined to be statistically correlated with contract proposal success. This result is in agreement with the statements made during the management interviews. In general, the attitude of industry toward contract R&D is: "we deserve to get and keep what we've paid for: a competitive edge over our competition." DGS's present policies the only protection mechanism available to industry is lead time. Even this mechanism is weak, however, because the objective of DGS's publication policy is to make results of the work available to the public shortly after completion of the work.

3.6 Findings on the Differences in the Characteristics of the Contracts with the Four Different Customer Types

It was hypothesized at the beginning of the study that one would find the characteristics of the contracted R&D work to be different for the different customer types because of their different budgetary constraints, organization objectives, and R&D needs. The different characteristics, if found, may have an effect on the strategic planning of the organization in terms of determining which business areas should
be aggressively pursued and which areas should be dropped. Furthermore, differences in these characteristics if determined can have an effect on the operation of the organization in terms of the level of marketing effort and the recruiting of required personnel in the different business areas. The discussion below summarizes the findings of the study and briefly mentions their implications.

Summarized in Table 3.8 are the averages and standard deviations of the program size, program duration and average annual budget for R&D contracts with the four different customer types. It should be noted that the frequency distributions for all of the characteristics were found to have an inverse power relationship with the magnitude of each of the characteristics. Hence, for example, the smallest contracts between $0 and $500,000 were more common than medium-sized contracts between $500,000 and $1,000,000, and so forth.

An investigation was performed to determine the statistical difference of the means of the contract characteristics for the four customer types. As mentioned in Appendix B the method of the statistical difference of the means test for two samples uses the number of measurements and the standard deviation of each sample to estimate a standard error of the difference between the two means. As seen in Tables 3.8 and 3.9, the magnitudes of the standard deviations for all of the contract characteristics are quite large. Hence, few statistically significant differences in the contract characteristics could be determined. Table 3.10 summarizes the statistically significant differences that were found. Note that no statistically significant
<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Program Size ($000's)</th>
<th>Program Duration (Years)</th>
<th>Average Annual Budget</th>
<th>Average</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Defense</td>
<td>Average</td>
<td>11,887</td>
<td>1.95</td>
<td>314</td>
<td>93</td>
</tr>
<tr>
<td>Non-Government</td>
<td>Average</td>
<td>1,527</td>
<td>3.03</td>
<td>3.89</td>
<td>2.55</td>
</tr>
<tr>
<td>Industry: Directly Funded R&amp;D</td>
<td>Average</td>
<td>759</td>
<td>1.58</td>
<td>1.80</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Note: The table shows the average program size, program duration, and average annual budget for four different customer types.
Table 3.9 Average percent research, design, development, documentation and testing for the four different customer types.

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Percent Research</th>
<th>Percent Design</th>
<th>Percent Development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Successful Procurement</td>
<td>Successful Procurement</td>
<td>Successful Procurement</td>
</tr>
<tr>
<td></td>
<td>Unsuccessful Procurement</td>
<td>Unsuccessful Procurement</td>
<td>Unsuccessful Procurement</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------------------------</td>
<td>----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Government Defense</td>
<td>Average 30.4, SD 36.4</td>
<td>Average 19.9, SD 20.4</td>
<td>Average 23.4, SD 26.8</td>
</tr>
<tr>
<td>(51 proposals: 35 successful</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 unsuccessful)</td>
<td>Standard Deviation 33.5,</td>
<td>Standard Deviation 26.0,</td>
<td>Standard Deviation 17.8,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government Nondefense</td>
<td>Average 39.9, SD 42.4</td>
<td>Average 28, SD 32.6</td>
<td>Average 13, SD 16.8</td>
</tr>
<tr>
<td>(18 proposals: 16 successful</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 unsuccessful)</td>
<td>Standard Deviation 47.5,</td>
<td>Standard Deviation 50,</td>
<td>Standard Deviation 0,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>67.1, SD 70.7</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Industry - DGS Defense</td>
<td>Average 26.7, SD 23.1</td>
<td>Average 30, SD 17.3</td>
<td>Average 10, SD 17.3</td>
</tr>
<tr>
<td>Subcontractor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8 proposals: 3 successful</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 unsuccessful)</td>
<td>Standard Deviation 13,</td>
<td>Standard Deviation 44,</td>
<td>Standard Deviation 28,</td>
</tr>
<tr>
<td></td>
<td>21.0, SD 8.9</td>
<td>8.9, SD 17.3</td>
<td>20.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Industry - Directly</td>
<td>Average 19.5, SD 34.2</td>
<td>Average 30.4, SD 26.9</td>
<td>Average 19.5, SD 25.9</td>
</tr>
<tr>
<td>Funded R&amp;D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(18 proposals: 11 successful</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 unsuccessful)</td>
<td>Standard Deviation 12.1,</td>
<td>Standard Deviation 40.7,</td>
<td>Standard Deviation 28.6,</td>
</tr>
<tr>
<td></td>
<td>21.9, SD 41.1</td>
<td>41.1, SD 41.1</td>
<td>30.8</td>
</tr>
</tbody>
</table>
Table 3.9  Average percent research, design, development, documentation and testing for the four different customer types (continued).

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Percent Documentation</th>
<th>Percent Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Successful Procurement</td>
<td>Unsuccessful Procurement</td>
</tr>
<tr>
<td>Government Defense (51 proposals: 35 successful 16 unsuccessful)</td>
<td>Average 9.4</td>
<td>10.1</td>
</tr>
<tr>
<td></td>
<td>Standard Deviation 12.2</td>
<td>14.8</td>
</tr>
<tr>
<td>Government Nondefense (18 proposals: 16 successful 2 unsuccessful)</td>
<td>Average 8.5</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Standard Deviation 10.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Private Industry - DGS Defense Subcontractor (8 proposals: 3 successful 5 unsuccessful)</td>
<td>Average 16.7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Standard Deviation 5.8</td>
<td>8.4</td>
</tr>
<tr>
<td>Private Industry - Directly Funded R&amp;D (18 proposals: 11 successful 7 unsuccessful)</td>
<td>Average 14.1</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>Standard Deviation 23.1</td>
<td>3.9</td>
</tr>
</tbody>
</table>
Table 3.10  Summary of the statistically significant differences in the means of the characteristics of the contracts for the four different customer types

**Government Defense Contracts: Successful versus Unsuccessful Procurements**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Successful</th>
<th>Unsuccessful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% Confidence Difference Threshold</td>
<td>$9,183,000</td>
<td>$10,455,000</td>
</tr>
<tr>
<td>Measured Difference of the Means</td>
<td>$10,455,000</td>
<td></td>
</tr>
<tr>
<td>Program Duration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% Confidence Difference Threshold</td>
<td>1.26 years</td>
<td>2.07 years</td>
</tr>
<tr>
<td>Measured Difference of the Means</td>
<td>2.07 years</td>
<td></td>
</tr>
<tr>
<td>Average Annual Budget</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% Confidence Difference Threshold</td>
<td>$2,618,000</td>
<td>$7,048,000</td>
</tr>
<tr>
<td>Measured Difference of the Means</td>
<td>$7,048,000</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Successful</th>
<th>Private Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% Confidence Difference Threshold</td>
<td>$9,104,000</td>
<td>$11,128,000</td>
</tr>
<tr>
<td>Measured Difference of the Means</td>
<td>$11,128,000</td>
<td></td>
</tr>
<tr>
<td>Program Duration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% Confidence Difference Threshold</td>
<td>1.55 years</td>
<td>1.91 years</td>
</tr>
<tr>
<td>Measured Difference of the Means</td>
<td>1.91 years</td>
<td></td>
</tr>
<tr>
<td>Average Annual Budget</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% Confidence Difference Threshold</td>
<td>$2,619,000</td>
<td>$2,745,000</td>
</tr>
<tr>
<td>Measured Difference of the Means</td>
<td>$2,745,000</td>
<td></td>
</tr>
</tbody>
</table>
differences could be found between successfully and unsuccessfully proposed efforts to the government nondefense departments or any of the contracts with private industry. It was found, however, that for defense contracts the average program size, program duration, and average annual budget were all significantly larger for successful proposals than for unsuccessful proposals. It is most likely that this difference is attributable to the older follow-on contracts on which the DGS Corporation created its base business. Also, it is quite likely that the unsuccessful defense department proposals correspond to smaller efforts because they more likely represent new contract R&D work in an evolving and growing business area.

Differences in the contract characteristics between the different customer types were also investigated. Once again, due to the large standard deviations, only a few statistically significant differences could be found. With respect to program size, the successful defense contracts were found to be significantly larger than both government nondefense contracts and directly funded industrial R&D contracts. Due to the small sample size no statistically significant differences in the program size could be determined between defense contracts and those contracts with private industry where DCS was a subcontractor on defense work. With respect to contract duration successfully procured R&D contracts with private industry were found to be significantly shorter than successfully procured R&D contracts with the defense department. Finally, with respect to the average annual budget it was found that
defense contracts have a significantly higher average annual budget than private industrial contracts.

The above results have important implications for the management of DGS Corporation. In particular, it implies that management can expect to have a longer term perspective in terms of marketing and planning if DGS Corporation emphasizes defense-related work as opposed to industrial contract work. For example, with respect to marketing it is seen that higher expenditures would have to be allocated for industrial contract marketing than for government defense marketing. Furthermore, the marketing efforts would be more continuous and less discrete for industrial contract work than for government defense work. Finally, it is seen that DGS's management can anticipate to have larger program teams for the defense R&D contracts than for the industrial R&D contracts.

In addition to the above three contract characteristics, the differences in the percent research, design, development, documentation, and testing performed on contracts for the four different customer types were investigated. It was found that the standard deviations in the percentages of the type of work performed for the different customer types were very large. This indicated that there was a wide range in the distribution of the percent research, design, development, documentation and testing performed on contracts. Due to the large standard deviations no statistically significant differences could be found in the percentages of research, design, development, documentation and testing involved in the work performed for the different customer types.
CHAPTER 4

CONCLUSION

4.1 Summary and Conclusion

This thesis has been concerned with an in-depth investigation of one firm's experience in: (1) how contract R&D is marketed, (2) the factors that were found to be crucial to the successful procurement of a contract, and (3) how the characteristics of the resulting contracts vary from one customer type to another. Standard statistical tools have been employed to measure the extent to which the data supported or refuted those hypotheses which were formulated at the beginning of the research. The purpose of this concluding chapter is to discuss the extent to which these hypotheses have been supported and to comment on the implications of a few of these results. After this discussion a brief presentation is given of the several areas for future study that became evident during the course of this work.

4.2 Major Results and Strategic Recommendations

With respect to the characteristics of contract R&D marketing it was found that:
• In established business areas the initiative for an R&D effort was as likely to come from the sponsor as it was to come from the contract R&D organization.

• The proposal success rate was independent of which party took the initiative.

• Follow-on efforts have a slightly higher but statistically insignificant proposal success rate than non-follow-on efforts.

• Most potential efforts were identified by
  (a) previous work of the contract organization with the sponsor,
  (b) third party referrals to the potential sponsor about the technical capabilities of the contract R&D organization, or
  (c) third party referrals to the contract R&D organization about the technical needs of the potential sponsor.

With respect to the non policy-related marketing factors that were hypothesized to be related to the success of a contract proposal and the average annual budget, no single factor was found to explain a large part of the variance of the data. Of the non policy-related factors investigated, the ones that were found to be most highly correlated with the success of a contract proposal were:

• The commitment of the client's management to the project,

• Political factors within the client's organization,

• Competition from other firms, and
• The competence of the client's technical person who evaluated the proposal.

Also, the following factors were found to be most highly correlated with the average annual budget of the contract:

• The relevance of the project to DGS's business,
• Knowledge of the workings of the client's organization,
• The commitment of the client's management to the project,
• The personal relationship of DGS's management with the client's employees.

With respect to the patent, publication, noncompetitive posture and nonprofit status policies of DGS, it was found that:

• The noncompetitive posture of DGS significantly inhibits the contract procurement success of government defense and government nondefense contracts.
• The patent policy of DGS which states that DGS retains all patent titles and grants limited term exclusive licenses to its sponsors, significantly inhibits the contract procurement success of industrial contracts.
• The publication policy which states that DGS has the right to freely publish the results of its work performed for its sponsors, and the nonprofit status policy were not found to have a statistically significant impact on contract procurement success with any of the four customer types: government defense, government nondefense, private industry-DGS defense subcontractor, private industry-privately funded R&D.
Finally, with respect to the contract characteristics it was found that:

- The program size, program duration, and average annual budget frequency distributions could all be approximated by an inverse power relationship. The standard deviations for these distributions were found to be very large relative to the means of the distributions. Only one statistically different subgroup of the entire contract proposal sample was found. Successful defense contract proposals were determined to correspond to larger and longer programs than either government nondefense or private industrial R&D contracts. This is possibly due to the fact that DGS has had the longest relationship with this customer base relative to any other customer base. All other subgroups could not be statistically distinguished from each other due to the large standard deviations of the distributions.

- The percent research, design, development, documentation, and testing performed in the contracts for the four different customer types were found to vary widely. Hence, no statistically significant differences in the percent research, design, development, documentation, and testing performed for these different customers could be determined.
Given the above results, several strategies can be formulated to improve a contract R&D firm's marketing effectiveness and business viability. Since personal contact and third party referrals were found to be very important in identifying possible work, it is important that the contract R&D organization maintain as high a profile as possible so as to generate proposal initiatives from the potential sponsors. Because of the difficulty and costliness of maintaining a high profile in many technical areas, it is suggested that the contract R&D organization concentrate its marketing efforts in or near to those technical areas where it has the greatest strengths and reputation. The major difficulty anticipated in moving into a new technical area or customer market is the lack of the visibility and third party referrals found to be very important for generating proposals and obtaining contracts needed to support a successful contract R&D business area. It is suggested that to maintain the requisite visibility in a particular technical area the technical and managerial personnel of the contract R&D organization should work as hard as possible to generate personal and professional contacts in that area. The marketing methods to be used should be based upon the commonly accepted ways in which marketing is performed to the various customer types such as personal marketing for government work and brochures and pamphlets for industrial work.

Once work with a potential client has been identified, there are a few things which may be done to improve the success or detect the inevitable failure of a contract negotiation. It is important that a sense of the commitment of the potential sponsor's management to the
project and political conflicts within the sponsor's organization be determined as early as possible in the negotiation effort. Adapting the work statement, increasing the personal marketing effort, or minimizing those political conflicts that are under the control of the contract R&D organization should be done as soon as possible. Since the quality of the technical proposals was found to be uncorrelated with contract negotiation success it is suggested that less effort be put into the fine tuning of proposals and more effort be put into personal marketing so as to have an impact on the above factors during the contract negotiations. The contract R&D organization should have an understanding of the competitive environment that it faces. Based on the degree of competition an appraisal should be made of the likelihood that the contract R&D organization is the preferred organization of the potential sponsor. If it appears that the contract R&D organization is not the leading candidate for the effort, then it is felt to be unlikely that a justification of work with the potential client can be made on a noncompetitive basis.

In terms of the contractual policies of a contract R&D organization it is felt that a noncompetitive policy is not conducive to the development of new business efforts with the federal government. A contract R&D organization should not operate with this policy if possible. With respect to patents this study indicates that it is desirable in terms of obtaining industrial business for a contract R&D organization to have a patent policy whereby the contract R&D organization grants to the sponsoring organization all rights and titles
to patents developed in the course of the work with the sponsor. This conclusion is substantiated by the work of Roberts [Roberts, 1982] which indicates that the probability of obtaining substantial royalties (greater than $50,000 per year) from any patent is small. It is felt that the royalty revenue which would be lost will be more than made up for by the additional contract R&D revenue that would be generated by a liberal patent policy. Finally, it is suggested that a contract R&D organization publish the results of its work as much as possible. Publications increase the visibility of the contract R&D organization and provide credit and satisfaction to the technical staff members who performed the work. Little if any penalty in terms of lost contracts is incurred by the contract R&D organization with this policy.

4.3 Suggestions for Future Work

There are two investigations which would serve to complement and extend the results of this thesis. First it is suggested that a study be performed to determine the sponsor's views on the aspects of contract R&D investigated in this work. In particular, complementary information from the potential sponsor on why the potential sponsor was interested in contracting out for an R&D effort, how the potential sponsor identified the contract R&D organization as the one to perform the work, and why the contract negotiations were successful or unsuccessful would be useful for obtaining a much more objective understanding of the critical success factors involved in a contract R&D business. Second, it is suggested that a study be performed to model the dynamic response of the revenue
and personnel levels of a contract R&D organization if it were to change a major policy or if it were to enter a new business area. Such a model would be useful for upper management in determining the attractiveness of pursuing a particular strategic direction.

In summary, this thesis has attempted to provide insight into the marketing of contract R&D. It is hoped that the results of this effort will prove to be useful to those firms interested in improving the effectiveness of their contract R&D marketing efforts.
BIBLIOGRAPHY


APPENDIX A

LISTING OF THE QUESTIONNAIRE
QUESTIONNAIRE

The Effects of Marketing Methods, Organizational Policies, and Standard Terms of Agreement on Obtaining Research and Development Contracts

Please answer the following questions relative to the contract procurement efforts on the following project on which a formal proposal was submitted.

Program Title: _______________________________________

Marketing Methods

1. Did DGS contact the sponsor _____ or did the sponsor contact DGS _____? (Check one)

2. At what level was the initial contact made? (i.e., division leader, staff member, etc.)

   DGS ___________________________ Sponsor ___________________________

3. Within the sponsor's organization - how many managerial levels up the line did the sponsor's contact have to go to get funding approval? ___________

4. If DGS contacted the sponsor: How did DGS find out about potential work with the sponsor? (Check applicable method)

   __________ Information from RFP (Request for Proposal)

   __________ Staff member referral

   __________ Top management referral

   __________ Newspaper, magazine, or trade journal article

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Former DGS employees or co-op students

Conferences

Previous efforts with sponsor

Other

Specify: ______________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

5. If the sponsor contacted DGS: How did the sponsor find out about DGS?

Previous dealings with DGS

Name obtained from other DGS clients

Published articles in newspaper, magazine, or trade journal

Former DGS employee or co-op student

RFP (Request for Proposal)

Sponsor personally knew a DGS employee

Other

Specify: ______________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________
6. Amount of Planning and Travel Money Spent for Procurement of this Contract (Dollars): __________________________________________

Amount of Bid and Proposal Money Spent for Procurement of this Contract (Dollars): __________________________________________

7. Is this Contract a Follow-on Effort to a Previous Contract?
   _____ Yes  _____ No

7A. If Yes, then What was the Annual Budget and Duration of the Previous Contract? ____________________ Dollars/Year ___________Years

Marketing and Negotiating Success Factors

8. What effect did the following factors have on the success of the marketing and negotiating efforts?

   -4  = Strongly Inhibited Success
   -3  = Intermediate
   -2  = Inhibited Success Somewhat
   -1  = Intermediate
   0   = No effect
   1   = Intermediate
   2   = Promoted Success Somewhat
   3   = Intermediate
   4   = Strongly Promoted Success

8A. Previous work with the customer

   /___/___/___/___/___/___/___/___/___/___/
   -4 -3 -2 -1  0  1  2  3  4
8B. Previous work and experience in the technical area

/__/__/__/__/__/__/__/__/__/__/\  
-4 -3 -2 -1 0 1 2 3 4

8C. DGS's general reputation

/__/__/__/__/__/__/__/__/__/__/\  
-4 -3 -2 -1 0 1 2 3 4

8D. The uniqueness of DGS's technical capability

/__/__/__/__/__/__/__/__/__/__/\  
-4 -3 -2 -1 0 1 2 3 4

8E. The technical capability of DGS's work force

/__/__/__/__/__/__/__/__/__/__/\  
-4 -3 -2 -1 0 1 2 3 4

8F. DGS's facilities and equipment

/__/__/__/__/__/__/__/__/__/__/\  
-4 -3 -2 -1 0 1 2 3 4

8G. DGS's understanding of the customer's requirements and problems

/__/__/__/__/__/__/__/__/__/__/\  
-4 -3 -2 -1 0 1 2 3 4

8H. Cost of the proposed effort

/__/__/__/__/__/__/__/__/__/__/\  
-4 -3 -2 -1 0 1 2 3 4

8I. The proposed duration of the project

/__/__/__/__/__/__/__/__/__/__/\  
-4 -3 -2 -1 0 1 2 3 4
8J. Financial condition of the client

\[ \begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4
\end{array} \]

8K. Previous Independent Research and Development efforts in the technical area

\[ \begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4
\end{array} \]

8L. Geographical proximity to the client

\[ \begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4
\end{array} \]

8M. Commitment of the client's management to the execution of the project. Management here refers to those persons who have the authority to allocate funds.

\[ \begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4
\end{array} \]

8N. Knowledge of the workings of the client's organization

\[ \begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4
\end{array} \]

8O. Personal relationships with the client's employees

\[ \begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4
\end{array} \]

8P. Quality of the technical proposal

\[ \begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4
\end{array} \]
8Q. The competence of the customer's technical person who evaluated the proposal

\[
\begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

8R. Competition from other firms

\[
\begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

8S. Political factors within the client's organization

\[
\begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

8T. Relevance of the project to DGS's business

\[
\begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

8U. The managerial level of the person through whom the negotiations were conducted.

\[
\begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

8V. Other

\[
\begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

8W. DGS's noncompetitive posture

\[
\begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

8X. DGS's patent right policy

\[
\begin{array}{cccccccc}
-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]
8Y. DGS's publication policy

8Z. DGS's nonprofit status

9. Was the proposal content specifically directed toward particular individuals? _____ Yes _____ No

10. Do you feel that DGS had any particularly significant advantages or disadvantages in the contract procurement efforts? If so please explain.

11. In your opinion were DGS technical personnel _____ supporting, _____ directing, or _____ competing with the technical personnel in the client's organization?

12. Did DGS's efforts on this contract ever cause conflicts with the client's technical staff due to an overlap of the capabilities of DGS's and the client's technical staff? _____ Yes _____ No

13. How many potential competitors did DGS have on this project? _____ (I.e., how many organizations with the desire and the technical capability to do the work at the time of the contract procurement efforts were actively marketing the same sponsor?)
Contract Characteristics

14. Technical Area: ____________________________________________________________

15. Sponsor: ________________________________________________________________

16. Type of Sponsor (Check one)
   _____ (a) Government Defense (Count NASA as Defense Sponsor)
   _____ (b) Government Nondefense (DOE, NSF, DOC, etc.)
   _____ (c) Industry - DGS Subcontractor to Government Defense Work
   _____ (d) Industry - Funded Directly from Contractor's R&D Budget

17. Total Size of the Program (Dollars): ______________________________________

18. Duration of the Program (Years): __________________________________________

19. Average Annual Budget: _________________________________________________

20. Approximately what percentage of the work in this project was
    _____ research, _____ design, _____ development and assembly,
    _____ documentation, _____ testing and field support.

21. Approximately how many months elapsed between the initial customer
    contact and the submission of the formal proposal? _____ months

22. Approximately how many months elapsed between the submission of the
    formal proposal and the completion of the contract negotiations?
    _____ months

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APPENDIX B

SUMMARY OF THE STATISTICAL TECHNIQUES
USED IN THE DATA ANALYSIS

B.1 Chi-Squared ($\chi^2$) Test for Two Independent Samples

A. Data Requirements: data of nominal or better strength

B. Null Hypothesis: two groups are identical with respect to
some characteristic

C. Statistic Definition

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{k} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

where

$O_{ij}$ = the observed number of cases in the $i$th row and
the $j$th column of an $r \times k$ observation matrix

$E_{ij}$ = the number of cases in the $i$th row and the $j$th
column which would be expected if the null hypothesis
were true

$r$ = the number of samples

$k$ = the number of ways each subject can be classified
D. Computation of Significance Level: Tables are available [Hamburg, 1977] which provide the researcher with sufficient information to quickly evaluate the significance level of a specific chi-squared value for a particular number of degrees of freedom. The number of degrees of freedom is given by the expression:

\[ \text{degrees of freedom} = (r - 1)(k - 1) \]

If the significance value obtained from the table is smaller than the value required by the study's design, the null hypothesis may be rejected. If this is not the case, then the null hypothesis cannot be rejected.

B.2 Inference about the Population Correlation Coefficient, \( r \)

Assume that a simple random sample of \( n \) units from a population is taken and that paired observations of \( X \) and \( Y \) are obtained. The sample correlation coefficient \( r \) as defined by the following equation is calculated:

\[
    r = \frac{\sum xy + b \sum x - n \bar{y}^2}{\sqrt{\sum y^2 - n \bar{y}^2}}
\]

where:

\( r \) = Sample correlation coefficient

\( a \) = The \( Y \) intercept calculated from the sample of observations in a least squares linear regression fit to the sample data
b = Slope of the regression line as determined by the least squares linear regression fit to the sample data
\( \overline{Y} = \) The mean of the observations of Y in the sample
n = The number of observations in the sample

The procedure involves a test of the hypothesis that the population coefficient, p, is 0 in the universe from which the sample is drawn. The purpose of the test is to determine if the null hypothesis, p=0, is true or false. If the computed r values in successive samples of the same size from the hypothesized population were distributed normally around p=0, then only the standard error of r, \( \sigma_r \), would have to be known to perform the usual test involving the normal distribution. Even though r values are not normally distributed, a similar procedure is provided by the statistic

\[
 t = \frac{r}{\sqrt{(1 - r^2) / (n - 2)}}
\]

which has a t distribution for n-2 degrees of freedom. Given the number of degrees of freedom and the significance level chosen to be appropriate for the hypothesis test, a threshold for the acceptance of the null hypothesis, C, can be determined. The decision rule becomes:

If \(-C \leq t \leq C\), accept the null hypothesis

If \(t < -C\) or \(t > C\), reject the null hypothesis
3.3 Interval Estimation of the Difference Between Two Means

The method of the statistical difference of the means test for two large samples was the number of measurements in each sample and each sample's standard deviation to estimate a standard error of the difference between two means via the formulation:

\[ \bar{x}_1 - \bar{x}_2 = \mu_1 - \mu_2 \]

\[ \sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} \]

where:

- \( \bar{x}_1 - \bar{x}_2 \) is the difference of the means of the two sample populations
- \( \mu_1, \mu_2 \) are the means of the first and second samples
- \( \sigma_{\bar{x}_1 - \bar{x}_2} \) is an estimate of the standard error of the difference between the two means
- \( \sigma_1, \sigma_2 \) are the standard deviations of the first and second samples
- \( n_1, n_2 \) are the number of measurements in the first and second samples

For large samples the Central Limit Theorem implies that the sampling distribution of \( \bar{x}_1 - \bar{x}_2 \) is approximately normal even though the distribution corresponding to \( \bar{x}_1 \) and \( \bar{x}_2 \) may not be normal. Thus for large samples a 95% confidence interval for the difference of the means can be determined by the expression:
\[ C = 1.96 \left( \frac{\sigma_{\bar{x}_1 - \bar{x}_2}}{\bar{x}_1 - \bar{x}_2} \right) \]

and the decision rule for a difference of the means test is given by:

- If \( |\mu_1 - \mu_2| > C \) the difference of the means is statistically significant
- If \( |\mu_1 - \mu_2| \leq C \) the difference of the means is statistically insignificant

For small samples \((n < 20)\) the hypothesis test is more difficult to perform. A small sample test requires that the two distributions be normally distributed and that the t distribution be used to determine the 95% confidence interval.