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COLLABORATION IN TECHNOLOGY: AN EXPLORATORY STUDY OF UNITED STATES
INVOLVEMENT IN INTERNATIONAL COOPERATIVE TECHNOLOGY PROGRAMS

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COLLABORATION IN TECHNOLOGY: AN EXPLORATORY STUDY OF UNITED STATES
INVOLVEMENT IN INTERNATIONAL COOPERATIVE TECHNOLOGY PROGRAMS

BY

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DISSERTATION

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CHAPTER I
INTRODUCTION

Any two organizations are likely to have difficulty cooperating to achieve a common objective because of conflict over sub-goals, methods or personalities. Two company divisions, two government agencies, or two military services, cooperating on ventures may experience interdepartmental conflict. But in each case a supra-organization (the company management, the President, the Secretary of Defense) exists which has the power, control and the final word to resolve conflict. In the international context, however, relations between organizations from different nations cannot be governed by appeal to a supra-organization; no organization exists which both organizations recognize as sovereign. Therefore an international cooperative effort, or joint venture, represents a unique extreme in cooperation.

A growing interest and involvement in international joint ventures reflects the increasing inter-connectedness of the world. Joint ventures continue to increase in number and scope. A 1969 study shows a major upward trend in international joint ventures from 1946 to 1967 as compared to starts of foreign wholly owned subsidiaries (Vaupel and Curhan, 1969). Peter Drucker predicts that ^{as predicted to become} international joint ventures ~~will become~~ increasingly more important because they allow companies to exercise their advantages and cover their disadvantages. He points out that "the joint venture is the

most flexible instrument for making fits out of misfits. It will become increasingly more important." (Drucker, 1969, p. 722)

The benefits of international joint ventures are numerous and real. For example, to a corporate partner from an industrialized state, the advantages of a joint venture include new or expanded markets, resource availability, tax shelters, lower labor costs, and so forth. To a government partner of a less industrialized country the advantages might include technology transfer, industrial development and a potential tax source. However, the record of successful international joint ventures is poor. A 1971 study stated that fully one third of US joint ventures researched had ended in failure, defined as the dissolution of the partnership or a takeover by the US partner. Invariably, failure occurred during the early years of a partnership--if the venture lasted more than five years, it could be considered to be permanent. Reasons cited for venture "divorce" included partner disagreement on marketing and distribution policy, differing response to expansion and success, production decisions made for political reasons, and communication barriers, (Franko, 1971).

A special case of the international joint venture is the international cooperative technology program conducted by military components. The joint military program is of particular interest because it lies on the extreme margin of risk of the class of all cooperative enterprises, including the international joint venture. Each dimension of the joint military program contributes a major element of risk. As an international program, its managers must

contend with the expected problems of differing language, culture, tax structure, business and accounting conventions, geographical separation and government. As a technology effort, particularly a research or development project, it faces the conditions of high technological uncertainty, one-of-a-kind nature, and relatively short life. As a cooperative effort, the differing goals, strategies and procedures of two or more coequal "partners" directed at a specific end product challenges managers daily just to "keep on cooperating."

A program managed by the military and directed at achieving a military capability presents unique problems of melding military objectives, organizations and technology. Because military organizations, are charged with defense of the nation, ventures including military participants are more rigid and less likely to bend to changing conditions. Compromise for expediency may not be possible due to both the structure and required national orientation of the military participants. Also, the layering and bureaucratic nature of military decisionmaking systems subject an international joint venture to many potential naysayers. The variety of organizations within the military bureaucracy, each with a special interest, demand satisfaction before coordinating on decisions. In addition, the military's special passion for technology may affect project success in unpredictable ways. Shapero (1972) points out

The desire to try out one's ideas and the professional paranoia which is the role of the military have always combined to provide support for the largest fraction of our men of technology. The military needs of governments have always been a source of funds for the development of ideas that have no chance in the commercial marketplace.

The military, by virtue of the role it performs in society is required to support risky technology in order to avoid technological surprise and to take advantage of the state-of-the-art to improve its capability. As a result, once convinced of the need for a specific technological capability, a military agency may be less likely to quit a project despite early signals which may clearly indicate failure. On the other hand, if not convinced of the need for capability, the military agency may resist its development and production despite high probabilities of technical success.

Each of the separate risk factors (international, cooperative, technology and military) combine to produce a very high potential for failure. Although many projects of this type fail, there are also those which succeed. The factors which contribute to success in such a risky set of conditions are elusive, but if they can be discovered, their application should lead to increased managerial success in more congenial cooperative structures and conditions.

Therefore it is of interest to enlarge the body of knowledge concerning industrial and technological joint ventures in the international context. The study of international joint technology ventures is important to the development of national and industrial policy, to an understanding of the special problems managers face in that difficult context, and the study of the subject provides an opportunity to add to scholarly interest in areas of interorganizational theory, joint venture management and the management of technology-particularly project management.

The special case of the military joint project provides a controlled population of projects, constraints and managerial experiences which is tractable since military projects are a matter of public record, the constraints are partially defined by procurement law and regulation, and the individual participants are a rather closed community of military officers and civilians. Success may also be more easily defined in the military case than in comparable commercial programs since the programs are national in scope and subject to public scrutiny. At the same time the technology involved in military joint ventures ranges from basic research to production, the participants from two to twenty, and the degree of success from miserable failures to outstanding successes.

This dissertation addresses the military managed, international joint research, development or production venture and is designed to:

- (1) Explore international cooperative technology ventures as conducted by the US military, focusing on the plans and actions of the Department of Defense (DOD) program managers, and
- (2) Examine the factors which distinguish more successful from less successful international technology programs.

Representative Programs

Since World War II the United States Government has been involved or associated with a variety of military joint ventures. Among the ventures are programs in which the USG participated directly and joint programs in which the USG did not actively participate, but provided or obtained technology. Past joint ventures in which the US

Government (USG) was a participant include the Skybolt air launched ballistic missile with the British, the V/STOL (vertical/short take-off and landing) fighter aircraft and the MBT-70 (main battle tank) programs with Germany, and the MALLARD communications system with Britain, Canada and Australia. Each of these programs was a development effort and was terminated before completion. Reasons given for their termination were numerous, from lack of well defined national requirements to incompatible management problems (Baas, 1971; McGarrah, 1969; Sheridan, 1970).

Two cooperative production programs in which the USG participated, which were not terminated, were the NATO HAWK and NATO Starfighter programs. These two programs, though they experienced severe problems, have been termed successful primarily because there were large numbers of hardware items produced and used (Hochmuth, 1963; Cornell, 1969).

The Roland missile (France, Germany), the Concorde SST (Britain, France), and the Multirole Combat Aircraft Tornado (MRCA) (Britain, Germany, Italy) are examples of non-USG international cooperative technology programs achieving various levels of success. The US is producing, under license to France and Germany, the Roland II; the Concorde has suffered from a lack of follow through on orders by airlines for a variety of reasons, and the Tornado is now in production (Currie, 1975; Hochmuth, 1974; Knight, 1976; Aviation Week, March 13, 1978).

Ongoing US international cooperative technology programs include two Navy programs, the NATO Seasparrow and the NATO PHM Patrol Hydrofoil. Also, the "arms deal of the century," F-16 lightweight fighter cooperative production with Belgium, Denmark, the Netherlands and Norway, is a venture of the largest scale and is expanding through additional arrangements with other countries. But these large programs overshadow several programs such as the Air Cushion Landing System with Canada and the Reliable Acoustic Path Sonar with France. The General Accounting Office had identified 29 international cooperative research and development programs as of 1973. They varied in cost from a few thousand dollars to almost \$80 million and from basic research through engineering development to production (US General Accounting Office, 1974). Each program represents different levels of participation, partner combinations, costs and technological objectives, but each is a program which is managed at the extreme of cooperative ventures. From an in-depth study of these and other programs, insight into the management of joint ventures may be obtained.

The dissertation is divided into five chapters. Chapter II combines selected literature on international cooperation between governments, international joint commercial ventures and advanced technology project management focusing on what denotes successful from unsuccessful efforts. Chapter III describes the method of approach to the study including the specific questions which guided the study, the data collected and method of analysis. Chapter IV

presents detailed discussion of the data obtained to include results of interviews and questionnaires in light of documentary evidence obtained and discusses the discrimination between programs identified as more and less successful. Chapter V draws on the results reported in Chapter IV to answer in detail the questions posed in Chapter III. Chapter VI summarizes the approach and findings, develops theoretical and practical implications and proposes fruitful areas for further research.

CHAPTER II
LITERATURE APPLICABLE TO INTERNATIONAL COOPERATIVE
TECHNOLOGY PROJECTS AND PROGRAMS

As there is no organized or systematic body of literature concerning the area of military managed, international cooperative technology projects, three distinct literatures were drawn upon: those concerning project and program management in the single nation case, international joint ventures, and the small group of studies directly concerning international cooperative technology programs. The first literature is very broad and concerns project management; the parts relevant to this study include those concerned with the factors of information, communication, organization structure and personnel as they affect project success. Governmental program management, a special case of project management, is considered through the literature on bureaucratic policy and procedures. Relevant subjects treated in the second literature on international joint ventures include the reasons two or more economic entities form joint ventures, factors affecting joint venture success, and factors influencing stability and dissolution. The third literature, mostly anecdotal, combines technical project management with the international joint venture. Emphasizing military managed technology programs, it draws heavily on limited analyses of case study material and personal experiences. Program success is highlighted, and factors

influencing success are identified. Each literature raises several questions bearing directly on the nature of success in the international joint technology program environment and associations with success of possible independent or controllable variables.

Research and Development Project and
Program Management

Research and Development (R&D) projects can be viewed independently or as the building blocks for larger scale system or subsystem programs. Steiner and Ryan (1968) clarify the distinction between a project and a program:

To clear away the semantic bramblebush, we have chosen to distinguish among project, program and system by using the line of demarcation the interface between a Government agency and the organization (either industry or nonprofit organization) that produces an article. A project is concerned with the article below this interface; it encompasses the production of an identifiable nonrepetitive item, large or small in scope, under conditions of technical uncertainty, and to be completed at a specific time. A program is an undertaking of a Government agency which integrates one project with many others into a larger system to achieve agency goals. (Pp. 6-7)*

For purposes of discussion, R&D project management factors are developed under four topics, each centered around project success or failure. As the literature is developed factors of three types emerge: (1) factors which tend to enhance project success, but the absence of which has little or no effect on failure; (2) factors that tend to promote failure, but the absence of which does not

*Project management is found in areas other than research and development. Manufacturing, construction, oil exploration, film-making, etc., projects share the characteristics of uncertainty and other factors which would be interesting to explore, but for the purposes of this study only R&D project management is addressed.

insure or enhance success; (3) factors, the presence or absence of which appear correlated with success or failure across a "spectrum" of project success (Murphy, Baker, Fisher, 1974).

Project Management

Steiner and Ryan (1968) define project management as the management of "temporary problems complex enough to require special treatment (p. 1)." The type of problem for which a project organization is established is "urgent," "important," and "infrequent." Because an end product or task must be completed by a specific date, a feeling of urgency pervades the project organization. A separate organizational element created to manage a project is one indication of a project's importance. A functionally oriented organization may be inefficiently used to complete a project if the project type is "infrequently" encountered. Task magnitude and skill requirements of relative importance require the establishment of an organization which can be created with the task and disbanded after it is complete (Steiner and Ryan, 1968).

Information and Communications

Gruber and Marquis (1969) identify communication behavior and processes as one of the six major categories of factors necessary for the development and use of technology. Shapero (1970) maintains there are only two resources central to the innovation process: people and information. Human resources in the innovation process have been relatively well studied in the individual and organizational behavior

literature. Project information resources and processes, however, are less well understood.

Information and Project Success. Project managers and their team members are communicators of information to a high degree. Keith Davis (1962), for example, studied three project managers and found that over 95 per cent of their working time was spent communicating. Shapero, cited above, mentions a study of chemists which found that over 50 per cent of their time was spent communicating. The content of the communication and its relationship to success or productivity in projects is more elusive. Gerstenfeld (1970) suggests that information-communication processes are of two types: formal and informal. He indicates that not only are the processes of each type different, but that one differs from the other in the quality of information transmitted, the major communicators, and the purpose and time importance of the communication. Task information is usually communicated along formal organizational lines, while state-of-the-art information follows the informal process. Written communication is usually formal, while oral information is primarily informal. Gerstenfeld also mentions that two types of information are required by R&D organizations: operational information and knowledge building information. Operational information results from procedures and questions required for organizational functioning. Knowledge building information has no apparent purpose but is stored by the recipient to be collated with other information of both types for later use. Shapero (1975) further develops the concept of

information types. He concludes that information is divided into logistic information (where the information seeker knows what he is looking for but not its content) and an information "nutrient" (information which, when digested, becomes part of a person's general pool of knowledge to be drawn upon in the future).

Kast and Rosenzweig (1970) and Pelz and Andrews (1966) have shown that operational information (akin to logistic information) processes are necessary, but not sufficient for organizational success. Informal information processes which are healthy and well-developed are highly correlated with project productivity and success. Specifically, Pelz and Andrews (1966) found a strong relationship existing between colleague contacts, both internal and external to the organization, and individual productivity. Productivity was measured by peer ratings, patents and applications, and papers and technical reports. Bodensteiner (1970) demonstrated that the use of richer communication channels (face-to-face and telephone) in contrast to less rich channels (message and letter) was significantly higher in more effective project organizations and increased just prior to serious problems in less effective project organizations.

Communications Processes. Allen (1966) found that the flow of technical information follows a two- or multi-step process identified by Katz, et. al. (1955, 1958, 1963) in political and social contexts. Allen and Cohen (1969) found a major distinction between the majority of scientists and engineers who had few contacts outside the laboratory and the w "communication stars" or technological "gatekeepers" who

seemed to transmit the vast majority of information of all types within and without the organization. Shapero, Huffman and Chammah (1978) have shown that logistic type information is transmitted at a high level by supervisors, whether or not they demonstrate other high communication behavior. State of the art and laboratory technique information comes via two distinct types of high communicators. In each of these studies it is implied that project performance or task success is enhanced by the presence of high communicators, but it is difficult to find empirical data to support the implications. In the international context, Allen, Peipmeier and Cooley (1971) demonstrated the existence of high communicator behavior in a study of agricultural technology institutes. The international technological gatekeeper, who fulfills the same role in the international scientific and technical community, has the same basic characteristics as domestic gatekeepers. Again there are no data on their effectiveness in improving organizational performance.

In a recent study of 646 individuals directly concerned with various types of projects, Murphy, Baker and Fisher (1974) present several guidelines to project success. Project organization "parents" (the supraorganization from which the project organization was formed) clients and project organizations are all addressed in their conclusions. Murphy, et. al., conclude that more successful projects are highly correlated with short, informal lines of communication and with openness and honesty between the parent, client and project organizations. They also found that projects were hurt by "arms

length" relationships and client requirements for excessive detail in project performance reports.

Obvious barriers to successful communication and information transfer exist in the international environment. Language and culture as well as managerial rules, conventions and procedures can all preclude effective communication. Project and program management literature on communication-information indicates that short, informal lines of communication and high levels of information of an unstructured, "nutrient" nature are highly correlated with project success. Although not proven, indications are that some sufficient number of high communicators of state of the art information might be beneficial to project success. In the international context however, where precise communication is required, important questions arise. Are the informal, unstructured information modes as useful as in single nation projects? Does a high level of informal information help or hinder a project's success? How important is openness and honesty in international projects? Finally, if precise communication is required between participants, is there not a greater need for more detail concerning project performance?

Organizational Authority and Structure

Several authors raise the issue of organizational structure and project manager authority and their relationship to organizational success in project management. In a classic study of organization for innovation, Burns and Stalker (1961) identified two types of organizations in their analysis of technical firms in Scotland.

"Mechanistic" or bureaucratic organizations were highly structured with well defined rules of operation, communication lines and hierarchy of authority; they were less innovative and responsive to changing market conditions than organizations termed "organic." Organic structure implies an adaptive organization which supports a high level of informal communication while vesting authority for projects in those with appropriate personal expertise rather than tenure or rank.

Specifically with regard to project organizations, Keith Davis (1962) described four types of organizations directed at achieving some measure of managerial unity on projects: (1) expediter --dealing with all persons involved to assure schedules are met; only authority is persuasion and source of project information. (2) coordinator--unity of control vested in a staff leader with budget control. (3) confederation --similar to the matrix form discussed below, where the project manager shares control with functional managers but provides unity of direction to project workers. (4) general management -- "pure" project management, where the project manager has unity of control over all project aspects.

Cleland and King (1975) see the project form of organization of recent years as an outgrowth of a need to develop and produce major products in a short time. To them the project form of organization had little theoretical basis but grew from a design to meet the needs of the post World War II technological expansion. A design which retained the advantages of the project organization with the

theoretical benefits to be obtained from the functional organization, was the matrix organization which they address in some detail. The matrix organization structure centers around a small project staff with experts in the various functional areas, such as research, marketing, finance, industrial relations, etc., attached to the project but still being assigned to the functional units. In essence they have two bosses, a project leader and a functional chief. Conflicts which result from this dual leadership are difficult to resolve and appear to be the major drawback to the matrix form. Cleland and King present no empirical evidence to support their suggestion that the matrix form is superior to either the project or functional forms.

Marquis and Straight (1966) found, in a study of 37 projects conducted for the US Government, that neither the project form nor the matrix form performed better than the purely functional form. Their study was inconclusive, however, as to which organizational form performed best, which they readily admit. They do suggest that organizational form may not be the major variable in the success of R&D projects.

Murphy, Baker and Fisher (1974) found that most project managers feel that flexible, flat organizations of the project team are the most successful. Using a contingency theory approach, they stress that each project is different requiring a different organization appropriately tailored to the project. In all projects, however, project managers felt that decisionmaking should include key project team members and that a high level of coordination should exist throughout the project's organization, whatever the type.

Project Leader Authority. Authority in project management is considered to have two components: formal authority and influence. Steiner and Ryan (1968), in discussions with 16 recognized industry and government project managers, concluded that a project leader must have broad, formal authority over all elements of the project for it to succeed. Each manager interviewed stated that his client (in most cases the US Government) had granted him a much higher level of authority than was typical in that environment. The managers felt that the success of their projects was directly attributable to the significantly higher than typical authority that they were given. They also felt, however, that the higher authority was earned by their previous performance. Whether any particular project leader would perform better with higher than typical levels of authority is difficult to assess. Murphy, Baker and Fisher (1974) support the idea of increased authority, concluding that the project leader should have the authority to select the key project decisions. They also suggest that the project leader be selected on the basis of a proven record of technical, human and administrative skills.

Influence in project management is recognized as a significant contributor to project success and a close companion to formal authority. Steiner and Ryan state that the consensus of the 16 project managers they interviewed was that most project work was accomplished through the influence and unspecified informal authority of the project leader. Successful project managers obtain and maintain loyalties of competent specialists in functional areas and are thus

able to identify problems before they would surface to less successful managers. According to those interviewed, the personal factors that contributed to project leader influence were persuasive ability, conflict resolution ability, and ability to instill commitment to the project among team members. The project managers felt that the parent organization could contribute to the project leader's influence by giving him status and respect, by increasing the project's priority, and by building the leader's reputation.

Cicero and Wileman (1970) maintain that major reliance on the influence of the Apollo project managers reduced delay and conflict which the exercise of formal authority might have created and that personal influence contributed directly to the Apollo program's success. Unfortunately, Cicero and Wileman present no detailed data to support their contentions. Since formal authority and influence are closely tied together, their relative contributions are difficult to separate. Cleland and King (1975) suggest that influence, positively related to project success, only augments formal authority and that formal authority alone would actually detract from success if project leader influence were absent.

Fiedler (1969) found that task oriented leaders determined by the Least Preferred Coworker score (Fiedler, 1967) perform best in situations of power and influence over work group members, and where the leader has virtually no influence or power, task leaders perform better than relationship oriented leaders. In the middle range, where power and influence are only moderate, the relationship oriented

leader performs better than the task oriented leader. Fiedler therefore implies that the project situation described by the 16 project leaders, where greater authority than was typical was granted to them, task oriented leaders would perform best. In an international program with power reserved by the participant governments, Fiedler would probably suggest that a relationship oriented leader would perform better than a task oriented leader as project team chief.

✓ The literature on project management suggests that organization structure and project leader authority are important issues in the conduct of international cooperative technology programs. The research literature drawn from studies within a single nation suggests that a flat, organic structure, tailored to the particular project, yet flexible under changing environmental conditions, should contribute to project success. The selection of a project leader, it would seem, should be made from proven individuals, and the leader should be given a high level of formal authority. If he is given a high level of formal authority, he should be selected on the basis of high task orientation. If only moderate authority can be granted because of participant nation desires, then a relationship oriented team chief should be selected. After the selection of the team chief, the team chief should be allowed to design the project organization to "fit" his leadership and managerial style. As many questions are raised by the literature as are answered, though. Should the project manager be allowed to select the key members of the project team or should these decisions be left to international

agreement? What factors contribute to the exercise of influence in international programs? Is the exercise of influence by the project manager positively related to project success if he exceeds limits agreed to by national participants? Finally, is there a relationship between project manager authority, as indicated possibly by the number or types of decisions he is authorized to make (Marquis and Straight, 1966), and the amount of delay in implementation of those decisions in international projects?

Satisfaction and Goal Acceptance of Project Personnel

The makeup of the project team, the internalization of project goals by its personnel and their reaction to the project environment would appear to be important factors in determining project success. If clients, parent organizations and project leaders can affect project performance with personnel policies and leadership approaches in single nation projects, possibly the same or similar factors are important in international cooperative projects.

Typically, project teams include a mixture of specialists with expertise in engineering, production management, finance, contract administration, logistics, etc. (Cleland and King, 1975) With a diversity in background, education and experience, project team members may respond differently to attempts by the project leader or others to manage the team. For example, Murphy, Baker and Fisher (1974) suggested in their study of project management success factors that parent organizations should demonstrate enthusiasm for and commitment to the project team. Project managers should, at the

project outset, develop commitment and a sense of mission among project team members. They also suggest that project managers constantly stress the importance of meeting cost, schedule and technical performance goals. Murphy, et al, apparently assume that goal internalization by project team members is desirable for project success, and that by the techniques they suggest, commitment can be attained.

Some evidence indicates that too much goal internalization by project personnel could be detrimental to a project's overall success. Marquis and Straight, in a study of 37 projects cited above, point out that a strong bias toward improved technical performance at the expense of cost and schedule control existed in the company and government respondents. Marschak (1962), in his study of the Bell Telephone microwave relay system development, also observed that functional engineers may have been motivated less by the desire to improve the overall product than they were to perfect the devices of their own project, thereby delaying the system development.

Because of the temporary nature of a project organization, team members have different role perceptions from personnel assigned to functional organizations who have similar expertise. The isolation of the project team from the rest of the functional organization also contributes to different role perceptions of project team members. Reeser (1969), in a survey of project personnel, identified nine unique role perception problems:

- (1) Greater frustration due to ambiguity of authority.
- (2) Perceived lack of career progression.
- (3) Greater internal organizational conflict.

- (4) Multiple layers of management.
- (5) A relative lack of role definition and formal procedure.
- (6) An anxiety that no one is concerned about their personal development.
- (7) Significantly more anxiety about "make work" tasks when their project is terminating.
- (8) Experience with a series of transfers from one organization to another as a result of contracts phasing out and others starting.
- (9) A lower sense of loyalty to their organization compared to functional organization members.

In a study of Air Force engineers, Moyer (1974) identified several behavioral distinctions between engineers assigned to functional organizations and those assigned to matrix organizations. This study is of interest because the matrix design is the latest attempt to reconcile the project with the functional organization form. Moyer found engineers' perceptions to be similar to those reported by Reeser, above. For engineers assigned to matrix organizations, they perceive that they must give up advantages in personal growth, task assignment, opportunity to work to creative capacity, and freedom to choose job type and length. Job satisfaction among those assigned to matrix organizations was much lower than their colleagues' level of job satisfaction who were assigned to functional organizations. Murphy, et al, also found that project team members were more uncertain about their individual prospects following project

completion than were members of functional groups. They suggest that project leaders obtain commitments from parent management concerning job security of the project team members early in the life of the project.

Without commitment by the project team to the project's goals, projects have a lower probability of success. The project team leader's major task of developing commitment among his team members must be divided between insuring their professional growth and job security and orienting them to the project as distinguished from their functional specialty. In addition, the project leader must provide positive direction of the project by insuring effective control of performance, cost and schedule. In international projects, the foregoing factors seem just as relevant. The problem of generating commitment to the project may be significantly greater, though, if representatives from different national participants are members of the project team. Not only must they be directed toward the project from their functional specialty, but also from their national affiliation. From the single nation literature on project goal internalization and role perceptions of team members, it may be assumed that the problems experienced are magnified for an international project leader. For example, the project leader's ability to guarantee job security to team members will probably be limited. Maintaining contact with national decisionmakers responsible for job assignments and participating in project decisions which are differentially popular with different countries are two factors which will limit

a team member of a multinational project team from obtaining job security. Several questions arise from the literature on project personnel factors. First, how important is project commitment to international project success? If it is an important factor, what strategies can project managers use to develop commitment which also satisfy the realities of the international environment? How can client and parent organizations help to insure project success through project team commitment?

US Government Program Management

The literature on US Government program management is very broad and highly detailed. In the early 1960's a new classic study, The Weapons Acquisition Process (Peck and Scherer, 1962) and a companion follow up (Scherer, 1964) addressed the problems of US military program management. The two studies concluded that the most serious problems in military systems acquisition were schedule slippage, cost growth, and poorly qualified program management. Since those early studies the combination of increasingly costly weapons and very large efforts to control the process has met with only limited success (Fox, 1974). Although a variety of the perceived problems have been continuously attacked, several authors maintain that a basic change is necessary in the process in order to obtain the desired results of balancing capability with cost and schedule (Fox, 1974; Shapero, 1975). What conclusions can be drawn from US government success of international cooperative programs?

Major Criticisms of US Program Management. The most common criticisms of US program management include: (1) The process is out of control in that neither time nor cost estimates are depended upon, (2) The relationship between the government and industry, potentially a bilateral monopoly, leads to unbalanced bargaining which results in cost growth, schedule slippage and performance shortfall, (3) Instead of incentives for realism and efficiency, industry is tacitly encouraged to bid low and get well paid later through changes and follow-on contracts which balloon costs and forgive mediocre or poor management. (Logistics Management Institute, 1970; President's Blue Ribbon Panel, 1970; General Accounting Office, 1971). Defense of current practices stress the inevitability of cost increases in the uncertain advancement of the technological frontiers to improve military capability (McConnell, 1972).

Institutional Characteristics of US Program Management. Three aspects of US program management which seem to have the most relevance to our understanding of factors affecting success of international cooperative technology programs are the following: program changes, demand for control and overlapping responsibility. The penchant for change in US programs is highlighted by Fox (1974). He points out that it is not unusual for a major program to experience over 2000 major changes per year. Three types of changes predominate: configuration changes, frequently referred to as engineering changes, are those which change or alter the system itself, such as the modification, addition or deletion of a part or subassembly. Task changes affect the nature of given tasks such as test programs or

feasibility studies. Program changes revise quantities, performance specifications, delivery schedules, or funding rates. The magnitude of change costs is revealed in a General Accounting Office study (1970) of 52 major weapons programs which found that the programs collectively experienced a cost growth from changes of \$23.9 billion. McGlashan (1969) found that one source of changes was uncertainty in requirements resulting from pushing technology to obtain rapid results. He discovered an average of 46 per cent cost estimate growth on 924 contract change authorizations. Meiners (1974) found that four factors contributed to the majority of changes: change in operational requirements, uncertainty in plans and specifications at the time of contract award, changes in program direction or funding, and changes to take advantage of improvements in the state of the art. Instead of U.S. government programs being well defined, complete packages, they are in constant flux, affected by changes in budget, technology, and other disturbances in the environment.

The second characteristic of US program management which appears relevant to international programs is the preoccupation with control as the solution to problems of cost, schedule and performance shortcomings. Gerloff (1971) described the rapid rise in demand by Government officials for control through managerial techniques required by contract of US Government contractors. Fox (1974), stating the conventional wisdom on control says:

The term "control". . . refers to the process by which Government and industry managers maintain an effective and efficient utilization of resources as program objectives are realized. . . In practice, Government managers need to maintain some form of control over all major development and production programs,

regardless of the type of contract that is negotiated. This is increasingly true as more and more contractors fail to perform according to contract terms. (384) Several authors decry the increase in control by Government.

McConnell (1972) points out that the control demanded of contractors is part payment of the dues necessary for contractors to do business with the Government or "buying into the club." Melman (1970), a critic of the project management process, contends that military procurement practices and procedures which deeply penetrate industrial decision making. In an excellent longitudinal study, Gerloff (1971) found that the major increase in the sixties of Government contractual requirements to use specific management techniques failed to improve technical, cost or schedule performance. In fact technical and schedule performance decreased with increased control.

The third characteristic potentially having impact on international cooperative technology programs is the multiple layering of responsibility within the government procurement process. Although layering and overlapping responsibilities are to be expected in a government bureaucracy, in part due to the requirements for increased control, more and more agencies and offices are being included in the decision and review processes for government program management. As an example, Meiners (1974), lists 16 offices required to coordinate on change proposals for Navy ship systems. Given a program which has started on contract before requirements are firmly established and is operating under several control systems which oversee every aspect of the program, and which has a high level of interest due to the size of the funds which are committed to it, it is not surprising

to find increases in cost resulting from the necessity for significant changes to configuration, task or program. Accompanying the changes are delays resulting from the necessity to coordinate with each of the sixteen offices. Because delays past a given optimal point result in cost increases (Harman and Henrichsen, 1970), the program experiences cost growth and comes under the additional watchful eye of more agencies. The changes, control and layering contribute to the feeling that the system is "out of control" as concluded by the Logistics Management Institute (1970).

Factors and Questions for International Cooperative Technology Programs. Three factors appear as potential determinants of international cooperative program success: Application of US procurement processes to programs with other countries, control of changes and number of program review agencies. Avoidance of the US procurement process has been proposed as one of the key factors in the success of the Sidewinder missile (McLean, 1963), the Polaris Fleet Ballistic Missile System (Sapolsky, 1974), the Agena-Dupper stage orbital vehicle (Perry, et al, 1971) and numerous European programs (Perry, 1974; Shapero, 1969; and Fox, 1974). Several of these studies also showed that through very tight change control, a high degree of success was achieved. Recently, Office of Management and Budget (OMB) circular A-109 was enunciated which requires the US military to "couch its weapons procurement documents in terms of mission goals" instead of hardware specifications (Harlamor, 1978). Several questions are raised, do international cooperative programs which are most successful operate outside US program management? Are changes more or

less difficult to introduce under the most successful international programs? Finally, do different stages of development and production require different degrees of control? How much association with the US procurement system is necessary?

International Joint Ventures

A relatively small part of the literature on international and cross cultural management has to do with the international joint venture. International joint ventures are defined as ". . . a business enterprise in which two or more economic entities from different countries participate on a permanent basis" (Kolde, 1973, p. 192). Several studies have shown a major increase in the percentage of international business enterprises which are joint ventures (e.g. Vaupel and Curhan, 1969). Along with an increasing number of joint ventures is an increasing number of "divorces" in international joint ventures. Franko (1971) describes the divorce process and proposes a relationship between instability of joint ventures and time. The important factors affecting international joint venture success which may also have a major direct bearing on international cooperative technology program success are:

- 1) Top management objectives and changes in objectives
- 2) Changes in parent firm strategy
- 3) Time
- 4) Expansion of the Joint Venture
- 5) Identification of participants with joint venture vs. with parent cooperation
- 6) Product lines structure

Survival, Stability and Strategy. Success of international joint ventures is usually measured one of two ways: return on investment (ROI) venture stability. The first measure, venture ROI, is usually compared to other ventures in the same market or ventures of the same foreign parent. When measured by ROI, the joint venture looks like a poor investment either because total return must be shared with the local partner or the venture does not perform as well as other wholly owned ventures. However, what is not appreciated is either the insistence by the local government for joint effort in order to do business at all in that country, or the significant advantages accruing to a foreign partner of a local company in terms of reduced taxes, increased labor availability, lower tariffs and rapid attention to venture problems by the local government. Comparison between the success of joint ventures and wholly owned subsidiaries, on the basis of ROI, therefore may be questionable (Kolde, 1973).

The second measure of success, international joint venture stability over the long run, is apparently very greatly influenced by the product mix strategy of the major partner. Fouraker and Stopford (1968) in an analysis of the structure of multinational firms has shown that firms which have been most successful in recent years in maintaining joint ventures are what they term Type III organizations. Their type I, II, and III organizations are:

Type I: Smaller size than other types, lower advertising expenditures, lower research expenditure. Least likely to become multinational.

Type II: Large size, few product lines, highest rate of expenditure on advertising, high rate of expenditure on research, highest degree of interchange and specialization among producing affiliates. Highly likely to become multinational through wholly owned subsidiaries.

Type III: Large size, many product lines, lesser rate of advertising expenditure, high rate of expenditure on research, lower degrees of linkage among producing affiliates, e.g. Sperry Rand, FMC. Highly likely to become multinational through international joint ventures.

(Vernon, 1972)

Franko (1971) describes the latter two types as "product market concentration" (Type II) and "product market diversification" (Type III). He maintains that the Type II organization uses the joint venture as a vehicle for entry into a market, but, because of the firm's strategy and the long run stability and saturation of the market, shifts to wholly owned subsidiaries, dissolving the joint venture if possible. The Type III, using diversified strategy, tends to be much more tolerant of joint ventures because political and economic risk brought about by an unstable and unsaturated market is reduced through diversification. Vernon (1972) clarifies the reasons for the behavior of the two different types. To him the Type II firms have a much higher stake in quality and in a given technology because of their lack of diversification. The result is that Type II firms develop a more centralized organization requiring a high level of control. The Type III organization, on the other hand, sees itself selling a generalized know-how, the immediate application of which in a market is not so clear cut. To the Type III organization, knowledge of how their know-how "fits" in a particular market can be obtained much more readily through a local partner. The Type III organization

is more diversified, tailored to the specific markets it is in, and, as a result, it is able to work with a local partner reducing conflict as it arises.

Under the return on investment criteria for joint venture success, the Type II, or product concentration enterprise, may excell. Under the joint venture stability criterion, the Type III or product diversification enterprise has been shown to excell.

Joint Ventures: Reasons for Initiation and Termination.

Joint ventures, particularly international joint ventures, are usually formed for several basic reasons and continue because managers and their parents follow proven guidelines. Adler and Hlavacek (1976) in a study of twenty six US joint ventures found that the principle reasons for entry into an agreement for domestic joint ventures were:

- 1) Acquire expertise in production, technology, or marketing
- 2) Obtain needed capital
- 3) Concentrate on special skills of the firm (e.g. a small, high technology firm which had no interest in developing marketry experience)
- 4) Speed up new product and market development
- 5) Facilitate diversification
- 6) Reduce antitrust litigation threat (which was expected if an acquisition strategy were used.)

In comparison Kolde (1973) proposes that the international joint venture is formed for the following principal reasons:

- 1) Acquire expertise in management know how and techniques (host country)
- 2) Direct local capital into most productive enterprise (host).

- 3) Eliminate danger of domination of economic and politics by foreign industry (host)
- 4) Efforts by a new business class to enter into international markets (host)
- 5) Obtain new, expanded markets (foreign)
- 6) Obtain guaranteed labor force in new area (foreign)
- 7) Take advantage of implicit or explicit encouragement by home government (e.g. 1962 Revenue Act of US which allows US minority owner overseas to avoid business income tax if returns are reused in foreign (to US) country -- (foreign)

Probably the most complete analysis of reasons for international joint venture termination is presented by Franko (1971). His model of tolerance for joint ventures is based on an "aging" concept adapted from Chandler (1962). In the "aging" concept the international joint venture is seen as developing through stages following from the firm's product strategy choices (Stopford, 1968). Franko found that firms which chose to product concentrate (or limit the number of products sold on foreign markets) eventually developed an area-functional international structure (such as a European Division, or African Division, each with marketing, finance, production, etc.) Almost simultaneously they developed an intolerance for joint ventures. The intolerance followed a high tolerance for joint ventures during the initial stages of their international involvement.

Firms which chose a strategy of product diversification in foreign markets developed worldwide product divisions and maintained a high tolerance for international joint ventures. They did so because they had designed into the joint venture a reliance on the partner for information, labor force, lower political risk, and so

on. Competition was based on meeting needs for differing products rather than on price. Price competition tended to pressure the product concentrating firm into higher levels of quality control and more rapid decision making. As a result, the product concentrating firms could not accept less than normal quality or slower decisions resulting from the need to consult with the host partner. Type II organization product concentrating strategy led to the dissolution or takeover of the joint venture.

Application to International Cooperative Technology Programs.

Since little empirical work has been done on internal joint venture operations, the major treatment of the international joint venture literature is in the area of strategy and structure. If the basic strategy entering into international cooperative technology programs is to obtain a single weapon system, and the US has the majority of the technology to accomplish this, a parallel might be drawn to the product concentrating firm. Under the threat of external competition for the same military capability, the US could grow impatient with the delay of a multinational program and attempt to control the entire program at the expense of the other partners. Pressures to dissolve the program would mount leading to a potential US takeover of the program.

If instead the US were to take a product diversification strategy, the structure which would follow would be based on a variety of products or weapon systems. Designed into the overall structure would be a necessary reliance on other partners for critical components. Under the threat of external competition, the tendencies would be to

form a stronger bond and a more efficient structure. This condition occurs because no partner could proceed independently without great cost on any one of the systems, and could jeopardize his benefits to be received from the other systems under development or production. It could also be observed that nations would be reluctant to participate in a cooperative program to develop a very important strategic technology or capability.

Within the strategy of product diversification, what factors would insure interdependence of partners? Are key or strategic technologies present in the most successful or least successful programs? Would the international joint venture model suggest that program offices should supervise a set of cooperative projects related by technology rather than country? Would the technology project set permit tradeoffs between projects? Would the product concentration strategy model indicate that key or strategic technologies would best be developed at the exploratory development or research stage leading to a domestic program as it proceeded to engineering development and production?

International Cooperative Research and
Development Project Literature

The literature on cooperative R&D projects closely parallels the efforts within the north Atlantic Treaty Organization (NATO) to integrate the military forces of the sixteen member nations into a single defense force. With each nation using different equipment,

weapons, logistics procedures and fighting doctrine, integration seemed impossible. Early writers, such as Vandeventer (1964), and others, discuss issues of cooperative weapons procurement citing benefits and obstacles, and proposing an integrated NATO weapons policy. Early efforts emphasized NATO direction of cooperative weapons research and development projects, called the "institutional" approach, and met with little success. A more effective concept, the "permissive" approach, used NATO encouragement and sponsorship of two or more NATO nations cooperating on a development (Cornell, 1969). Later efforts, in the civilian aircraft and space realms, have followed the latter independent cooperation with sponsorship, and quite often total funding, from the home governments of the civilian industries. More recently, proposals to integrate European aerospace industry under NATO or an all-European industrial organization have been voiced (Callaghan, 1974; Behrman, 1971).

The literature on cooperative R&D is small and emphasizes case studies based on personal experience or unstructured interviews. Little analytical work has been done to explore the factors affecting R&D cooperation between countries. Probably the most comprehensive study is by Hochmuth, 1974, which analyzes six cooperative programs using the strategy-structure paradigm of Chandler (1962). Hochmuth's work grew out of his personal experience with two large scale programs -- the NATO HAWK low altitude missile defense system and the United States/Federal Republic of Germany (US/FRG) Main Battle Tank cooperative program (MBT-70).

Program Success

The implicit, and sometimes explicit, dependent variable, discussed in each contribution to the literature, is program or project success. A common definition for success in the international cooperative context, however, is not available.

To some, achieving the rigid criteria of a producible end item within a predetermined cost frame constitutes success, while to others, data exchange and even cooperation, itself, are degrees of success. For example, D. M. Davies, the industrial manager of the Anglo-French cooperative helicopter program, concluded before the 1971 meeting of the Advisory Group for Aerospace Research and Development (AGARD) that his organization achieved success in that each of their three projects produced end items in predetermined quantity. K. H. Heilmann, of the FRG Ministry of Defense, agreed with Davies' measure as the primary criterion, but also acknowledged secondary measures of national economic and technological interests. Even the proposed primary measure, a producible or produced end item has cost and time constraints which are regularly exceeded in normal projects, and requirements, when specified to include such measures of capability as speed, range and payload, are often compromised.

Another related aspect of successful cooperation is program completion, with or without an end item. If a program is terminated early, despite a recognition by all parties that further cooperation is folly, it is often deemed a failure, though some objectives may have been obtained. Hochmuth (1974) supports the early termination-equals-failure criterion. In the forward to Hochmuth's book,

Christopher Layton emphasizes program completion in specific cooperative efforts:

Why is it that Concorde, despite a strangely conceived structure, and aims which were a disconcerting compromise between two completely different views of the market, still goes on achieving its technological objectives, and seems to have inspired a lovehate relationship between Bristol and Toulouse? . . . Why did the American-German main battle tank project, heralded by trumpet blasts of rhetoric on the American side and led by a super high-powered management team, slowly disintegrate under the pressure of disparate industrial efforts and national technological conceit? How did ESRO (European Space Research Organization), a hospital patient teetering like its sister ELDO (European Launcher Development Organization) on the verge of death, recover, treated by the skillful hand of Hermann Bondi, so that today Europe, albeit after many compromises with national interest, now has a space programme after all? (xiv)

Baas (1971), concluded from extensive interviews of government and industry executives and document research that cooperative development programs cannot be considered failures if they do not lead to a producible end item or achieve original stated goals. Baas maintains that the partial success of jointly exploring technology toward an end item, the data exchange which results, and the overall broadening of the technological base of participant countries, constitutes reason enough for the original cooperation.

Howard (1974) also recognized that completion of an end product or achievement of the original stated objectives were inadequate measures of success. He specifically addressed Air Force projects and found that the US Air Force had no program for evaluating its effectiveness in international R&D project participation. He attempted to develop an a priori/ a posteriori evaluation scheme through a group of international technological gatekeepers (Allen, 1971).

In either a dichotomous success measure or one which recognizes multiple subjective measures, success as a dependent variable may only have meaning if its presence or absence affects future action. How does any success measure affect either political or managerial behavior? Does success in one program or with one nation, lead to renewed offers of future cooperation? Does failure in a project affect how management organizes and operates a future cooperative venture? If program success or the lack of it does affect future political and managerial action, do common factors exist which contribute to success or failure of international cooperative R&D programs? If so, what are these factors and how do they relate to each other and to program success?

Factors Affecting Program Success

The literature on international cooperative Research and Development has generated a variety of conclusions on factors that affect program or project success. For convenience the factors and conclusions are grouped by policy, organization, general management, leadership and technology implications.

Policy. The policy factors which contribute to or detract from success at the international level, include factors such as common goals, objectives, requirements, characteristics of international agreements, and the role of the policy representatives of the participants.

Common Goals -- Probably the key factor in initiating an agreement to cooperate is a mutually overlapping set of goals or

objectives for the concerned nations which signifies a mutuality of interest between them. Hochmuth (1974) observes that successful programs have more than superficially congruent goals shared by the partners. He specifically stresses that higher goals, such as a major military requirement, must be specifically addressed and found to be significantly overlapping by participants for successful cooperation. The program objectives must serve both participants' higher goals or program termination will result. Vitetta (1972) attributes the failure of both the MALLARD command and control program and the Main Battle Tank (MBT-70) program to failure to agree on common requirements, or higher goals, by each participant. Knight (1976) attributes an eightfold cost increase in the CONCORDE supersonic transport program to serious differences between Britain and France concerning commercial requirements. Cornell (1969) predicts that requirements and other higher goals will be less of a factor in the future because he sees a trend toward fewer participants per program and a greater opportunity to have a larger overlap in requirements. Quill, Heilmann and Chevalier (1971) all agree that common requirements kept their programs together. Quill points out that the prime requirement need not be identical for each participant, the end item. For example, the Jaguar strike fighter met both the British advanced trainer requirement and the French tactical support aircraft requirement due to similar required parameters of range, speed and payload.

International Agreement -- The instrument by which nations cooperate in an R&D project is a memorandum of agreement or under-

standing (MOU). It highlights and specifies what each participant must give up in terms of financing, technology, and sovereignty, and what they should receive in terms of end products, work shares, technology transfers and the like. The agreement usually addresses management structure, authority, payment procedures, conflict resolution policy and procedures. Details of the agreement dealing with organization, management and technology are discussed below. The work and cost allocations, escape clauses and other "rules of the game" have been shown to have major impacts on the life of a project. Hochmuth (1974) points out the critical nature of the original agreement and the effort which the participants must make to establish an effective conflict resolution policy:

Certainly not all eventualities can be foreseen; . . . But a multilevel series of discussions can reveal most potential areas of conflict and permit their resolution before they become political tempests. It is unlikely that a future board of directors will be able to reach a healthy agreement after a crisis has arisen if national or firm representatives cannot agree prior to the startup.

Sheridan (1970) specifically addresses the problem of cost allowance. He found major conflict between the US and FRG participants over allowable and nonallowable costs in the MBT-70 program. Behrman (1971) lists rules to be specifically decided upon prior to final agreement. They include, production sharing, financial burden, technology acquisition rules, and international payments. In addition he mentions cost and pricing policies, organization and management, technology transfer, and taxes and duties.

Role of Policy Representatives -- In almost every project or program discussed in the literature, a board of directors, or

similar group, was constituted composed of representatives from each participating country. Most authors look on the role and size of this group as crucial. Hochmuth (1974) found that each of the programs he studied had one or more transnational policy groups between the operating agency and the governments involved. He concludes that for a successful program (1) only one policy making board should be constituted, and (2) the board should be composed of top officials who would be responsible for the venture if it were purely national. The board must concern itself with policy issues, not issues of day-to-day management. Cornell (1969) would limit the board size to one representative from each participating country. Knight (1976) points out that in the CONCORDE program, the numerous policy groups were very cumbersome (and required reports over twelve inches thick for quarterly meetings of the Standing Committee of 40 people (Hochmuth, 1974, p. 146). Later in the program Geoffry Knight, the British Aircraft Corporation representative, would meet with Henri Ziegler of Aerospatiale for problem solving sessions. When they

. . . considered that we had a collection of problems that needed a decision at the top, he and I would hold very short meetings to take decisions. We often met a deux, or with no more than one or two other people with us, and then make swift work of clearing the whole agenda. I would like to think that this worked pretty well. (Knight, 1976, p. 107).

Other Factors -- Two other factors deserve mention here, though they are not considered major factors by most authors. First, broadening the context of a particular cooperative effort serves to allow a relaxation of constraints on the project itself. A project team which is allowed to extend beyond the original project's time

horizon permits experience gained by them and trust developed in their leadership and management to be applied to later projects (Hochmuth, 1963, 1974; Chevalier, 1971; Davies, 1971). Another aspect of broadening the context is to allow policy tradeoffs between several ongoing projects. For example, if Country A has a particularly high capability in tank technology and B a high capability in aircraft, a sharing arrangement which allocated work and costs across two resulting projects, rather than constrain allocation within each project, would logically benefit all participants. Chevalier (1971) and Davies (1971) have observed such a tradeoff arrangement in the cooperative helicopter programs.

Second, Catledge & Knudsen (1969), Vitetta (1972) and Knight (1976) all point out the problem of excessive government regulation and control in international programs. Apparently, government offices focus increased attention on international programs because responsibility is weakly defined (Howard, 1974) and the political risk is high. Knight attributes much of the increased cost and technical problems of the CONCORDE to government officials who were basically ignorant of engineering, sales and production, yet second guessed chief designers, sales and production managers. They even demanded the right to determine the aircraft basic weight (Knight, 1976, p. 81)!

Policy factors shown to be important in achieving success include insuring a major overlap in participant goals, a major effort at clearly establishing the "rules of the game," and creating and maintaining a small, single board of directors to decide policy

issues throughout the life of the program. By expanding the scope and life of the board to include an ongoing effort across several projects, and by reducing government involvement in the project, except through the board of directors, greater success should be achieved.

Organization. Two major organizational factors which appear to affect program success are the government operating organization structure and its relationship to industry.

Two views of the most effective government structure are presented in the literature. The first, proposed by Hochmuth (1963), and developed by others, maintains that only a single organization, operating full time, functionally oriented and hierarchical can achieve the degree of program orientation and attract the quality of people from each participant country to positively influence success. Hochmuth maintains that the single organization was a key factor in the success of the NATO HAWK program and generalizes the conclusion in the 1974 analysis of five other programs. Of the six he analyzed, neither the MBT-70, Concorde nor ELDO had a full time single management and these were the least successful programs he studied. Hockmuth maintains that without the full time management and unity of leadership, conflicting strategies which may be developed by the participants may not be resolvable. Cornell (1969) supports Hochmuth, correlating project success on the Atlantique, HAWK, and F104G with *small stable project organizations composed of high quality people representing each participant.* Sheridan (1970) and Vitetta (1972) both state that the MBT-70 failed in part due to the dual management

structure and resulting lack of interface between the full time US office and the part time German office.

Opposing views are held by Heilmann (1971) and others. Heilmann's experience with the multi-role combat aircraft (MRCA) Tornado was that each nation should maintain its own highly professional project office to manage its own variant and industrial contribution and protect its vested interests. A small coordinating group would handle the interface between national efforts. Although he admits that his proposed form can be cumbersome, he is impressed by its success. Davies (1971) supports Heilmann's views based on his experience with the Jaguar strike fighter. In that development there was virtually no overlap in development and production tasks, and few joint decisions were required. Each project office managed approximately one half of the system acquisition.

Problems have arisen with each of the two extremes. For example, the Concorde was managed with two project offices. Knight (1976) states that the total duplication of effort, which resulted produced a cumbersome, unresponsive management contributing to extensive delay and massive cost overruns. On the other hand, programs with single management organizations have also produced failures when the single organization failed to detect a major program deviation which drastically affected one participant's higher goals. In the Atlantique patrol aircraft, for example, Great Britain may have opted out because the British design was not chosen and, as a result, the work share was going disproportionately to France (Cornell, 1969).

Relationship of Industrial Participants -- Beside the structure of the government organization, the role of industry, including its decision making power, and orientation, is an important variable in project success.

Catledge and Knudsen (1969) identified several problems in US Government/Industry relations in cooperative technology programs. First, the US military procurement authorities viewed all cooperation as secondary to direct sales to foreign countries. The cooperative "spirit" was absent. Since emphasis was on direct sales and since US military officials did not view themselves as arms middlemen, they felt they must maintain an adversary relationship with the industry producing export items. The results of the relationship was a strong sense, on the part of industry, of over-control by the US Government. Congress helped maintain the adversary relationship through policies and laws perceived by industry as highly unfavorable, especially when compared to European government-industry cooperation. The foregoing attitude is in sharp contrast with European government-industry cooperation. Chevalier and Davies (1971) describe the attitudes of British and French government agencies in permitting and encouraging tradeoffs in the helicopter program and agreeing to be the supporting agency on the program in exchange for the lead on another. In the Jaguar program, Quill (1971) points out the ease with which SEPECAT (the joint company producing Jaguar) was formed under French regulation and was accepted by the British.

Hochmuth (1974) points out the necessity of the decision by the participating governments to consciously place the "seat of strategy*" in the government management agency or with industry. If the participants did not decide, industry automatically obtained the seat of strategy since they had the technical competence and information to make strategic decisions. If the participating governments decided to retain the seat of strategy, then contracting and administrative power and technical expertise were given to the government management agency in the more successful programs.

A conscious decision to determine the role industrial participants will play is determined essential to program success by Hochmuth. An understanding by the participating governments that a cooperative program is different from direct foreign sales, as Catledge and Knudsen point out, is necessary for program success so that the structure of laws, policies and regulations will not place unnecessary restriction on industry.

The literature seems to reach no consensus on the most effective organization for international cooperative technology programs. Questions which arise concerning organizational form include: Do the most successful projects tend toward a common structure, or do different structures fit differing conditions such as the objectives of the technology, the size of the program, or the number of participants? Under what circumstances does a coordinating organization

*Strategy as used by Hochmuth is Chandler's (1962) definition--"determination of the basic long term goals and objectives of an enterprise, and the adoption of courses of action for carrying out these goals."

function more effectively than a central program office having maximum authority? Do program offices with membership from each participating country perform better than those composed of members from a "lead" nation? Are programs more or less successful if the "seat of strategy" is at the industrial level vice governmental level? Should governments be actively involved in the program management or should they take a "hands off" stance?

Leadership and Management. The characteristics of the team leader, his approach to international program management, and his relationship with other organizations have all been mentioned as important to program success. The comments, however, are quite general and platitudinous. For example, Cornell (1969) concludes that leaders at all program levels, government and industry, must be competent, tactful, understanding of other participant's points of view and must have the will to succeed. Sheridan (1970) states that the program manager must be sincere and impartial. Hochmuth (1969; 1974), Cornell and Sheridan all stress the need for the program leader's strong commitment to program goals, even when they conflict with his own nation's goals for the program. A program orientation helps to insure that fewer decisions are made at the program office level for political, rather than technical purposes. Confidence in the program manager's fairness by participants helps to build trust in him and reduces the likelihood of participant over-management and usurping of the leader's authority. Also, trust established in one program carries over to the next program, making cooperation easier.

As one mechanism to insure that the program orientation is communicated throughout the organization, Hochmuth (1974) found that the program manager must control the reward system for his team members. Hochmuth's proposal, however, is most difficult to implement. If all members of the team are from the same nation and service, then the formal and informal control over the reward system can be designed into the project leader's position. If, as most authors suggest, the program office is multinational, the only way to insure reward is promotion within the program. Continuing programs, such as ESRO and ELDO (now combined into the European Space Agency -- ESA) allow much more of an internal reward system than a short term project. However, as pointed out by Hochmuth, if a person remains in an international program, he is essentially absent from his prime job and "out of the system" for that period. Because the contact (at least in the US systems acquisition process) between single nation and international program teams has been minimal in the past, an effective manager of international programs may be regarded as second rate by his national program manager.

Even if a program leader is program oriented and is able to generate program orientation in his team, he still faces a host of management obstacles to success. Communications, management procedures, and decision processes, under an almost given increase in cost and time (Stefanini, 1976) have been shown to be obstacles to success. Communications barriers are real (Davies, 1971; Hellmann, 1971). Although differing languages and cultures present problems, the problems are resolvable primarily through extensive face-to-face

communication. With widely separated operating facilities, travel is a must. Heilmann estimates that at least 15 per cent of the total MRCA workforce was travelling during the development phase and therefore, he urges separate, dedicated air travel and teletype facilities. In another aspect of communication, Howard (1974) found that cross program communications, such as between tank and aircraft program offices from the same countries, were nonexistent. Without cross communication, much had to be learned again and again.

Another major obstacle to program success has been the decision processes. Stefanini (1974) cites a common belief among European system acquisition leaders that both development cost and time are greater for a cooperative program than for a single nation program due to multiple decision layering. Knight (1976) estimates that collaboration added, at a minimum, 30 per cent to the cost of a program and that decisions and other transactions took up to four times longer in the Concorde program than in a comparable single nation development. Although logical arguments exist for these foregoing contentions, no empirical data are available to support them. Since projects are usually one of a kind, comparative data is difficult if not impossible to obtain though comparison within a single program might be possible.

Questions which arise concerning leadership and management include: What leadership style is most effective in international cooperative technology projects? Is a leader more effective if he has served on a previous international program team or directed a domestic program? What relationship exists between success, trust

and program orientation? Do the special problems of communication which exist in language, culture, etc., affect program success? How does delay in decisionmaking affect program success?

Technology. The vast majority of programs and projects discussed in the literature include or are centered on advanced technology. Is international cooperative project success affected by technology to a greater degree or in different ways than single nation projects?

✓ From the international cooperative case study literature three factors of technology seem to affect success: technology transfer and balance, technological objectives, and duplication of technological effort. Technology transfer seems to be one of the most important reasons for entering into a cooperative development (Catledge and Knudsen, 1969). Rather than to jointly create new technology, many countries tend to view cooperative developments as a means to obtain advanced technology. Because a greater technological capability often implies a military advantage, military leaders of nations possessing the more advanced technology logically want to protect the advantages and limit transfers to non-strategic technology. Heilmann (1971) suggests that programs which involve a two sided technology exchange are more successful than those where technology primarily flows one way. He maintains that when an imbalance exists, participant goals regarding key program technologies are conflicting. Conflicting goals could result in contention and a national, rather than an international program, orientation. An example of the behavior described by Heilmann is given by Vitetta

(1972). He found that US reluctance to release communications technology in the MALLARD program was one of the major factors in terminating the international program.

A second technological factor, program technological objectives (or place of the program in the R&D "spectrum"), also seems to affect success in international programs. Baas (1971) indicated that advancements in several technologies, required for the US/FRG V/STOL fighter, contributed to its early termination. The NATO Seasparrow, however, a ship defense weapon composed of proven subsystems, was more successful because of a position on the "spectrum" much closer to an operational system -- fewer technologies (and hence uncertainties) had to be developed. Also, under the criterion of success calling for a producible end item, the program with the fewer uncertainties has more of a chance to survive to production because it is exposed to cancellation forces for a shorter time.

A different favorable phenomena may exist at the other end of the R&D "spectrum." Analysts from the US General Accounting Office (1974) found that US-international cooperative basic research and exploratory development programs were more successful than engineering developments. Research and exploratory development programs required a significantly lower resource commitment and hence attracted less attention than engineering developments such as the US/FRG V/STOL and Main Battle Tank programs. The analysts concluded that the obstacle of differing requirements, policies, capabilities, attitudes and standards became particularly crucial in programs where end products were hardware rather than information.

A final aspect of technology which both serves as a motive for entering cooperative programs, yet contributes to their dissolution, is duplication of effort. Callaghan (1974) estimated that within European NATO nations duplication of technological effort was \$2.6 billion in 1974 and was composed of duplication due to parallel projects and duplication by partners in cooperative projects. Heilmann (1971) found in the MRCA (Multi Role Combat Aircraft) program that rather than reduce duplication of technological effort, participants continued efforts on program elements assigned to other participants because they feared that a pullout by one participant would set the entire technological effort back by years or destroy the program. As a result, cost shared by all participants rose creating pressures for participants to withdraw.

Possible technological factors affecting program success in international programs include the flow of critical technology, the location of the project in the R&D spectrum, and unnecessary technological duplication. A study of the literature has raised several questions about the effect of technology on international programs. First, is technology really a distinct factor in international, as compared to domestic, program success? Specifically, do programs which involve major technology sharing, rather than one way transfer, have a better record of success? Why? Does the program's R&D stage make a difference in international programs? What level of duplication is necessary for participant assurance of the program viability?

Table II.1 is a matrix of factors derived from the three literatures which have distinct application to the success of

international cooperative technology programs. Many of these factors are presented in the literature at such a general level that they are not useful or do not fit together in an overall management approach. The attempt of this research is to elaborate on these and other factors at an operational level and pose a compact body of knowledge of international cooperative technology management.

Questions Guiding The Research

The overall question which guided the research was: What denotes the successful from the unsuccessful international cooperative technology program? Referring to Table II.1 again it can be seen that the program management literature concentrates on leadership and management factors affecting program success, while the sparse joint venture literature is more organization structure oriented. Much conjecture and personal experience is put forth in the international cooperative technology program literature.

Transitioning from a single nation program and project management environment, extensively studied, through introduction of multiple sovereigns in the international joint venture to the additional complexities of military bureaucracy and high technology stretches the limits of empirical understanding. Analysis of Table II.1 raises significant questions dealing with management action to affect success in at least four major areas: environments of military bureaucracy, international relations and technological uncertainty, and management structure and procedures.

Table 2.1: FACTORS AFFECTING INTERNATIONAL COOPERATIVE TECHNOLOGY PROGRAM SUCCESS: Literature Derived Factors

Literature (Validity)	Project and Program Management (Strong)	International Joint Ventures (Medium)	International Cooperative Technology Programs (Weak)
Factor Categories			
Policy			
Goals Strategy	Sequential vice Parallel	Changing due to expansion (-) Changing market (-)	Goal Congruence, Defined Requirements
Agreements			Early identification of Problem Areas Clear, Impartial Conflict Resolution Policy Based on National Authority of Representative Single Board of Directors
Changes	Minimized		
Policy Representatives			
Government Role	Involvement in Decisions (-)		Regulation and Control (-) Between Projects and Over Time
Tradeoffs			
Organization			
Authority	Concentrated in Project Leader		Leader Control of Team Reward System Single Program Leader Single, Multinational Government Program Office Multiple, Single nation Project Offices Functional, Hierarchical Strong Government Control (-) Cooperative Government/Industry Relationship
Structure	Organic or Horizontal	Decentralized	
Industrial Relationship			
Size	Small supporting structure	Large, Based on sales Many	Multiple Projects
Product Lines			
Leadership and Management			
Information Communications	Nutrient Rich Channels (Face to face, telephone) Short, informal lines Honesty between clients, parents	Linkage, interchange between producing affiliates (-)	Rich Channels, High-level of Travel
Project Team	Goals internalized by project team Job security	Identify with joint venture rather than parent	Multinational, Small
Leadership	Ability to exercise authority, influence Selected on past project success		Selected on past project success Self-reliance oriented leader Leader program commitment Leader sincere, impartial, trustworthy Limited and segmented Based on trust
Decisionmaking Control			
	Through required managerial techniques (-)		
Technology			
Transfer/Balance			Sharing technology One sided transfer (-) Strategic or key (-) Research, exploratory development
Types			Engineering Development, Production (-) Components, subsystems proved Increased costs (-) Increases participant confidence
Duplication of Effort		On research	
Spending			

(-) indicates an inverse relationship between the factor and program success

In the relatively rigid military bureaucratic environment do project and program management conclusions hold when complicated by two or more "final authorities?" What international factors are germane to program success? Are there technological factors which are particularly important in international programs? Do organizational structure and management "make a difference" in successful programs? The following four basic questions were addressed by the research reported in this dissertation:

1. What is the association between military bureaucratic environmental factors such as decision review processes, funding policy, interagency conflict, and decision delay with the perceived success of international cooperative technology programs?
2. What is the association between international environmental factors such as geographical separation, cultural and language differences, national technological capacity, and management philosophy differences with the perceived success of international cooperative technology programs?
3. What is the association between collaborative arrangement and procedural factors such as the agreement to collaborate, program policymaking, conflict resolution, and program management structure with the perceived success of international cooperative technology programs?
4. What is the association between such factors as technological nature, complexity and stage with the perceived success of international cooperative technology programs?

CHAPTER III

RESEARCH METHODOLOGY

This study of international cooperative technology programs was an exploratory field of study of the determinants of success and failure in military sponsored programs where two or more countries were participating to jointly conduct research, develop hardware or produce systems or subsystems. Several authors have speculated on what are the determinants of success or failure in cooperative research, but as the previous chapter shows, little is known in a systematic way about the conduct of programs of this type and what factors contribute to or detract from success.

Selltiz, Wrightsman and Cook (1976) state that when areas of inquiry contain little of a systematic nature, the exploratory study is most appropriate. An exploratory study is one which is open ended with a major emphasis on the discovery of ideas and insights. The purposes of exploratory studies are not to verify theory or test hypotheses, but to "gain familiarity with a phenomenon or to achieve new insights into it, often in order to formulate a more precise research problem or to develop hypotheses." (Selltiz, et. al., 1976, p. 90) The study reported here generated a set of inferences, based on a variety of data sources used in a systematic exploration of international cooperative technology. The basic method of analysis was derived from the guidance provided by Glaser and Strauss (1967)

in the generation of grounded theory. Grounded theory, or "the discovery of theory from data" is inductive as opposed to a logico-deuctive theory based on ungrounded assumptions.

In discovering theory, one generates conceptual categories or their properties from evidence; then the evidence from which the category emerged is used to illustrate the concept. The evidence may not necessarily be accurate beyond a doubt. . . , but the concept is undoubtedly a relevant theoretical abstraction about what is going on in the area studied. Furthermore, the concept itself will not change, while even the most accurate facts change (Glaser and Strauss, 1967, p.23).

In keeping with Webb, et al, the study was designed to be balanced between reactive (interview, questionnaire) and non reactive data (document, archival) collection methods. As they point out:

No research method is without bias. Interviews and questionnaires must be supplemented by methods testing the same social science variable but having different methodological weaknesses (Webb, Champbell, Schwartz and Sechrest, 1966, p. 1).

The Research Questions

The central question behind the research was "What constitutes and is associated with success in international cooperative high technology programs?" The question may be divided into a subquestion concerning the dependent variable--"What constitutes success," and a subquestion concerning the independent variables--"What factors seem to produce or determine success." In the previous chapter on the literature relevant to international cooperative R&D, several factors were identified as possibly relevant to project success. They include factors about the program itself:

- 1) Technological goals
- 2) Net technology transferred

- 3) Stage of R&D
- 4) Number of participants
- 5) Program size in dollars
- 6) Schedule
- 7) Product or information oriented output

about the conduct of the program:

- 1) Level of management control
- 2) Degree of management control
- 3) Locus of strategy formation
- 4) Existence/authority of steering group
- 5) Control of change
- 6) Management structure
- 7) Formal and informal information channels
- 8) Decision processes

about the program manager and team:

- 1) Leadership style
- 2) Authority granted
- 3) Exercise of influence
- 4) Team size
- 5) Experience (single nation program vs. international context)
- 6) Commitment
- 7) National composition of team

The factors listed above as well as others appear to act on one another and on program success or failure in a complex, overdetermined manner in that no single factor can be considered as the determining

factor. Through the literature study and initial comprehensive interviews with US Air Force officials concerned with international R&D, a number of general questions were developed concerning success and failure in international cooperative technology. Among the questions that guided this study were the following:

1. What is the association between military bureaucratic environmental factors such as decision review processes, funding policy, interagency conflict, and decision delay with the perceived success of international cooperative technology programs?
2. What is the association between international environmental factors such as geographical separation, cultural and language differences, national technological capacity, and management philosophy differences with the perceived success of international cooperative technology programs?
3. What is the association between collaborative arrangement and procedural factors such as the agreement to collaborate, program policymaking, conflict resolution, and program management structure with the perceived success of international cooperative technology programs?
4. What is the association between such factors as technological nature, complexity and stage with the perceived success of international cooperative technology programs?

Data Collection Methods

The data collection methods used included:

- 1) preliminary unstructured interviews

- 2) questionnaire
- 3) follow up interview
- 4) documentation

During early semi-structured discussions a snowball sample of potential respondents to a more structured questionnaire and set of interviews was taken. Kadushin (1968) describes a snowball sample as

. . . a device for obtaining an open ended sociometric. Starting with a given list, usually a sample of some universe, each respondent is asked to name several others who are then interviewed, and so on.

During the field research document search and archival material was gathered separate from the interviews.

Initial Interviews. Initial open ended interviews took place with officials contacted during an earlier research (Ohman, Parker and Sweeney, 1974) and several identified and contacted by the Air Force Business Research Management Center at Wright Patterson AFB, Ohio. The 12 initial interviews, as well as the questionnaire and in depth interviews, used the critical incident technique to identify categories of factors and suggest potential relationships. The critical incident technique was developed during World War II by US Army Air Forces psychologists in the Aviation Psychology Program. The critical incident technique was further developed and reported on by Flanagan (1949a, 1949b, 1949c, 1951, 1954) who defines it as

. . . essentially a procedure for gathering certain important facts concerning behavior in defined situations. It should be emphasized that the critical incident technique does not consist of a single rigid set of rules governing such data collection (but) . . . a flexible set of principles which must be modified and adapted to meet the specific situation at hand.

The essence of the techniques is that only simple types of judgements are required of the observer, reports from only qualified observers are included, and all observations are evaluated by the observer in terms of an agreed upon statement of the purpose of the activity.

The general tenor of the technique is based on specific recall of the interviewee of especially good or especially bad behavior, conditions or performance. Interview and questionnaire questions using the critical incident technique asked respondents to remember occurrences which were particularly "bad" or "good." The questions asked during the initial discussions centered around those presented in Table III.1.

TABLE III.1

INITIAL DISCUSSION QUESTIONS

1. Think of the last time you observed an effective action on a cooperative program. Did that action help in a measurable way to achieve the level of success of the program?
2. I wonder if you could think of an effective action that did have such an effect. Tell me exactly what this person did that was so helpful at that time.
3. Think of the last time you observed an action which had a substantial negative impact on a cooperative program. What was that action?
4. What did this person do that was so destructive to the program at that time?
5. (For 1 - 4 above) When did this happen?
6. (For 1 - 4 above) How long had he (she) been on the program?
7. How old? Military or civilian?

Note: During the course of the discussion problems and solutions were addressed, but the attempt was made to center the discussion around these questions, and the critical incident count was applied based on responses to these.

Two basic principles underlie the critical incident technique:

(a) reporting of facts regarding behavior is preferable to collection of interpretations, ratings and opinions based on general impressions: (b) reporting should be limited to those behaviors which, according to competent observers, make a significant contribution to the activity (Flanagan, 1954).

The critical incident technique records specific behaviors from those people in a position to observe and evaluate. The list generated is then used to provide a sound basis for the development of inferences (Flanagan, 1955). To accomplish this during the initial discussions, each answer was recorded on tape and on pages of a data collection notebook. From the answers tentative factors were identified, potential relationships postulated, and more specific questions were developed for both the questionnaire and the follow on interviews.

The Questionnaire. A ten page semi-structured, open ended questionnaire (Appendix A) was constructed to obtain information concerning the following:

- 1) International technology exchange experience
- 2) Participation in international cooperative technology programs
- 3) Evaluation of the success of programs with which the respondents were familiar
- 4) A breakdown of problems and incidents into seven categories according to a modified system model of Kast and Rosenzweig (1970) and the application of the critical incident technique to each category. Categories were:

- a) Political and Economic Problems External to the Program Office--United States
- b) Political and Economic Problems External to the Program Office--Other Countries
- c) Technological Uncertainty
- d) Organizational and Structural Problems
- e) Personnel and Staffing Problems
- f) Problems Concerning Program Processes
- g) Other Problems

5) Determination if respondents viewed international programs as different management problems from US-only programs

- 6) Assessment of the value and costs of international R&D
- 7) Personal data

Space was provided for the assessment of three programs under item 4) above. The questionnaire was constructed according to the guidance of Babbie (1973) on question content, wording and sequence and on the writing and layout of contingency questions. Since it was not possible for a prior determination of a respondent's participation in international cooperation, the bulk of the questionnaire was based on an affirmative answer to a question concerning such an association. The questionnaire was pretested using ten individuals knowledgeable of international R&D and of the US procurement system; minor corrections were made and the questionnaire was distributed.

The questionnaire was sent to two groups of respondents. Group A was composed of individuals identified by others from the snowball sample and included Air Force, Army and Navy military and civilian

personnel who were known to have participated in international cooperative R&D. Group B was composed of a systematic sample of the population of all Air Force officials* who had travelled overseas on international R&D matters. Every tenth person, chosen alphabetically, on a list of the population was sent a questionnaire. 126 questionnaires were sent out of which 114 were returned. The very high return rate may have resulted from sponsorship of the study by the Air Force Business and Research Management Center and because all surveys of Air Force personnel must be approved by Headquarters, US Air Force. Table III.2 shows the return and response rates:

TABLE III.2
QUESTIONNAIRE DATA

	<u>N</u>	<u>Per. Cent.</u>
Questionnaires		
Distributed	126	100
Returned	114	90.8
Accomplished	96	76.2
Experience of Respondents		
No Relevant Experience	32	33.3
Relevant Experience	<u>64</u>	<u>66.7</u>
Total	96	100.00
Types of Experience for Each		
Program Assessment		
Program Office Members	54	59.4
Official Program Support	37	35.2
Knowledgeable but Unofficial Connection	<u>14</u>	<u>13.2</u>
Total Program Assessments	105	99.9*

*Totals less than 100 percent due to rounding.

*N = 1

Follow On Interviews. A second set of in-depth interviews was held to obtain a more qualitative, richer understanding of the problems and to determine the most important factors as perceived by as many of the members of the snowball sample as could be contacted. Forty-five Department of Defense, contractor and foreign military officials were contacted prior to and during the period which the questionnaires were circulated. Again the critical incident technique provided data on key factors and their relationships. The interviews were unstructured, and sought answers to the question: "When you think of cooperative research, development or production, what problem or issue comes to mind first?" Then, "Can you think of a specific program where this problem arose? Tell me about it." Although the interviews lasted up to three hours, varying degrees of specificity were not related to length of the interview. Much anecdotal information did arise in the interviews, but 53 critical incidents were obtained from the 45 interviewees. Flanagan (1949a) indicates "for complex jobs performed under a wide variety of conditions two or three thousand observations of critical behaviors have been found necessary to achieve stability (p. 45). Selltitz, et. al. defines stability as "the consistency of measures on repeated applications." (p. 183) Because it was impractical to obtain a larger set of observations to retest the same individual at a later date, stability was roughly attained through comparison with the previous interviews and questionnaire by using comparison categories. The 53 responses were divided into 16 groups with from three to 12 responses per group. Several responses fell in

more than one group indicating relationships between the groups. A list of the 16 groups is presented in Table III.3. The 16 groups listed below were further reduced to seven categories used in the questionnaire.

TABLE III.3
PROBLEM CATEGORIES

1. Technical Data Disclosure Policy
 2. Delay directly attributable to foreign aspects of program
 3. Legal restriction (US and foreign)
 4. Authority/Responsibility conflicts or inadequacies
 5. Requirements Specification
 6. Benefits to the US
 7. Communication Problems
 8. Allocation of Development and Production Work
 9. Standardization between allies
 10. Management at the Program Office level
 11. Foreign travel restrictions
 12. Confusion of Cooperative Ventures with Foreign Military Sales
 13. Cost and Finances
 14. Item production
 15. Adjustment to Change
 16. R&D procedures
-

Document. An effort was made to collect as much documentation as possible on each program included in the study to both confirm and clarify interview results and to attempt to obtain an historical track of the programs overtime. The data collection formats are presented in Appendix B. Data collected were from Air Force Systems Command Headquarters Forms 0-34, Project Status Sheet, from internally generated project material, and from correspondence files at several levels. The primary use of the correspondence files supplement and clarify data obtained from questionnaires and interviews.

The Data. Table III.4 shows the sources of data for each of the 32 programs studied. Sixteen programs were studied through the critical incident technique and open discussion during initial interviews. Eighteen programs were similarly studied in the follow-on interviews including six which had previously been discussed. The questionnaires provided the bulk of the quantifiable data including assessments of success and surfacing of problems in the seven categories used. Questionnaire data were collected on 26 programs although success ranking were unuseable for 2 of these. Finally, unobtrusive document data, used to support the data of the interviews and questionnaires and to map the formal communication flow, are collected on ten programs.

Table III.5 presents selected characteristics of the programs studied. The technology categories are the R&D stages and production stage as defined by the US Department of Defense:

TABLE III.4
 THE INTERNATIONAL COOPERATIVE PROGRAMS INCLUDED IN THE
 STUDY AND THE DATA SOURCES USED

<u>PROGRAM</u>	<u>INITIAL INTERVIEW</u>	<u>FOLLOWON INTERVIEW</u>	<u>QUESTION- NAIRE</u>	<u>DOCU- MENT</u>
NATO ATLANTIC	X			
NATO AIR DEFENSE			X	
NATO PATROL HYDROFOIL		X	X	X
NATO SEASPARROW		X	X	X
NATO STARFIGHTER		X	X	
NATO MRCA		X		
NATO FIGHTER F-16	X	X	X	
AIR CUSHION LANDING SYSTEM	X		X	X
COMBAT GRANDE			X	
BARE BASE PROJECTS	X		X	
DIGITAL SCAN CONVERTER	X	X		
DISPERSION STRENGTHENED ALLOY	X	X	X	X
E-3A AWACS (POTENTIAL NATO)			X	
F-111C		X	X	
F-4 COPRODUCTION	X		X	
F-5 COPRODUCTION	X		X	
GRC 103 RADIO BANDS		X		
MULTIMODE MATRIX DISPLAY	X	X	X	X
POLAR CAP II			X	
INJECTION LUMINESCENCE	X	X	X	X
MALLARD COMMUNICATIONS		X		
MBT-70 TANK		X		X
SKYBOLT		X	X	X
THRUST MEASUREMENT SYSTEM	X	X	X	
UPD-5 SIDE LOOKING RADAR	X		X	
UPD-X SIDE LOOKING RADAR	X		X	
V/STOL FIGHTER		X	X	X
V/STOL DEVELOPMENT		X	X	X
XJ-99 LIFT ENGINE		X	X	
OTHER CORESEARCH	X		X	
OTHER DEVELOPMENT	X		X	
OTHER COPRODUCTION	X		X	

TABLE III.5
SELECTED PROGRAM CHARACTERISTICS

<u>CODED PROGRAM</u>	<u>NUMBER OF GOVERNMENT PARTICIPANTS</u>	<u>CATEGORY OF TECHNOLOGY**</u>	<u>RANGE OF COST**</u>
A	2	P	V
B	2	X,A,E	L
C	2	R	L
D	2	E	V
E	2	A,E	H
F	2	E	V
G	6	P	V
H	2***	P	V
I	4	P	V
J	2	A	H
K	2	A,E	V
L	2	E	M
M	2	A	L
N	2	X	M
O	2	E	V
P	4	E	H
Q	2	X	L
R	2	X	M
S	2	A	H
T	2	E	L
U	2	X	L
V	2	X	L
W	2	P	L
X	2	P	H
Y	2	A	H
Z	5	P	V
AA	3	E,P	V
BB	6	P	V
CC	6	E,P	V
DD	3	E	V
EE	9	E,P	V
FF	5	E,P	V

* Categories of Technology
R - Research
X - Exploratory Development
A - Advanced Development
E - Engineering Development
P - Production

** Ranges of cost:
L (Low) - Less than \$1 million
M (Med) - \$1 to \$10 million
H (High) - \$10 to \$100 million
V (Very High) - more than \$100 million

*** Several Two Participant Projects

Research includes all efforts toward increasing knowledge of phenomena and environment as well as efforts toward solving scientific problems having no clear military application. As such, it includes both basic and applied investigations. Basic or fundamental research aims to satisfy man's curiosity in general areas of scientific interest. Applied research envisions a possible military use. Exploratory development includes all efforts to demonstrate feasibility or to solve specific military problems, short of major development projects, and may vary from fairly fundamental applied research to studies and investigations and minor development activities. Advanced development includes all projects which develop component and subsystem hardware for experimental tests. Engineering development includes activities that aim to develop engineered items for Service use but not yet approved for procurement or operation.
(Industrial College of the Armed Forces, 1968)

Production includes the construction and deployment of Service weapons and support systems.

The cost categorizations were determined on total program costs if the program underwent several R&D stages. The value assigned represented total contracted dollars including allocated share of US in-house effort for certain Foreign Military Sales items. The cost values used were: Very High (greater than \$100 million), High (\$10 to \$100 million), Medium (\$1 to \$10 million), and Low (less than \$1 million). Final figures were not obtainable. Several programs had not terminated or did not have all costs allocated at the time of data collection.

Table III.6 describes selected characteristics of respondents to the questionnaire. Of the 96 respondents, 64 had experience within a program office, on a supporting staff, or in an organization which gave the respondent special knowledge of a program. Twenty five respondents had no association with a program or chose not to identify

a given program. Seven respondents had no experience, and their questionnaires were considered unusable.

Table III.6 describes the differences in respondents' rank; training; experience in R&D (systems acquisition or production in years and by type of experience) and assessment of the value to the US of international technology exchange. Those with applicable experience were approximately equally divided between military officers and middle to upper level civilian managers. Relevantly experienced respondents had more training and more years of experience than their inexperienced counterparts. Civilians had approximately twice as many years of experience as military officers. Though not shown in the table, the job titles or types of duty of the military officers corresponded closely to those of the civilians except for approximately 20 per cent of the civilians who were specialists in procurement, law or engineering. Experienced respondents also had more of other types of international technology experience (data exchange agreements, international technology meetings or working groups such as the Advisory Group for Aerospace Research and Development, and exchange officer programs) than those who had no international cooperative experience. There was little noticeable difference between groups as to their assessment of the value of international technology exchange. The military officers tended to be more closely clustered around "great" value, although there was no significant difference in means.

TABLE III.6
SELECTED CHARACTERISTICS OF RESPONDENTS

	MILITARY		CIVILIAN	
	COOPERATIVE EXPERIENCE	NO EXPERIENCE	COOPERATIVE EXPERIENCE	NO EXPERIENCE
RANK (AT TIME OF STUDY)				
COL/CAPT GS-16*	8	2	2	0
LCOL/CHOR GS-15	8	4	8	4
MAJ/LCHOR GS-14	9	2	14	5
CAPT/LT GS-13	5	0	9	7
GS-11			1	1
	<u>30</u>	<u>8</u>	<u>34</u>	<u>17</u>
TRAINING (APPLICABLE)				
DEFENSE SYSTEMS MANAGEMENT SCHOOL	1	0	4	0
SYSTEMS PROGRAM OFFICE SCHOOL	5	1	1	1
PROJECT ENGINEERS COURSE	0	0	6	2
OTHER	16	0	15	3
EXPERIENCE (YEARS)	9.9	7.0	18.15	16.0
DATA EXCHANGES	12	5	13	12
INTERNATIONAL MEETINGS	19	3	16	14
EXCHANGE OFFICER	4	0	3	5
COOPERATIVE PROGRAMS	30	0	34	0
OTHER	6	4	5	3
RESPONDENT'S RATING OF VALUE OF INTERNATIONAL TECHNOLOGY EXCHANGE				
HIGHEST	2	2	7	0
GREAT	17	4	11	7
SOME/NO OPINION	8	2	14	8
LITTLE	2	0	1	2
NONE	1	0	1	0
	<u>30</u>	<u>8</u>	<u>34</u>	<u>17</u>

*For convenience only--not to imply equivalent civilian rank.

Analytic Approach

The analytic approach used in this exploratory study centers around the constant comparative method of qualitative analysis of Glaser and Strauss (1967). Within the constant comparative method the critical incident technique, discussed above, and the method of content analysis of questionnaire and interview responses was used. A descriptive analysis of documentary data was used to supplement the critical incident and content analysis. Results of each technique were used in quantitative and qualitative comparisons of programs to discover factors associated with relative success of international cooperative research, development and production programs.

The constant comparative method of qualitative analysis is described by Glaser and Strauss as having four stages: (1) comparing incidents applicable to each category, (2) integrating categories and their properties, (3) delimiting the theory, (4) writing the theory. (p. 105) During the initial stages each incident is coded into as many categories as possible. Each incident is compared against previous incidents in the same or different groups coded in the same category.

As his theory develops, the analyst will notice that the concepts abstracted from the substantive situation will tend to be current labels in use for the actual processes and behaviors that are to be explained, while the concepts constructed by the analyst will tend to be the explanations. (107)

Second, the analyst integrates categories and their properties. The analysis changes from comparison of incident to incident to comparison of incident to properties of the resulting category. Third, the theory is delimited--which means that both the theory and categories

become more well defined and modifications become fewer. The two major requirements of theory, (1) parsimony of variables and formulations, and (2) scope expanding to a wide range of applicability, emerge. Finally, writing the theory takes place from the analyst's coded data, series of memos, and the interrelationship of the resulting categories and their properties. (pp. 107-113) A modification to the constant comparative method was used to analyze the qualitative data in the interviews and questionnaires. As previously mentioned, the units of analysis for comparisons were critical incidents collected and treated as suggested by Flanagan (1954). The primary criterion for defining the categories was the relative success of the program from which the critical incident was drawn.

Content analysis, as described by Babbie (1973), consists of codifying and analyzing narratives to make descriptive or explanatory assertions about the group of narratives, usually literature, authors or respondents, or the social milieu which the narratives describe. Babbie suggests that the coding of survey responses is essentially content analysis. Seltiz, Wrightsman and Cook (1976) discuss the characteristics of content analysis:

Content analysis is objective in that each step is made explicit, systematic because material is consistently included or excluded on the basis of rules, and general because the findings should have broader theoretical relevance.

They further note that content analysis is applicable to material besides mass media, it is usual application, including: personal documents, unstructured interviews, patient-therapist interactions and so forth. The use of content analysis for questionnaire and

interview response analysis in this study followed the guidelines set out by Babbie and Seltiz, Wrightsman and Cook.

Content analysis was used also to develop potential associations between elements of responses through use of the Systems Analysis and Integration Model developed by Shapero, Rappaport and Erickson (1961). Qualitative associations between categories of problems resulted from the use of this model. The System Analysis and Integration Model is essentially a square matrix of interactions between categories. Interactions were determined systematically by applying critical incident and content analysis rules (strong, weak or no association) to questionnaire comments. Matrix associations for each respondent were summed to obtain a weighted representation of interactions between problem categories. The next chapter will describe each of the analytical techniques as they were applied to the relevant data.

CHAPTER IV

RESULTS

The data are reported in this chapter in terms of the data collection instruments used and comparison of more or less successful programs. In the following chapter the data are related to the research questions that guided the research. The data are presented below under the following headings:

Early Interviews

Questionnaire

Follow-on Interviews

Discrimination Between More and Less Successful Programs

Early Interviews

Interviews were conducted early in the research to determine the programs that constituted the population of international cooperative technology efforts by the US in the past two decades. The early interviews were also used to identify the critical issues in international cooperative technology as perceived by the interviewees experienced with international technology. The population of programs that resulted are listed in Chapter III, Table III.5. The structure for the categories of critical issues and problems and the interactions between them are based on an approach suggested by Shapero, Rappaport and Erickson (1961). The seven categories finally selected and used throughout the analysis are presented in Table IV.1. Further,

TABLE IV.1
 CATEGORIES OF PROBLEMS DEVELOPED FROM EARLY
 INTERVIEWS AND EXAMPLES IN EACH CATEGORY

Political and Economic Problems External to the Program--United States	-	Includes interagency, interservice problems; US political actions; Congressional inquiries; Inflation; Labor problems; other domestic issues not under the control or influence of the program manager.
Political and Economic Problems External to the Program--Other Countries	-	Includes changes in foreign governments; inter-bureaucratic issues; concerns of foreign military; legal differences; offset limitations; exchange rate differences; accounting practice differences; industrial capacity and capability of foreign participants; other foreign political and economic issues not under the control or influence of the program manager.
Technological Uncertainty	-	Includes state of the art problems in components, materials, processes, or manufacturing technologies; Scaling problems of previously proved technology; Systems engineering problems; other technological problems.
Organization and Structure Problems	-	Includes steering group authority and responsibility; Program office organization, authority, responsibility, procedures, relationship to higher national and international levels; Differences in R&D/acquisition philosophies, policies and rules between participants; Relationships to US and foreign supporting agencies, such as plant representatives, and to US and foreign contractors; other organizational and structural problems.
Personnel and Staffing Problems	-	Includes interpersonal conflict; exceptionally good-inadequate performance by specific individuals; Ability-inability to get good individuals from US or foreign countries; Ability-inability to place individuals at positions inside or outside program organization where talents could best be used; Ability-inability to remove inadequate performers; other personnel and staffing problems.
Program Process Problems	-	Includes goal formation, requirement generation, and specification process issues; Planning, programming and budgeting; Contracting; Control processes--configuration management, quality assurance, C/SCSC or similar systems; Communications processes including formal and informal channels, language and culture factors, dealing with non-DOD organizations; other program process issues.
Other Problems	-	Includes anything that clearly does not fall into one of the above categories.

the interviewees were asked to identify how they perceived success in international programs.

Success in International Cooperative Technology Programs

There is no accepted definition of program success in international cooperative technology. Interviewees indicated that success is viewed along several dimensions. The starting point for perceived success is the achievement of the stated goals as identified in the memorandum of understanding or agreement. For example in the Multi-mode Matrix Displays advanced development program conducted between the US and Canada, the stated goals include a cost, a sharing ratio, a time schedule and technical work to be performed: development of one prototype and four instruments (5" x 6") consisting of light emitting diode modular arrays with multifunction, flexible format operation; investigate and integrate into the design, human factors aspects of display resolution, contrast, and format selection; flight test; and completion and dissemination of a technical report (Multi-mode Matrix Project Agreement, 1974). Any or all of the stated goals could be modified throughout the conduct of the program by proper procedure. The degree to which the stated goals were reached or were modified has a bearing on perceived success. No known audit has been conducted to determine the extent to which stated or modified goals have been reached on international programs.

A second dimension for determining perceived success is the achievement of implied goals. The implied goals of the participants usually were well recognized by the interviewees. One implied goal

mentioned by several interviewees was the desire for production of the end item of an R&D program by one of the participants. Although the US entered into the program to obtain data for future development of a system or component, several other countries entered desiring the opportunity to produce or coproduce the end item; their intention, it was felt by several of those interviewed, was to obtain technical information from laboratories or contractors in the US which would be obtainable in no other way. Then they would produce an item for sale to the US based on the technology acquired. US officials stated that one of the US's own implied goals was to obtain Foreign Military Sales (FMS), or as one respondent said, "Coproduction degenerates to 'how many (aircraft) can we sell?'" Another US implied goal mentioned was the reduction in total expenditures of military forces stationed abroad. For example, cooperative productions in Europe were thought to increase European defense commitments, thereby reducing the need for the US to deploy and maintain as many forces there. Success is determined in the two cases above by the number of end items produced for foreign sale. The same measure was not considered applicable for research or development efforts where no end item was produced. Implied goals for cooperative R&D, even if they were known completely, were more difficult to isolate than those for cooperative production.

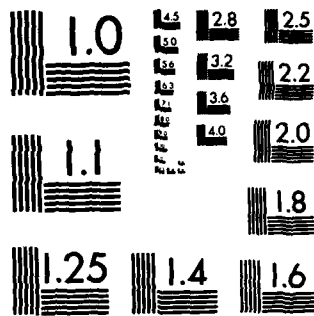
Another measure of success, mentioned by several interviewees, was terminations: If a program were terminated by the withdrawal of a partner or by mutual agreement, then it might have been considered a failure. To a great degree the failure of both or all parties to agree to continue work on a program to completion was considered a

measure of program success. However, during the interviews several programs were mentioned which had been terminated early yet were perceived as successes. Two reasons emerged for them being considered successful: (1) the quality of the data obtained at the time of termination was high enough for both parties to feel they "got their money's worth" from the venture, and (2) the opportunity to cooperate with the other country fulfilled a political need at that time which was no longer required.

A fourth dimension suggested by one of the interviewees was "Consensus"; he suggested that a poll should be taken of all those who had worked on the program to determine a consensus. The consensus approach was used in the interviews where a clear opinion of the success or failure of a program was indicated by the interviewee. Polling the individuals concerned with the program as a measure of success attempts to synthesize the other three dimensions into a usable measure of perceived success. Data on success ratings by interviewees were included with similar data from follow-on interviews and are presented below in that section.

Questionnaire

The questionnaire identified those respondents who had international cooperative technology experience in order to separate their responses from those who had other types of international technology experience but who were not familiar with specific international cooperative programs. The individuals with the desired experience were asked to judge the success of the programs with which they were most



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

familiar, to identify the number of program phases in which they participated, to determine the relative attention given in their programs to the problems identified above, and to make subjective comments concerning categories of problems which were relevant to the program or programs with which they were familiar.

Measure of Perceived Success

Each respondent was asked to judge the success of each program with which he was associated using a seven point semantic differential scale (Question 8). The scale range was from "Highly Successful" to "Highly Unsuccessful." The respondent was also asked to identify the phases during which he was associated with the program, from initial planning to program termination. Table IV.2 shows the distribution of responses (99) by the number of program phases in which the rater participated. The distribution shows a strong tendency toward assessing the programs as "highly successful." The literature on internalization of goals would suggest that an individual might tend to rate a program higher if he had been with it longer, however the data did not reveal such a tendency.

To discriminate between the more successful and the less successful international cooperative programs, each program was ranked by the mean of the respondents' success ratings, and only those programs that had four or more respondents were considered in the final ranking. Four respondents, the mean number for the sample, were considered sufficient for purposes of questionnaire analysis. The three highest ranked programs (S, Z and CC) and the three lowest

TABLE IV.2
 QUESTIONNAIRE RESPONDENTS' RATINGS OF SUCCESS
 COMPARED TO THE NUMBER OF PROGRAM PHASES PARTICIPATED IN

Rating	Phases Participated In					Total
	1	2	3	4 or More		
Highly Successful	1	7	8	8	12	35 (35.4)
	2	7	4	3	3	17 (17.2)
	3	6	5	4	2	17 (17.2)
Just Successful	4	1	2	4	2	9 (9.1)
	5	4	2	1	1	8 (8.1)
	6	2	0	1	1	4 (4.0)
Highly Unsuccessful	7	<u>3</u>	<u>0</u>	<u>5</u>	<u>1</u>	<u>9 (9.1)</u>
		30	21	26	22	99 (100.1)*

Chi square statistic = 16.4
 df = 18

p = .55 Siegel (1956)

*Does not add to 100% due to rounding.

$r_{xy} = -.84$ where x is rating
 and y is sum in each
 rating

ranked programs (E, H and K) were selected for more in-depth analysis in order to discriminate between the concentrations and kinds of problems associated with more successful programs from those associated with less successful programs. Rankings appear in Table IV.3.

The three programs rated highest included an aircraft cooperative production program with more than two nations participating, a naval cooperative engineering development program leading to cooperative production and having more than two participants, and an aircraft instrument advanced cooperative production program with two

TABLE IV.3
PERCEIVED SUCCESS OBTAINED FROM QUESTIONNAIRE RESPONSES
FOR 24 COOPERATIVE TECHNOLOGY PROGRAMS

PROGRAM (CODED)#	NUMBER RATING PROGRAM	WEIGHTED MEAN	OVERALL RANKING	RANKING WITH 4 OR MORE RATERS
A	1	5.00	22.5	
B	9	2.44	10	5
C	8	2.38	9	4
D	1	7.00	24	
E **	6	5.00	22.5	10
F	1	1.00	1	
G	3	2.33	8	
H **	5	3.40	16	8
I	4	3.25	15	7
J	1	3.00	12.5	
K **	6	3.83	18	9
L	2	3.50	17	
M	3	4.00	19.5	
Q	2	2.00	6	
R	2	3.00	12.5	
S *	6	2.17	7	3
U	3	1.67	4.5	
X	2	1.50	3	
Y	6	3.17	14	6
Z *	7	1.29	2	1
BB	2	2.50	11	
CC *	12	1.67	4.5	2
DD	3	4.33	21	
EE	1	4.00	19.5	

N=24

*Three highest ranked programs **Three lowest ranked programs

#Programs cannot be named because of guarantees to both questionnaire respondents and interviewees that their responses and ratings would be kept in confidence and not related to a specific program.

participants. The three programs rated lowest include an aircraft engine cooperative engineering development program having two participants, a related aircraft cooperative advanced and engineering development program with two participants, and an aircraft cooperative production program with more than two participants.

Distribution of Perceived Problems

To identify a distribution of problems as perceived by the respondents, they were first asked to estimate the fraction, expressed as a percentage, of the problems encountered by the program office which fell into each category listed in Table IV.1 (Questions 9 to 11). The purpose of this set of questions was to force a subjective distribution of problems to isolate problem groups as the respondents viewed them, so that critical incidents could be more easily categorized. The aggregate distribution is given in Table IV.4 and is composed of aggregate numbers of responses in each of ten percentage ranges for each of the problem or factor categories listed. As respondents could choose any percentage, the number of responses in each range were averaged and the averages normalized to 100 per cent.

Respondents were then asked (Questions 12 to 14) to provide critical incident narratives specifying the single most important incident causing the respondent to weight each problem category as he did in questions 9-11. The critical incidents were categorized into the seven categories listed in Table IV.1 by means of content analysis.

On the basis of the content analysis the problems were further sorted into first and second order problems. The first order problems,

TABLE IV.4
 PROBLEMS PERCEIVED BY QUESTIONNAIRE RESPONDENTS: FORCED
 DISTRIBUTION OF PROBLEMS BY FACTOR CATEGORY FOR ALL PROGRAMS

Factor Category	Weighted Average (n = 96)	Percentage
Political and Economic Problems - US	17.29	19.0 %
Political and Economic Problems -- Other Countries	14.27	15.7
Technological Problems	19.38	21.3
Organization and Struc- tural Problems	16.56	18.2
Personnel and Staffing Problems	6.25	6.9
Program Process Problems	12.40	13.6
Other Factors	4.90	<u>5.4</u>
		100.1%*

*Does not add to 100% due to rounding.

those initial problems in a train of events, were separated from the second order problems, those resulting from the first order problems. For example, several respondents identified a problem of incompatible funding processes between the participants which resulted in delayed funding decisions. The delayed funding decisions resulted in increased costs to all participants which strained the cooperative arrangement. The first order problem--incompatible funding processes--needed to be separated from the resulting chain of problems encountered by

the program. An association matrix approach, suggested by Shapero, Rappaport and Erickson (1961), was used to separate first order from second order problems without eliminating the associations or content of the second order problems which had been implied or stated by the respondents. Table IV.5 shows the matrix of associations suggested by respondents between first order and second order problems as developed from the content analysis of the critical incidents.

The distribution of first order problems which resulted from summing the cell counts in each first order problem category, is presented in Table IV.6. The two categories of problems originating external to the program account for almost 50 per cent of the problems as perceived by the respondents. The two "external" categories represent the non-technological environment of the program--the dimensions of uncertainty resulting from the international and cooperative natures of the program. Thus almost half of the problems encountered by the program resulted from the collaboration.

It can be noted that problems associated with technology are weighted at slightly over ten per cent. One of the major reasons for international cooperative technology programs is to generate or transfer technology, yet the category is only weighted at less than half of the two non-technology environment categories. Apparently, technology, the third dimension of uncertainty in international cooperative technology programs, presents relatively few problems compared to the economic and political environments.

Second Order Problems. Among the consequences of first order problems were subsequent, or second order, problems. The second order

TABLE IV.5
 ASSOCIATIONS BETWEEN FIRST AND SECOND ORDER PROBLEM CATEGORIES DEVELOPED FROM CONTENT
 ANALYSIS OF QUESTIONNAIRE RESPONSES:
 ALL PROGRAMS

First Order Problems*	Second Order Problems							Totals	Distribution
	1	2	3	4	5	6	7		
1	17	14	14	8	3	36	2	94	22.9
2	12	11	16	15	4	40		98	23.9
3	3	5	27	1	1	8		45	11.0
4	5	9	5	16	4	30	3	72	17.6
5			2	3	14	12		31	7.6
6	7	13	14	5	2	21	2	64	15.6
7	1	1	1			1	2	6	1.5
Totals	45	53	79	48	28	148	9	410	100.1**
Distribution	11.0	12.9	19.3	11.7	6.8	36.1	2.2	100.0	

*Problem Categories: 1--Political and Economic External to the Program Office--US
 2--Political and Economic External to the Program Office--Other Countries
 3--Technological Uncertainty
 4--Organization and Structural
 5--Personnel and Staffing
 6--Concerning Program Processes
 7--other

**Does not add to 100 per cent due to rounding

TABLE IV.6
 DISTRIBUTION OF FIRST ORDER PROBLEMS ENCOUNTERED
 DEVELOPED FROM CONTENT ANALYSIS OF QUESTIONNAIRE
 RESPONDENT CRITICAL INCIDENTS: ALL PROGRAMS

<u>PROBLEM CATEGORIES</u>	<u>TOTALS</u>	<u>PERCENTAGES</u>
Political and Economic Problems External to the Program - US	94	22.9%
Political and Economic Problems External to the Program - Other Countries	98	23.9
Technological Uncertainty Problems	45	11.0
Organization and Structure Problems	72	17.6
Personnel and Staffing Problems	31	7.6
Program Process Problems	64	15.6
Other Problems	<u>6</u>	<u>1.5</u>
	410	100.1%*

*Does not add to 100% due to rounding.

problems are of particular interest because program management has the chance to operate on them to affect the outcome of a train of events resulting from a first order problem. Continuing the earlier example of incompatibility of participants' funding processes, the second order problems of delayed decisions, cost increases and potential program termination might be affected by program management through design or action. The effect of delayed decisions might be avoided by shifting resources and effort to other program areas independent of the specific decisions. Future cost increases might be avoided by larger early buys of components. If cost increases are thereby minimized and resources more effectively used in the interim, less of strain on the cooperative arrangement to be expected. First order problems may be ameliorated by program management; however second order problems can be addressed directly at some point in the chain of events by design, strategy or response by program management. Successful programs might be distinguished from unsuccessful ones in the allocation of scarce management resources between first order and second order problems.

Problems Revealed by Response Content

Several major problems were clearly revealed by the subjective responses to the questionnaire. The problems identified in the questionnaire responses paralleled those mentioned during the initial interviews. In the area of US-influenced factors external to the program office, problems of bureaucracy, financial procedures and legal restrictions are shown in the representative comments below.

Problems of bureaucratic politics included actions and inaction by higher echelons concerning various programs:

Not a real "USAF" (US Air Force) program thus did not get total US support. Negotiations by DSAA (Defense Security Assistance Agency) were conducted without USAF concurrence, attendance or knowledge.

US promised unrealistic completion date--one of the factors contributing to early termination.

Push by Headquarters, AFSC (Air Force Systems Command) to demonstrate operation to Congress before an appropriate cushion (technology) had been fabricated.

Funding problems, especially with the matchup of the US and other nation's funding processes, mentioned above, caused the program offices extensive delays waiting for both processes to be complete:

Air Force budget procedures do not permit the flexibility for the program manager to respond in a timely manner.

Enormous difficulties in getting funding from US; this caused costs for various items (e. g. Missile Simulator Test Set) to rise by 50% for all participants.

Funds for Canadian program competes at local level with all other programs. There is no separate source of funds for international cooperative programs. There is no tangible support for these programs from Hq AFSC or USAF. Only words.

Canadian fiscal year runs from April 1 to March 31. This is indirectly reflected in late technical reports and USAF forward financing problems.

Legal restrictions in the US and abroad caused the program office and higher echelons problems in cooperative problems. One example reflected a continuing problem for staff agencies attempting to establish cooperative efforts:

Difficulty of waiving "Buy American" rules when Canadians were clearly far superior technologically.

In the area of international politics, decisions were made or actions taken which may not have been in the interest of the program, yet served political goals. The program office had to contend with problems such as these:

US determination (OSD (Office of the Secretary of Defense)) that use of foreign engine in prototype system was mandatory (even though not best for system) or program would not get US approval.

On one occasion the Air Minister complained to the Secretary of the Air Force about the radar operation. The result: overreaction by USAF to this cocktail party comment took only a short time to resolve-lessons learned.

Leverage was applied by the participant through State Department and OSD to insure their demands were met.

The importance of personal diplomacy was shown in these two examples:

During program planning and the negotiations with (other country) the lack of trust caused some bitterness. (Other country) believed the US was not buying as extensive a system as they should within the funds available.

Extreme sensitivity by other governments to preservation of status as partners rather than buyers of US hardware.

Within the participating countries events took place or conditions existed which impacted on the conduct of the cooperative program:

Government sensitivity to socialist party activities hindered construction and equipment installation.

Canadian Department of Industry, Trade and Commerce organizational structure and procedures too rigid to facilitate vital exchange of information.

Difficulties of getting speedy, timely, sufficient, collective foreign national approvals backed by financial commitment of adequate force.

Foreign country insistence on building engine their way for their long range goals instead of what was best for prototype.

And financial and work sharing arrangements were restrictive to the extreme:

Basis of US/UK agreement was equal work for respective contractors. Equating this to monetary value and then to work division resulted in endless negotiations. A very difficult, almost impossible basis to administer.

The % of Balance of Payments presented a problem in the engineering development (ED) proposal effort since the overall program cost in ED had to be established before the % cost in each of the participating governments industries could be calculated. It became an iterative process to determine cost and what particular item was to be "fabbed" in the overseas contractors.

Tickets were purchased on participating government airlines to balance the gold flow.

Technological factors mentioned included a distrust of other nation technical abilities, unwillingness to transfer technology and a lack of communication of technological differences between partners. Also mentioned were technological factors which would have been present even if the program had not been a cooperative one.

Reluctance, or absolute refusal, of US to accept with good faith, technology and equipment of European origin. This is partly due to Navy pressure: US Navy's exceptionally rigid shock requirements for electronic equipment bolted or welded to a deck vs. European "plastic deformation" shock mounting.

(Other country) withheld technical design details of engine and test-failure analysis which prevented proper assessment of development risk and impact by system program office.

Dismal failure of (Major Army) program was based on a total lack of understanding of American vs. European manufacturing design standards. Although (other country) officers sat at desks (at US company), US Army personnel would not reconcile differences in European and American mechanical engineering and it is suspected that the (other country) officers could not understand American practices.

Although concept had been demonstrated, application to large aircraft was uncertain--concern born out by technical problems in the air cushion bladder.

For an engineering development of a radar system:

Program involved development and fabrication of high risk components--No way to measure total system performance.

Organization and structural factors which were mentioned by the respondents included comment on the role and usefulness of higher echelons, collateral agencies, and complex interrelationships of these organizations with the program offices.

Fractionated organization structure due to number of MAJCOMs (Major Commands)/SOAs (Separate Operating Agencies)/Centers involved.

Air (Force) Staff functioning as a filter did not permit full and free communication flow between the SPO (Systems Program Office) and the customer. (Note the word "customer" applied to the participant). (Parallel program) did not experience the same problem. Direct contact between SPO and country team was permitted for the (Parallel program) but not with (our program).

Program office organization worked well internally and with (other country) Ministry of Defense and Air Force. Reporting channels thru Sec'y AF and OSD were totally ineffective and poorly defined. Excellent support and assistance from Air Staff. AFSC (Air Force Systems Command) was of little help.

Disagreement between SPO and Contract Administration Agency on who performs CAS (Contract Administrative Services) functions in Europe. Europeans felt that they could control their contractors with almost no help from US. We disagreed.

Other countries' officials speak for their government; US official approves, then changes later when higher echelons disapprove.

Inability of US program manager to act as an international manager: regardless of international agreements, the US Navy hierarchy must be followed.

Closely associated with organizational and structural factors are the quality and assignment of qualified personnel to upper echelons and the program office by all participants:

US representatives on (engine) program were not assigned to or made responsive to the system program manager. They pursued a laboratory design approach without due concern for the overall system.

Poor organization resulted in a lack of (other country) participation in the program office. As a result decisions required of (other country) took excessively long.

No (other country) representatives with authority assigned to the System Program Office.

(Other Country) late in assigning well qualified technical representatives. They were also very inexperienced in program management.

Lack of knowledgeable personnel at Hq USAF and their unresponsiveness to Foreign Government questions.

Trying to interest the best qualified people to take an active part in the program.

Qualified foreign nationals were extremely hard to hire. . . temperamental. . . caused delays in implementing improvements.

Program process factors included requirements generation, communications and contracting procedures:

Lack of adequate definition of program gave many contractual problems.

US requirements which were in excess of what the Participating Governments had agreed on, and which delayed the contract award for both the system and the LLTV (low light level TV).

A system should be set up for us in the "hinterland" to carry on a phone conversation without being preempted by some Washington bureaucrat or career Pentagon-er.

Direct contact between USAF contractor and Ministry of Defense when contractor was unhappy with USAF management decisions. . . not enough contact with USAF program manager.

Examination and modification of US contracting techniques to the extent necessary to accommodate the program and to insure its success.

Some of the other problems which were mentioned but do not clearly fall in the other categories of problems include:

Some confusion results from language differences (while all (program) Steering Committee Members and Deputies are required to speak English, there is room for vrying interpretation of words).

The sales effort on the part of the United States and the contractor was so hectic that lower echelons were unable to live within established policy.

The (other country) have made changes to their program without notifying us. There is a problem since the (program) contractor is responsible for the automatic digital interface between the Spanish and French systems.

Follow-on Interviews

The follow-on interviews were designed to further develop the categories of problems associated with international cooperative technology and to obtain critical incidents in terms of problems encountered by the interviewees and their association of the problems with perceived success. On some programs in-depth narratives were obtained, while on others just brief incidents were mentioned. The interviews provided both information on how some key program problems were handled and a broad coverage of problems of many programs.

Program Success

First order problems were also identified through the critical incident technique during the interviews. At the same time the critical incidents were related with positive, negative or neutral assessments of program success by the interviewee. One hundred and sixty-eight out of 220 critical incidents were determined to be either positively or negatively related to a program through

interviewees' assessments. Negative assessments outweigh positive assessments by a factor of almost two to one. Table IV.7 displays the breakdown of positive and negative responses by program for programs.

TABLE IV.7

ASSESSMENTS OF SUCCESS BY INTERVIEWEES:
CRITICAL INCIDENTS DETERMINED TO BE POSITIVE OR NEGATIVELY
ASSOCIATED WITH PROGRAM SUCCESS FOR 22 PROGRAMS

PROGRAM	INTERVIEW RESPONSES		
	POSITIVE	NEGATIVE	NET
A	1	1	0
B	5	22	-17
C	2	3	-1
F		2	-2
G		1	-1
H **	5	16	-11
I	5	3	+2
J		2	-2
K **		19	-19
L	4	1	+3
M		5	-5
N	1		+1
O		3	-3
P		5	-5
T		2	-2
Y	4	2	-2
Z *	2	2	0
AA		1	-1
BB	6		+6
CC *	23	13	+10
EE	3	13	-10
FF		1	-1
TOTAL	61	117	

(N = 22)

* Highest ranked by questionnaire

** Lowest ranked by questionnaire

In terms of the highest and lowest rated programs, interviewee and questionnaire assessments are displayed in Table IV.8 for top and bottom rated program. The top three interview-rated programs were combined with the top three questionnaire rated programs. Program CC is included in both top three ratings, but neither of the other top three questionnaire rated programs received net positive comments (defined as the total positive comments less the total negative comments for that program). The bottom three interview rated programs included two of the bottom three questionnaire rated programs. Although a rough correspondence existed between interview and

TABLE IV.8
COMPARISON OF ASSESSMENTS OF PROGRAM SUCCESS BY QUESTIONNAIRE
RESPONDENTS AND INTERVIEWEES: THREE HIGHEST AND THREE LOWEST
RANKED PROGRAMS FROM EACH SOURCE*

PROGRAM	QUESTIONNAIRE		INTERVIEW	
	RATING	RANK (N = 10)	NET POSITIVE RESPONSES	RANK (N = 30)
Z	1.29	1	0	7
CC	1.67	2	+10	1
S	2.17	3		**
BB	2.50	**	+6	2
L	3.50	**	+3	3
B	2.44	5	-17	29
H	3.40	8	-11	28
K	3.83	9	-19	30
E	5.00	10		**

* Only nine programs are listed due to overlap.
** Insufficient responses for ranking.

questionnaire respondents' assessments of success, the questionnaire assessments of top and bottom ratings were used for further analysis due to the more systematic method by which they were obtained.

Distribution of Problems

As with the questionnaire, problems were categorized through the critical incident technique from incidents reported by interviewees. The distribution of problems encountered as perceived by the interviewees is presented in Table IV.9.

TABLE IV.9
DISTRIBUTION OF PROBLEMS AS PERCEIVED BY INTERVIEWEES IN REPORTED
CRITICAL INCIDENTS

<u>Problem Category</u>	<u>Number of critical incidents by category</u>	<u>Per cent</u>
Political and Economic Problems External to the Program--US	63	28.6%
Political and Economic Problems External to the Program--Other Countries	34	15.5
Technological Uncertainty	35	15.9
Organization and Structure	22	10.0
Personnel and Staffing	17	7.7
Program Process Problems	46	20.9
Other Problems	<u>3</u>	<u>1.4</u>
	220	100.0%

The distribution of problems shows the largest problem concentration on political and economic problems in the US of almost 30 per cent. Almost half of the responses in this category resulted from three programs, B, K and CC of which the latter two are included in the group of the three highest and three lowest ranked programs from the questionnaire assessments. Program K, an Air Force cooperative development program, was discussed with two former key members of the system program office. Much of their discussion in the political and economic area centered on the termination of the program. The former Deputy Program Manager said:

(Program) termination came as a big surprise. Colonel (Systems Program Director) presented status of the program at a US/(Other Country) Steering Committee meeting at Edwards AFB, California, at which several programs were being discussed and reviewed. The program status was OK through the definition phase and he wanted a decision to go into full scale development (leading to production). Both governments were apparently behind the program, but it was terminated anyway at that meeting. Officially, both governments felt that the program was going to be too costly to proceed. I felt that the (Other Country) Vice Minister for Defense, on his way to the meeting, stopped off in Washington to meet with the US Director of Defense Research and Engineering. In a personal chat, though the minister spoke reasonably good English, he erroneously got the impression that the US wanted to opt out. The Director got the same message from the Minister. Apparently each country thought it was doing the other country a favor by cancelling the program.

And from the other member of the program office:

Program wasn't really terminated; just didn't go into the prototype construction phase. The evaluation for the construction phase was completed; the decision not to proceed was made by Secretary of Defense. It appeared to me that there was a misunderstanding between the (Other country) and Secretary of Defense, each thinking the other country wasn't really interested. In addition, the procurement philosophy at that time did not include prototypes unless a firm requirement existed for the system. Since

there was no definite requirement and since it seemed that (Other country) didn't really want to proceed, program was cancelled.

Two points to note from this narrative are (1) that the steering committee was not uniquely associated with Program K--other programs were also under their purview, and (2) that US political action coupled with a lack of a strong requirement for the program's system placed the program in jeopardy. The first order problem in Program K was the lack of US support at the Secretary of Defense level, which was apparently unknown to the program office. The lack of support was such that another first order problem, the communications breakdown between the US and other country Minister, led to cancellation.

Program CC, a Navy cooperative development and production program, experienced a US bureaucratic problem that almost brought the program to a close:

When the development program was formed, the Foreign Military Sales Act of 1968 was not in being. The Act required that all purchases from stockpiles be at actual cost plus an overhead charge. The original Memorandum of Understanding, signed by the US, provided that the US would supply a major subsystem around which the system was designed. At that time a price was decided on and the cost, work, and balance of payment shares for the Participating Governments established. When it came time for the US to deliver the subsystem, it had gone out of production, and a later modified subsystem of the same type replaced it in the US inventory. The cost for the new system was several times higher than the older system, which was still available, but in war reserves. Replacing the war reserves would require either starting up the production line on the older system or replacing them with the new systems. As the Foreign Military Sales Act read, cost of the new subsystem would be charged to the program. Resulted in a Steering Group meeting which led to the US member going to the Secretary of the Navy. Result was that the cooperative spirit of the program was gone, the program delayed for several months, and the program cost significantly increased.

The first order problem resulted from the lack of flexibility in the US procurement law at that time to accommodate the special requirements of an international cooperative technology program. The resulting second order problems were cost escalation, schedule stretchout and a major threat to the cooperative arrangement as the program was entering production. The problem was ameliorated somewhat because of trust by the Steering Group members of one another. The problem was partly solved by effective response to the problem by the US member of the Steering Group. He was able to have the price reduced so that the program impact was tolerable by the other countries.

The second category of problems of note is the category of program process problems with a weight of 21 per cent. Problems in this category included problems of contracting, communications and objective setting. In the contracting area:

Under the conditions of assembly of (program H) in the participating country, the reputation of the US is so important, affecting all other cooperative as well as FMS (Foreign Military Sales) items, the US protected itself by inserting a contingency clause in the contract with the US prime contractor which said that if the other country's prime contractor is unable to complete its portion of the cooperative production the US prime would complete the production so as not to cause embarrassment to either country.

Several of those interviewed mentioned the critical role of communications, not only internationally, but within US management structures. An example of the results of inattention to communications problems is the following:

On the (missile) program with the Australians, the program manager was required to go by military aircraft to save the money of a commercial ticket. Out of a planned 17 day trip, he sat on the ground awaiting transportation for 14 days, leaving him only three in Australia. When he had arrived, all the decisions had been made by the Australians, and the cooperative program folded, apparently because they felt that the US wasn't interested.

Another problem of communications is having too many communicators. One program had seven major contractors and five government agencies (including two other country program offices). In one meeting concerning the interface of the aircraft with its high technology engine, representatives from each organization were present. The problem concerned responsibility by the contractor teams for the area of interface. The individual interviewed said that there were 25 to 30 different conversations going on simultaneously and "everyone came out of the meeting at the Embassy after talking his own problem, and nothing was solved. The decision was finally made after several months by a US official, and everyone abided by the decision."

In speaking of two potential US/European cooperative developments that never came to pass, an Air Force official commented on the objectives or requirements matching problem:

For friendly governments to incorporate US technology in their requirements, they must know something about the technology. At least two to three years before the technology is generally known to other countries, either who are not allies or who do not have the technology base to absorb the particular technology, the efforts should be revealed to them (friendly governments).

Of particular note as with the questionnaire data is the paucity of incidents in the personnel and staffing problems area (17 of 220 comments) considering the emphasis on personnel in the R&D

management literature. Both incidents concerned the feeling in the military R&D community that being a program manager for an international cooperative technology program is a "dead end job." One former manager's view is:

The program manager's job in cooperative R&D is viewed as an additional duty. It's very easy to get burned. As a result good Air Force managers shy away from them.

Another's:

The international area is avoided by program managers because of the additional layers of offices you must coordinate with and because there is a greater amount of uncertainty in the international program.

Discrimination Between More and

Less Successful Programs

Using data from documents, questionnaires and interviews, the more successful programs as determined from questionnaire respondents (Programs S, Z, and CC) were compared to less successful programs (E, H, and K). The programs were compared in terms of the following:

- (1) Program characteristics
- (2) Views of and action taken by program management

Program Characteristics and Relative Success

Table IV.10 displays selected characteristics of highest and lowest rated programs which were derived from documentary data and interviews. The relatively common characteristics of both groups include the spanning of the technological stages by each group, the program cost ranges within each group, and the location of the program offices in the US. Further analysis of the technological stages

TABLE IV.10
 COMPARISON OF SELECTED CHARACTERISTICS FOR
 THREE HIGHEST RATED PROGRAMS AND THREE LOWEST RATED PROGRAMS

CHARACTER- ISTIC	HIGHEST RATED PROGRAMS			LOWEST RATED PROGRAMS		
	PROGRAM	S	Z	CC	E	H
TECHNOLOGY STAGE	ADVANCED DEVELOP- MENT	PRODUC- TION	ENGINEER- ING DEVEL- OPMENT AND PRODUCTION	ADVANCED DEVEL- OPMENT	PRODUC- TION	ADVANCED AND ENGI- NEERING DEVELOP- MENT
COST RANGE	\$1-10 mil	Over \$1 bil	\$100 - 500 mil	\$10 - 50 mil	UNK	\$100 - 500 mil
ACTIVE STEERING COMMITTEE	Yes	Yes	Yes	No	No	Partial
NUMBER OF PARTICIPANTS	2	5	6	2	2	2
STATED US REQUIRE- MENTS	Yes	Yes	Yes	No	Yes	No
PROGRAM OFFICE LOCATION	US	US & Europe	US	US	US	US
PARTICIPANTS ACTIVE IN PROGRAM OFFICE	No	Yes	Yes	No	No	No
TERMINATED EARLY	No	No	No	Yes	No	Yes

reveals that the advanced development in the highest rated group (Program S) was focused on a small component of an aircraft system, while that (Program E) in the lowest rated group attempted to produce a major subsystem quite important to the success of program K. Also, program K, as an engineering development effort, attempted a major stretch of the state of the art, where program CC included both an engineering development and follow-on production of a system. Program CC integrated proven subsystems which had been developed and produced by several of the participants' home industries. Programs Z and H were cooperative production programs which had production lines both in the US and collaborating countries.

Also, cost appeared to have little association with success in this comparison despite the suggestion of one interviewee that lower cost programs have lower visibility and hence less interference in program management. Another characteristic common to both high and low rated groups was program office location. Program offices for all six programs were located in the US; however, for program Z a major segment of the program office was located in Europe to oversee European production effort.

The most striking difference between the two groups is in program policymaking organization. In the highest rated group all programs were directed by dedicated, active steering committees, while in the lowest rated group, none were so directed. Steering group presence in all higher rated programs is of particular interest because it confirms conclusions reached by Hochmuth (1974) in his case analysis of six programs.

Other less clear differences between the groups deal with number of participants, active participation by cooperating government managers in program office, US stated requirements, and early termination. The multiple (five and six, respectively) participants in the more successful programs Z and CC are contrasted with the dual nature of collaboration in the lowest rated group. The exception in the highest rated group is program S, a small program (four to five personnel in the program office) in which there were only two participants and no management participation by the non-US partner. Membership in each program office by military or civilian government representatives from each participant occurred in four of the six programs analyzed, but only in the more successful programs Z and CC did they actively perform functional management tasks for the entire program.

US requirements appear to play an important role in the success or failure of a cooperative program. The requirements generation process for the US military has undergone significant changes during the lifetime of the cooperative programs studied. The presence of a US stated requirement for a particular system or capability was present in more successful programs S, Z, and CC as well as in less successful (and also not terminated early) program H and apparently reflects a concerned commitment to continue the program despite pressures resulting from conflict in the cooperative endeavor. The importance of non US partners' requirements seems also to contribute to program success, but possibly at a significantly lower level (Sheridan 1970). What seems to increase the chances for

success is a complex combination of importance of the US requirement and the importance of the alliance under which auspices the program was undertaken. Importance of requirements and alliances to US officials were not directly assessed in the questionnaires but emerged primarily through the follow-on interviews.

Finally, early termination seems to have branded programs as failures as indicated by the contrast between programs S, Z and CC and programs E and K. Early termination, it would seem is associated with the perception of failure after the fact and obviously could provide no direct indication of program success prior to termination. On the surface it might appear that a program was terminated early because factors within the program were faulty or the results from continuing the program would not be worth the cost. Program K, however, was apparently terminated by a misunderstanding between the cooperating partners. Program E, as a major input to Program K, lost support to the extent it was dropped by the US and picked up and modified by the non-US partner into a new, highly productive program.

In summary

- Steering committee/Board of Directors strongly associated with success
- US stated requirement strongly associated with success
- Multiple (more than 2) national participants important to success in larger programs
- Active participation in program management by all partners strongly associated with success

--Strong non program ties between participants (such as NATO) associated with success

--Effect of Technology* stage uncertain

Management Perceptions and Actions

In addition to differences between high and low rated program characteristics (controllable to some extent by representatives of the sovereign partners), actions of program managers are of particular interest. One way of distinguishing between management actions on high and low rated programs is to measure the relative attention given to first and second order problems. First order problems were previously defined as those which initiated a chain of events, while subsequent problems in that chain were termed "second order."

Understanding of how management allocated management and time resources between first and second order problems may be derived from content analysis of questionnaire respondents. Differences in concentrations of problems for highest and lowest rate programs in first order categories suggest differences in perceptions of problem sources by managers from the high and low rated program groups. Differences in concentrations of problems in second order categories for the two groups suggest differences in kinds of interventions by managers of high and low success programs into the chain of events stemming from first order problems.

*Further analysis of technological factors will take place in the following chapter.

TABLE IV.11
COMPARISON OF THE DISTRIBUTIONS OF FIRST ORDER PROBLEMS IN EACH
PROBLEM CATEGORY FOR THE THREE HIGHEST, THREE LOWEST, AND ALL
RATED PROGRAMS: MATRIX DISTRIBUTIONS FROM CONTENT ANALYSIS

Problem Category*	Three Highest Rated Programs		Three Lowest Rated Programs		All Rated Programs	
	n	%	n	%	n	%
1	33	27.0	16	22.5	94	22.9
2	27	22.1	19	26.8	98	23.9
3	10	8.2	8	11.3	45	11.0
4	28	23.0	8	11.3	72	17.6
5	6	4.9	7	9.9	31	7.6
6	18	14.8	13	18.3	64	15.6
7	<u>0</u>	<u>0.0</u>	<u>0</u>	<u>0.0</u>	<u>6</u>	<u>1.5</u>
	122	100.0	71	100.1**	410	100.1**

*Problem Category: 1--External Factors--US
2--External Factors--Other Countries
3--Technological Factors
4--Organization and Structural Factors
5--Personnel and Staffing Factors
6--Program Process Factors
7--Other Factors

**Do not add to 100% due to rounding.

Table IV.11 shows the comparison of distributions of first order problem (problem source perceptions) for highest rated, lowest rated and all programs. Interestingly, the differences in percentages for problem categories One and Two indicate that the respondents from

the highest rated programs saw the largest concentration of problems (27.0 percent) resulting from the political and economic environment of the US. Contrast that perception with the largest concentration of perceived problems (26.8 percent) from respondents on the three lowest rated programs resulting from external factors of cooperating countries.

The other major apparent difference occurs between Organizational and Structural problems and Program Process problems. While respondents from the three lowest rated programs saw a major source of their problems as related to such factors as requirements, budgeting, control techniques and other program process issues, (18.3 percent) those from the three highest rated programs viewed major problems as those of program office organization, authority, and relationships to higher echelons and supporting US and foreign organizations (23 percent).

Table IV.12 shows the resulting distribution of second order problems after transformation of the critical incidents by the association matrix discussed above. For the highest rated programs, categories of problems that were affected included a significant decline in political and economic problems (from a total in categories one and two of 49.1 to 32.0 percent) as well as a moderate decline in organizational and structural problems (from 23.0 to 18.9 percent). Increases occurred in technology problems (from 8.2 to 12.3 percent) and problems of program processes (from 14.8 to 29.5 percent). For the three lowest rated programs similar patterns of declines and increases in category weights occurred. The shifts in concentrations

TABLE IV.12
 COMPARISON OF THE DISTRIBUTIONS OF SECOND ORDER PROBLEMS IN EACH
 PROBLEM CATEGORY FOR THE THREE HIGHEST, THREE LOWEST, AND ALL RATED
 PROGRAMS: MATRIX DISTRIBUTIONS FROM CONTENT ANALYSIS

Problem Category*	Three Highest Rated Programs		Three Lowest Rated Programs		All Rated Programs	
	n	%	n	%	n	%
1	18	14.8	6	8.5	45	11.0
2	21	17.2	11	15.5	53	12.9
3	15	12.3	14	19.7	79	19.3
4	23	18.9	8	11.3	48	11.7
5	8	6.6	4	5.6	28	6.8
6	36	29.5	26	36.6	148	36.1
7	<u>1</u>	<u>.8</u>	<u>2</u>	<u>2.8</u>	<u>9</u>	<u>2.2</u>
	122	100.1**	71	100.0	410	100.0

*Problem Category: 1--External Factors--US
 2--External Factors--Other Countries
 3--Technological Factors
 4--Organization and Structural Factors
 5--Personnel and Staffing Factors
 6--Program Process Factors
 7--Other Factors

**Do not add to 100% due to rounding.

reflect both the nature of the first order problems in producing second order problems and the perception of the respondents about the results of the first order problems. Assuming the kinds of problems were similar in having the potential to produce similar effects,

it is necessary to observe the differences between the second order problem distributions of the highest and lowest rated programs to identify the results of the two sets of first order problems. Four of the seven categories are noticeably different. First, the external political and economic problems of the high ranked programs are six percentage points higher than the low ranked programs. Also the perceived organizational and structural problems are higher (by 7.6 percent) for the high ranked than for the low ranked programs. Finally, the emphasis placed on technology and program processes by the low ranked programs compared to the high ranked programs are 7.4 and 7.1 per cent, respectively. Two explanations for these differences are suggested:

(1) A more local (program office) orientation by members of the program offices of programs E, H and K, as compared to those of programs S, Z, and CC. Two interview comments would tend to support this speculation: On program K the termination came as a great surprise to the members of the program office. On program E, the members isolated themselves, organizationally, from the aircraft program they were supporting, taking a "closed systems" viewpoint. In the contingency organization literature previously reported, organizations with the closed systems view are less able to react to changes in their environment, hence do less well in a rapidly changing environment, than organizations with a more open systems view of their environment (Thompson, 1967).

(2) The technology uncertainty dimension of the lower ranked programs, E and K, was much higher than other programs against which

they are compared. Programs E and K were attempting to apply major new technologies to the development of a weapon system. In the higher rated group state of the art advances were minimal. The relatively low weights in the international and cooperative categories may indicate that the program management was forced to concentrate its managerial resources on the solution of technology problems and let the problems of organization, structure and relationships with foreign and US hierarchies accumulate.

Management views of sources of problems appear to be a distinguishing feature between high and low rated programs. Managers from more successful programs see the majority of their problems stemming from the US military bureaucracy and the political and economic environments of the US. On the other hand, managers from lowest rated programs see the majority of problems stemming from the international cooperative dimension--the political and economic environment of non-US cooperating nations.

Management responses to problems, although primarily concentrated on program processes in both high and low rated programs, showed major differences in the relative attention to program processes and program structure and organization. Managers of the highest rated programs sought solutions to first order problems through the structuring and organizing of the program office and its supporting hierarchy to deal with problems normally encountered on a single nation effort. But their responses indicated that they also concentrated their attention on the structure and organization to deal with

problems generated as a result of the international cooperative nature of the program. Apparently, managers in the lowest rated programs, instead, concentrated their attention on the short run solutions to program process problems, preferring to treat problems as they arose, rather than to structure organizations and mechanisms to deal with them.

The degree to which major technological advances required on the lowest rated programs sapped the managerial attention of the programs is indeterminate; however, the heavy concentration on the technical problem category by the lowest rated group indicates inordinate attention there which could have been devoted to program structure and organization.

CHAPTER V

ANALYSIS

The overall question which guided the research was: What denotes the successful from the unsuccessful international cooperative technology program? Four basic questions, derived from the overall question concerning program success factors, address the four general aspects of the management of international cooperative technology program management. The US bureaucratic aspect is addressed by Question One and concerns what happens to a program because of the necessity to operate in multiple military bureaucratic environments. Question Two isolates the international aspect, addressing program success in terms of the interaction of two or more sovereign "parents" and their respective political, economic and cultural environments. Question Three concerns the program itself, focusing on program management and the structure, organization and procedure of the program while Question Four addresses the effects of technology on program success.

Response of US Bureaucracies

Question One: What is the association between military bureaucratic environmental factors such as decision review processes, funding policy, interagency conflict, and decision delay with the perceived success of international cooperative technology programs?

Military bureaucratic environmental problems can be divided into two areas: (1) problems resulting from the US military

bureaucracy managing international cooperative programs, and (2) problems stemming from the interaction between participant bureaucracies. The first area deals with problems of decision review process, quite often accompanied by interagency conflict, funding policy problems and program delay. Interaction is discussed under Question Two.

Decision Review Process and Interagency Conflict

The group of highest rated programs avoided most of the problems of decision review and interagency conflict by their structural inclusion of a central policymaking group for each program. The least effective of the three policymaking groups, or steering groups, was associated with the advanced development program S; however the other two programs' steering groups succeeded in isolating their programs from the attendant bureaucracies, providing access to high level officials who could reasonably and quickly obtain action on major issues, and allowing a close relationship among the participants and program management. Several problems still arose, however, which threatened the survival of one program and the viability of European participation on the other. On program CC, legal provisions of the US Foreign Military Sales Act of 1968 caused a potential tenfold cost increase to the major US contributed subsystem, and the other participants prepared to terminate. Access to the Service Secretary by the US Steering Group Representative succeeded in de-escalating the situation through a significantly reduced cost for the US subsystem. On program Z, an agency charged with a major US

procurement task expected to perform that task at European subcontractor plants. Such an imposition of US procurement practice was intolerable to the European participants for a number of reasons, not the least of which was the sovereignty issue. Action by the steering group elevated the problem immediately and a compromise solution obtained.

None of the lowest rated group of programs contained a similar policymaking group--as a result they were each subject to multiple layers of the bureaucracy which "wanted to help" by providing analysis and assistance teams to each program. Such analysis and assistance served to delay decisionmaking and elevated the day-to-day management of the program from the program office to the staff. The tendency for programs of an international nature to attract "helpers" was real: one project engineer for a small international cooperative exploratory development program reported that he was required to coordinate each project decision through eight offices, while an equivalent unilateral effort required only two coordinations. Another program manager (on program K) detailed the extensive "help" provided, especially in Europe, by several staff agencies. A previous, highly successful program, received little "help" because the prevailing attitude was that the program would fail. Additional help seems to draw managerial attention away from program management and increasingly toward supplying answers to inquiries from decision levels and independent, "concerned" specialist agencies.

Other low rated programs exhibited similar problems with decision review processes and interagency conflict. Program H

respondents decried the lack of support for their decisions, second guessing by higher levels, and technical decisions reversed for political reasons.

In general, programs which were able to avoid multiple layers of review reflected a higher perceived level of success among questionnaire and interview respondents. Avoidance took place primarily through steering groups which isolated program offices from bureaucratic layers yet obtained entry at several organizational levels. Programs which were unable to avoid layering experienced apparently greater decision delay and associated cost growth and tended to be rated lower. Also, interagency conflict occurred to some extent in each program studied but appeared to have a greater negative impact on those programs without a functional steering group.

Funding Policy

Two aspects of funding policy differences were repeatedly mentioned as causing anxiety among program management personnel: (1) incremental funding (characteristic of not only the US but of several European partners) and (2) fiscal year differences. Incremental funding apparently was experienced little more than on a unilateral program. The incremental funding was complicated, however, by the different fiscal years and accompanying budget cycles of participants so that fund reprogramming could occur more often. Less successful programs dealt with both problems as they arose, and with different levels of success. More successful programs designed, through commands of agreement, operating funds which were usually

under the overall control of a steering group. As a result funds were not available for reprogramming into other unilateral efforts. (Program CC respondents related the story of a funds manager's attempt to use funds appropriated for the international program to "bailout" a unilateral effort. When the reprogramming was discovered, the individual was fired). In addition the more successful programs structured means for precluding major changes in participant contributions through currency fluctuations.

Decision Delay

Decision delay resulting from the interactions of the partner bureaucracies and political structures pervaded each program. However, delay was recognized as a necessary cost of conducting an international cooperative technology program. Because of the complex nature of the delays, no average length of delay for a program could be determined, but questionnaire and interview respondents almost universally commented that delays as high as twice the expected length of an equivalent program were not uncommon. Stefanini (1977), discussing European cooperation in the armaments field, presents a relationship based on his experience between time increases and number of participating countries. The form of his relationship is one of diminishing marginal increases in time to completion (e.g. a total increase for six partners of 82 percent), however he supplies no data to support his contention.

In an earlier study by the author, one aspect of decision delay was analyzed for international cooperative programs: that of

on cooperative programs at a much earlier time during the process to program go ahead. Two aspects of the chart should be noted: First, the extensive delay in initiating the programs of international cooperative nature as compared to the unilateral effort (Programs A and G took about twice as long to initiate as the unilateral Program C). Second, the regular pattern of communication which appeared for Program C contrasted with the apparently erratic and repetitious communication patterns of both of the international cooperative programs.

Decision delay, however, did not seem to be directly associated with success or failure of a program except in the extreme. Instead, the factors causing decision delay and the responses to delayed decisions by program management appear to be more germane to program success.

In summary, programs separated or isolated from the military bureaucratic environment were rated more successful than those which were not. As an apparent result of the isolation, decision review processes were shortened and interagency conflict was reduced. Program managements which were aware of the potential effects of incremental funding and differing fiscal years and which structured financial instruments to protect from resulting fluctuations in funding were rated more successful than those which did not. Decision delay, recognized as a necessary aspect of an international program, did not seem to be associated with more or less success.

International Environment

Question Two: What is the association between international environmental factors such as geographical separation, cultural and language differences, national technological capacity and management philosophy differences with the perceived success of international cooperative technology programs?

Problems associated with the international environmental comprised 15.7 percent of total problems from questionnaire forced data, 23.9 percent from content analysis of questionnaire data and 15.5 percent from interview critical incident analysis. Perceptions by respondents from highest rated programs indicated that the international environment accounted for 22.1 percent of first order problems while respondents from the lowest rated programs perceived international environmental problems as comprising 26.8 percent of total program problems. Two factors could account for the differences between high and low rated programs: (1) more, and more severe international problems did occur to low rated programs which led to their low success ratings, or (2) the orientation of program managers of low rated programs was that a large proportion of problems stemmed from the programs' international aspects.

Geographical, Cultural and Language Factors

Several instances where geographical separation affected program success were noted, but no general pattern emerged. Problems of communication and transportation due to geographical separation arose

several times, most notably in the potential US Australian collaboration which failed because the program manager took excessive time in travelling to Australia. US European geographical separation also appeared to aggravate communication problems. Fund limitations encouraged less rich forms of long distance communication, such as letter and message, which further complicated problems. US Canadian programs were on the whole successful in achieving technical objectives, though at cost and time penalties. But technical success could have been more influenced by close language and cultural ties or a special cooperative environment which built up and was codified in special US Canadian cooperative institutions (such as the United States Canada Defense Production Sharing Program). Officials interviewed indicated that although individual programs succeeded in accomplishing technical goals, no cooperative production of US Canadian developed equipment occurred. All of the most successful programs were with NATO allies (two under NATO auspices), while two out of three of the least successful programs were with NATO allies (but not under NATO auspices). Managers associated with the third program in the least successful group reported many cultural "horror" stories in dealing with non NATO nations. Cultural and social problems arose also, however, with US European programs in terms of holidays, overtime, status of labor unions, accounting conventions, role of quality assurance, measurement systems and so forth. Apparently geography, culture and language, though factors which must be addressed in cooperative programs, were only marginally important to program success.

Management Philosophy Differences

Table V.1 displays some of the management philosophy differences between participants which tended to cause stress in international cooperative programs. Where the US applied large manpower and dollar resources to military technology programs, made numerous and large program changes and emphasized governmental control of contractors, Europeans tended to make more marginal changes, apply more limited resources to programs and leave control to contractors, providing only broad general guidelines. As a result US control techniques applied to European contractors on several programs elicited negative reactions and threatened several key contractors' participation. Although the management philosophy differences did not appear to be directly associated with relative success, such differences led to strain of the cooperative arrangement and possible failure.

Several other differences arose as issues between US and other national participants. Program office size and program manager authority were two areas of disagreement - the latter especially causing problems. European government program offices are necessarily limited because of the size of the military and supporting bureaucracies, especially among smaller European countries. As a result significant effort, performed in the US by government officials, is performed by contract in Europe. With small procurement staffs, program managers know supporting staff personnel well and appear to exert more personal influence than do US program managers. On one

TABLE V.1
SELECTED CHARACTERISTICS OF US AND EUROPEAN SYSTEMS ACQUISITION PHILOSOPHIES

CHARACTERISTIC	US*	UK**	COUNTRY	FRANCE**	FRG**	SWEDEN**
SYSTEMS ACQUISITION STRATEGY	DISCRETE PERFORMANCE INCREASES, CONCURRENCY	MIXED, COMPLETE DEVELOPMENT BEFORE PRODUCTION DECISION		EVOLUTIONARY, COMPLETE DEVELOPMENT BEFORE PRODUCTION DECISION	MIXED-SIMILAR TO UK	SIMILAR TO FRANCE
USE OF PROTOTYPING	INCREASING	HEAVY		HEAVY	HEAVY	HEAVY
DESIGN TEAMS	LARGE, ANONYMOUS, ANALYTICAL#	1-25 OF US SIZE		.1-.25 OF UK SIZE, STABLE, KNOWN, TESTING ORIENTED	SMALL, SIMILAR TO FRANCE	SMALL
SPECIFICATIONS*	DETAILED	GENERAL, PERFORMANCE ORIENTED		SIMILAR TO UK, INDUSTRY INVOLVED IN SPEC PROCESS	SIMILAR TO UK	SIMILAR TO UK
CONTRACTING/ PROFITS*	EXTENSIVE, HIGHLY DETAILED/BASED ON ANTICIPATED COST	SAME AS US, LESS DETAILED/BASED ON COST AND EMPLOYED CAPITAL		SHORT, SIMPLE/ SIMILAR TO US	PROFIT POLICY SIMILAR TO US	
PROGRAM CONTROL BY	GOVERNMENT	CONTRACTOR		CONTRACTOR		
GOVERNMENT ROLE	ADVERSARY	ADVISORY		COOPERATIVE#	ADVISORY	
MANAGEMENT TECHNIQUES	USE EXTENSIVE (PERT, CSCSC, LCC, DTC, ETC.)	MINOR USE PERT, SHOULD COST*		LITTLE USE	LITTLE USE*	MINOR USE, SMALL SCALE PERT

SOURCES: FOX (1974)*, PERRY (1971)**, SHAWERD (1972)#

highly successful program a European manager indicated that plans called for him to change positions with his program's contact in his home service staff so that continuity and detailed understanding of program structure and progress could be maintained. In contrast, an interviewed US civilian program manager with years of international cooperative experience was isolated from similar current work due to US personnel policy.

Lack of authority of the US program managers and steering committee members to speak and act for the US on international programs was mentioned by US and European respondents in contrast to the authority of European representatives. One highly rated program nearly was terminated because a commitment made by the steering group's US representative was reversed by higher authority. The lack of authority of program managers on several lower rated programs was admittedly exploited by cooperating partners by their bypassing of program directors to obtain action not favored by US program managers.

National Technological Capacity

Related factors associated with program success were the capacity of partners to absorb and exploit US generated technology and the perceptions of the respondents of US technology exploitation. Reference to Table III.7 shows that both military and civilian respondents felt that international technology exchange had significant value to the US. But questionnaire comments revealed that the majority of respondents felt that key technologies would flow from the US to cooperating partners as a result of most

international cooperative technology programs. Concerning two of the three highest rated programs, respondents indicated that the end result of the program was or would be a joint production of technology rather than a net outflow from the US. In the third highly rated program a major technology outflow was recognized by all participants through the memorandum of understanding, and recovery of US expended funds for the development of the technology was provided for. On the three least successful programs respondents indicated that a major outflow of US technology resulted in each case. Program E technology was transferred to the European partner who developed the technology further into a system which the US subsequently purchased. On Program K the European partner obtained US technology in conjunction with the program which was adapted later for a joint European system.

Programs where the cooperating partner(s) has the capacity to absorb but not exploit US generated technology, as occurred in Program H, appear to be unaffected by a net technology outflow from the US. But programs which contain a US developed technology as a key element of the program and include partners with the capacity to extend or exploit the technology outside the confines of the program appear to be less successful than those which jointly develop technologies. Minimizing net technology outflow from each participant, through matching US and other participants' technological expertise, appears to be associated with program success.

To summarize, the international environment presented a much larger perceived source of problems to respondents from lower rated programs. Among the perceived problems, geography, culture and language were important, but differences in these factors were not necessarily associated with program success or failure. Differences in management philosophy, especially between US and European managers, appeared to generate stress, but again problems resulting from such stress occurred within high rated and low rated programs. The capacity of a partner to exploit a net technology outflow from the US was associated with lower rated programs. In each case, however, success appeared more dependent on how national leaders and managers prepared for and responded to international environmental problems than on the nature of the problems themselves.

Program Structure and Management

Question Three: What is the association between collaborative arrangement and procedural factors such as the agreement to collaborate, program policymaking, conflict resolution and program management structure with the perceived success of international cooperative technology programs?

The cooperative dimension deals with the interaction of two or more sovereigns in the structure and conduct of a joint technology effort. Distinctions arose between high and low rated programs in both program structure and conduct. Organizational and structural problems accounted for 18.2 percent and process problems for 13.6 percent of the forced distribution of questionnaire responses. After

content analysis they accounted for 17.6 and 15.6 percent respectively. Interview respondents reported 10 percent of perceived problems were organizational and structural while 20.9 percent were procedural. In the discriminant analysis between the three highest and three lowest rated programs, organizational/structural and procedural problem distinctions are striking. While the highest rated programs strongly emphasized organization and structure over procedure (23.0 to 14.8), just the reverse occurred in the lowest rated programs (11.3 to 18.3).

Agreement Characteristics and Policymaking

Successful programs struck a balance in their agreements between coverage of major problem areas and detail with which each area was treated. The outline for programs' agreements included program goals, policymaking authority, management procedures and termination procedures as well as a host of other considerations. Sharing ratios were particularly important aspects of the agreement. For successful programs the cost, work and benefit shares were balanced within a liberal range (plus or minus 25 percent) to both reduce the impact of exchange rate fluctuations and balance of payment disparities and to minimize conflict over such problems. One less successful program limited fluctuations to plus or minus five percent while another both limited fluctuations by a narrow percentage and by total dollar cost. As program cost escalated the percentage changed, exceeding established limits. Participants

hurt by the increases pressured for renegotiation of the sharing ratios after the fact and created severe program tensions.

As mentioned above highest rated programs which had more than two participants used an active and dedicated steering group or board of directors to set and enforce policy for their programs. The steering groups also acted as buffers against attempts by government agencies to influence program management. Since steering groups had international status they were able to gain entry to national bureaucracies at several levels and rapidly resolve conflict with national agencies. Just the presence of a steering group as a structural program element appeared insufficient to influence success. Highest rated programs' steering groups met regularly, had decision authority over funding, configuration changes, and schedule changes as well as prime contact awards, and had at least veto power over personnel assignment to program management. Steering groups of less successful programs met infrequently, remaining unfamiliar with program events, and guided several programs simultaneously, diffusing their knowledge about each.

The general tone of the agreement also affected the orientation of the cooperating partners toward the program. If the wording of provisions indicated non-US participants were equal partners, with their views and expertise seriously considered, participants tended to support a program oriented decision even when it tended to conflict with national interest.

Conflict Resolution

In the highest rated programs, conflict resolution took place within the steering group. In the lowest rated programs, conflict resolution took place on a case by case basis with several settlement methods. Of all programs studied with more than two participants, decisions were made by several methods: majority--based on one participant-one vote, majority--based on work or cost share, unanimity, etc. Advantages of the majority method included speedy decisions and "equitability," however, when critical issues arose, such as the addition of another member to the group or proceeding from development to production, majority rule was inadequate. Program termination or partner withdrawal occurred in some earlier programs which relied on majority rule for major decisions. One of the highest rated programs conflict resolution policy called for majority rule on all decisions, but the steering group, itself, adopted unanimity as the policy. As a result those interviewed indicated that a greater level of program orientation arose among steering group members.

On lower rated programs conflict resolution policy was less well defined or adhered to. Interview and questionnaire comments identified several areas where conflict was handled on an ad hoc basis: examples included conflict over personnel assigned by non-US partner, technical data disposal/use after program termination, termination decision criteria, and production of follow on spare parts.

More successful programs had well defined conflict resolution policies, and management adhered to the policies. Less successful programs had less well defined policies which were bypassed routinely. Lack of an agreed upon set of rules to resolve conflict invited program instability and national polarization of partners.

Perceptions of Program Managers

Competing orientations of program management personnel are associated with extremes of program success. On one hand, managers may be considered "program oriented" if their attitudes and actions indicate that they held the programs' interests above national interests. An example would be a decision by a US program manager to favor a partner's home contractor over an equivalent US contractor to insure continued participation by the partner and to maintain program integrity. On the other hand, managers may be considered "national oriented" if they view their basic task as obtaining the best conditions and benefits for their own country at the expense of the program.

One indication of program management orientation would be the ratings given by program managers to programs in which they participated. Questionnaire respondents, composed of over 60 percent program office participants, tended to rate programs as successful, with over half of the respondents giving programs with which they were associated ratings in the top two blocks (see Table IV.2). Interviewees, well over half of whom were not program managers, responded that international cooperative programs were less successful

TABLE V.2
PROGRAM ORIENTATION OF MEMBERS AND NON MEMBERS
OF HIGH AND LOW RATED PROGRAMS

QUESTIONNAIRE RESPONDENTS	THREE HIGHEST RATED PROGRAMS		THREE LOWEST RATED PROGRAMS	
	<u>N</u>	<u>MEAN RATING</u>	<u>N</u>	<u>MEAN RATING</u>
PROGRAM OFFICE MEMBERS	16	1.25	11	4.73
NON MEMBERS	11	2.18	7	4.00

than equivalent US only programs. Given the rating orientation, it is necessary to look at the rating extremes for program orientation of managers. Table V.2 shows that for the highest rated programs, program managers gave the highest mean ratings, while for the lowest rated programs program managers again gave the lowest mean ratings.

Two indicators of program orientation occurred among the highest rated programs: non-US participation in the program office and perceptions of problem sources. Two of the top three rated programs included members of other participants' armed forces within the program office as working members. Interaction between all program office members occurred at the program, not national, level. The program manager of one of the highest rated programs, when interviewed stated he actively encouraged strong social and work related relationships between all program office personnel and had designed several specific features into his management to insure

this. Additionally, he actively discouraged socialization by US personnel with members of their own service. The attitude was confirmed by non US officers interviewed who expressed a strong attachment to the program and other national representatives within the program office.

Also associated with program orientation were the respondents' perceptions of the source of the majority of non technology program problems. Respondents on the highest rated programs perceived the majority of political and economic environmental problems as stemming from their own nation's political and economic milieu. Respondents on the lowest rated programs perceived the majority of such problems stemming from the "foreign" milieu.

Program orientation by members of the program office appears to be positively associated with program success. The inclusion of non US participants in the program office as working managers and the perceptions of managers that the majority of program problems stem from their own political and economic milieu both contribute to program orientation of program managers.

Action of Program Managers

Specific successful and unsuccessful actions by program managers were described in questionnaire response content and interviews. Kinds of actions which were associated with success were those which anticipated problems generated primarily within political and economic environments. Through content analysis of questionnaire responses, chains of first and second order problems were identified

and recorded. A distinction between the highest rated and lowest rated programs occurred in how first order problems were perceived by respondents and the ways in which management responded to first order problems with the second order mechanisms.

Referring first to Table IV.11, respondents on the three highest rated programs viewed first order problems occurring in program organization and structure (23.0 percent) as compared to procedure (14.8 percent). Respondents on the three lowest rated programs, however, viewed problems of organization and structure as minimal (11.3 percent) as compared to procedure problems (18.3 percent). Second order problem weights also show a great disparity between high and low rated programs and reveal how program management responded to first order problems. Naturally, one might expect procedural problems to rise significantly (highest rated programs to 29.5 percent; lowest rated to 36.6 percent) reflecting action by program managers. The seven point difference between high and low rated programs shows up in an equivalent, but reversed, difference in organization and structure between the groups of programs (highest rated programs 18.9 percent; lowest rated steady at 11.3 percent). The differences, combined with the content of actions of managers revealed by questionnaires and interview, show a strong orientation of managers from highest rated programs toward structuring and designing mechanisms to deal with problems in their formative stages when problems are more tractable. Lowest rated programs managers preferred to face problems as they arose and on a problem by problem basis.

In summary, collaborative arrangement and procedural factors focus on the characteristics of the collaboration agreement, policy-making and conflict resolution structure, and attitudes and actions of program managers. Successful programs were born in comprehensive, but not detailed, program agreements which provided for a senior policymaking group which would resolve major program conflict according to established rules. Unanimity proved the best rule for conflict resolution. Program managers who were program oriented performed better than those with a more national orientation. Program orientation was enhanced by having functional managers from all participants within the program office and by managers viewing problems as stemming from their own political and economic milieu. Successful program managers viewed problems primarily as being structural/organizational in nature calling for anticipative structural mechanisms to deal with them.

Technology and Success

Question Four: What is the association between such factors as technological nature, complexity and stage with the perceived success of international cooperative programs?

Technological nature, complexity and stage are three aspects of the technological uncertainty dimension of international cooperative programs. Technological nature deals with the particular technologies sought or used in the programs in question. Complexity deals with the degree to which the program attempted to advance the state of the art, both in a single technology and a complex of technologies, to

achieve program goals. Technology stage (defined on page 71) deals with the output goals of the program such as knowledge, demonstration, prototype, or end product.

Technological Nature

The particular technologies represented in the group of programs studied covered missiles, electronics, airframes, tanks, propulsion, ship design, metalurgy and instrumentation. Unfortunately, only missiles, aircraft, and electronics were represented in the three highest and three lowest rated programs, and no differences in success due to technological nature were noted. A possible relationship between technology nature and a particular national technological expertise, reflected in perceptions of net technology transferred, might exist, though no evidence occurred to support such a relationship.

Technological Complexity

The higher the degree of technological complexity attempted the more management attention seemed to be directed at technological problems and less at problems associated with the international nature of a program. Two of the three lowest programs were directed at major advances of the technological state of the art (See Perry, 1971, for one measure of such advances). None of the highest rated programs sought similar major advances. In two of the lowest rated programs quantum leaps in technology were called for to achieve program objectives; in the three highest rated programs, technology had been demonstrated, and technological problems revolved around systems

integration. Differences in advances also show up in perceived problems of program respondents. On the three lowest rated programs, technological problems accounted for 11.3 percent of first order and 19.7 percent of the second order problems. On the three highest rated programs technological problems accounted for only 8.2 percent of first order and 12.3 percent of second order problems. Relatively modest technological goals appear associated with program success.

Technology Stage

Of the four technology stages analyzed, programs of cooperative research and exploratory development and programs of cooperative production were rated higher and with less dispersion than were programs of advanced and engineering development. Figure V.2 displays all programs rated by questionnaire in the four stages addressed. The engineering development stage shows the widest dispersion and lowest average rating (3.39). The highest rated stage was coproduction (2.29) with research and exploratory development a close second (2.30).

Probable explanations for a "U"-shaped success association, supported by interview and questionnaire comments, include the kind of "product" expected from a program in the different stages and the "degrees of freedom" in the design of that product. Where research and exploratory development have knowledge generation or technology as the "product", the other stages have hardware as the product. As the product moves from knowledge or laboratory demonstration to

FIGURE V.2

COMPARISON OF 24 INTERNATIONAL COOPERATIVE TECHNOLOGY PROGRAMS:
SUCCESS RATINGS BY QUESTIONNAIRE RESPONDENTS VS. TECHNOLOGY STAGES

SUCCESS RATINGS	PROGRAMS IN EACH STAGE				
	RESEARCH AND EXPLORATORY DEVELOPMENT	ADVANCED DEVELOP- MENT	ENGINEERING DEVELOPMENT	PRODUCTION	
HIGHEST	1			F (1.00) Z* X CC*	
	2	U (1.67) Q C B	S* (2.17) B	CC**(1.67) G BB	
	3	R (3.00)	J Y K** M	I H** EE	
ACCEPTABLE	4		DD		
	5		E** (5.00)	E** A (5.00)	
	6				
LOWEST	7		D (7.00)		
WEIGHTED AVERAGE RATING		2.30	3.23	3.39	2.29
NUMBER OF RATINGS		18	25	24.5	29.5

* Three highest rated programs of those rated by 4 or more respondents

** Three lowest rated programs of those rated by 4 or more respondents

hardware, prototype, and production, it tends to reinforce or conflict with preconceptions, often based on predetermined requirements, held by responsible engineers or managers from participating countries. Where the product reinforces the preconceptions, technological conflict may be minimized; where the product conflicts with preconceptions, technological conflict may be increased. The potential for technological conflict may be greatest where several design approaches are feasible, as in advanced and engineering development. When the basic design is settled on, as in a cooperative production program, conflict over technological approach may again be reduced because participants have "bought off" on the design approach in the memorandum of agreement.

Technology stage appears to be associated with program success to the extent that knowledge or demonstration oriented programs and programs where the product design is relatively fixed are more successful than programs producing components or prototypes where the potential for technological conflict is higher. The dispersion in program ratings, however, indicates that advanced and engineering development programs have the potential for high success due to other factors discussed above.

In summary, technological uncertainty factors of state of the art advancement and technology stage are associated with success, while technological nature does not appear to be associated with success. Technological goals which call for modest, non-complex advancements seem to be associated with success, while major state

of the art advances seem to be associated with failure. Research, exploratory development, and production programs are associated with success, while advanced and engineering development programs are more associated with failure.

CHAPTER VI
SUMMARY, CONCLUSIONS AND IMPLICATIONS OF THE RESEARCH

Summary

Any two organizations may have difficulty cooperating to achieve a common objective because of conflict of various kinds. In an international context, relations between organizations cannot be governed by appeal to supra-organizations, as they might in a single nation, or single business or company context.

A growing interest and involvement in international cooperative ventures reflects an increasing inter-connectedness of the world. The benefits of international cooperative ventures include new or expanded markets; shared development costs; natural, managerial and technological resources previously unavailable; and other, less substantive benefits. However the record of successful international cooperative ventures is dismal. A special case of the international cooperative joint venture is the international cooperative technology program conducted by military services. The joint military program is of particular interest because it lies at the extreme margin of risk of the class of all cooperative enterprises including the international joint venture. As an international program, problems of language, culture, differing business philosophies and conventions arise. As a cooperative effort, differing goals, strategies and procedures of participants may conflict. As a technology effort,

high technological uncertainty, one-of-a-kind nature and limited life combine to provide an additional dimension of risk. As a military managed venture, the bureaucracy and character of "protector of the nation" conflicts with the concepts of technology transfer and data disclosure which international cooperative technology programs call for. Each of the risk factors combine to produce a very high potential for failure.

The object of this study was to identify relatively successful programs of this type and to determine what factors separate relatively successful from relatively unsuccessful international cooperative technology programs.

The method of approach was an exploratory field study to identify programs, people and issues involved in international cooperative technology program management. Data collection methods included:

- Initial interviews--to identify the population of programs
 - to identify cognizant government officials
 - to identify key issues and categories of problems
- Questionnaire
 - to obtain a measure of perceived program success
 - to obtain critical incidents associated with specific programs
- Follow-on Interviews--to clarify the concept of program success
 - to obtain in-depth critical incidents

Documentary Data--to obtain facts concerning international
cooperative programs studied

The data for 32 international cooperative technology programs were analyzed to determine measures of relative success; to determine distributions of perceived problems using critical incidents; and to isolate important characteristics of programs for association with perceived success.

The measures of success were applied to the full sample of programs and to the three highest rated and three lowest rated programs as identified by the questionnaire respondents. The critical incidents from the questionnaire were redistributed on the basis of a content analysis of the responses into seven categories developed early in the research. Associations stated or implied by respondents between problems were categorized into first order problems, or problems perceived to be initial problems in a train of events, and second order problems which were consequences of the first order problems. The high and low success programs were then compared on the basis of their associated program characteristics and the first and second order problem distributions.

Using content analysis of questionnaire critical incidents and subjective analysis of both questionnaire and interview critical incidents, responses were constructed for the following four questions:

Question One: What is the association between such military bureaucratic environmental factors as decision review processes, funding

policies, interagency conflict, and decision delay with the perceived success of international cooperative technology programs?

Programs which were able to avoid multiple layers of review had a higher perceived success than those which did not. Programs avoided the multiple review process through steering groups composed of high level officials from each participating country. Although successful programs were isolated from the multiple layers, through the status of steering groups they were able to obtain direct entry to bureaucratic levels where problems could be solved. Programs which were unable to avoid multiple layers of review were rated lower by questionnaire respondents. Interagency conflict was reported on almost all programs studied, but lowest rated programs seemed to experience a greater impact from the conflict apparently because they lacked the effective steering group structure to quickly resolve conflict.

Incremental funding coupled with the differing budget cycles of participants were identified as providing more problems to programs studied than has been reported for incremental funding alone in US-only programs. Highest rated programs had written into their memoranda of understanding provision for financial structures under program management control. This form of funding evidently reduced high levels of funding uncertainty.

Delayed decisions, naturally present on multi-nation efforts, were recognized as a necessary cost of conducting such a program. The causes of the delay, such as multiple review levels or interagency

conflict, and the responses by program management appeared more germane to program success assessments than the presence or length of the delay.

Question Two: What is the association between international environmental factors such as geographic separation, cultural and language differences, national technological capacity, and management philosophy differences with the perceived success of international cooperative technology programs?

Greater concentration by managers on the international aspects of programs was associated with lower program success. This may be explained because either such programs actually did experience greater international problems or because managers tended to incorrectly blame lack of success on the international aspects.

Geographic separation and cultural and language differences were only weakly associated with lower program success. More importantly, differences in managerial philosophy, found primarily in the cases of the US and European partners, were associated with lower program success. Especially in US program manager and steering committee member authority, US and European differences became especially acute. Where US programs adopted such European systems acquisition philosophies and practices as small program offices, higher authority for the program manager, and use of personnel experienced in international R&D programs, they achieved a higher rating of success than did others.

Where partners exploited rights to technology obtained from joint programs with the US, programs were rated lower; where each partner contributed a major share of the technology employed, programs were rated higher.

Question Three: What is the association between such collaborative arrangement and procedural factors as the agreement to collaborate, program policymaking, conflict resolution, and program management structure with the perceived success of international cooperative technology programs?

Differences between high and low rated programs were identified with forms of programs structure as well as the style in which they were conducted. Memoranda of understanding for successful programs contained broad coverage of major problem areas and little detail as to how problem areas were to be treated; as a result steering groups and project management were able to structure methods for preparing for and handling specific problems. Lower rated programs were structured on agreements treating each potential problem in extensive detail. Problems arose during the course of the program requiring partners to renegotiate program provisions as the environment changed.

Policymaking for more successful programs was conducted by active steering groups composed of representatives of each participant nation; less successful programs either had no such group or had a group which steered them along with other programs having the same national participants. The more successful program agreements, and the conduct of such programs, stressed the full partnership of non

US participants. In more successful programs where conflict occurred between participants it was resolved at the steering group level according to rules for handling conflict established in the memorandum of understanding. For less successful programs conflict was resolved on an ad hoc basis through specific negotiation between participants.

Program managers of successful programs demonstrated a close identification with the program, even where such an identification conflicted with short range national interests. A high level of program identification or orientation was associated with active participation in the program office by military officers from each participant nation. Program orientation was also associated with perceptions by program office members that the largest source of non-technology problems stemmed from their own nation's political and economic milieu. A more national orientation of respondents was associated with program management views that the largest source of non technology programs stemmed from a program's "foreign" nature. A higher level of national orientation, as contrasted with program orientation, was demonstrated by respondents on lower rated programs.

Actions of program managers for higher rated programs focused on problems of program structure and organization--anticipating problems generated primarily within political and economic environments. For programs rated lowest, respondents' problems were concentrated on program procedures or day-to-day dealing with problems as they arose.

Question Four: What is the association between such factors as technological nature, complexity and stage with the perceived success of international cooperative technology programs?

Technology-associated factors such as state-of-the-art advancement and technology stage are associated with success, while the specific technology used did not appear to be associated with perceptions of success or failure. Technological goals which call for modest, non-complex advancements seem to be associated with success, while major state of the art advances seem to be associated with failure. Research, exploratory development, and production programs are associated with success, while advanced and engineering development programs have much greater variation in success ratings and, on the average, were rated much lower.

Table VI.1 summarizes the findings of the study by factor and high or low success ratings.

Conclusions

The essence of the challenge of managing international cooperative technology ventures lies in a basic distinction between such ventures and other kinds of ventures: a required joint organizational relationship between venture partners. A small but growing body of knowledge seeks to identify the unique features of inter-organizational relationships as a subset of organizational theory (Levine and White, 1961; Litwak and Hylton, 1962; Evan, 1965; Aiken and Sage, 1968; Torte, Chisholm and Radnor, 1972; and Neghandi, 1975). The conclusions derived from this study of international cooperative

TABLE VI.1
INTERNATIONAL COOPERATIVE TECHNOLOGY
FACTORS ASSOCIATED WITH PROGRAM SUCCESS RATINGS

FACTORS	HIGHLY RATED PROGRAMS	ASSOCIATION WITH LOW RATED PROGRAMS
1.0 <u>MILITARY BUREAUCRATIC ENVIRONMENT FACTORS</u>		
1.1 PROGRAM MANAGER DECISIONS	ISOLATED FROM MULTIPLE ORGANIZATION LEVEL REVIEW	SUBJECT TO MULTIPLE ORGANIZATION LEVEL REVIEW
1.2 FUNDING POLICY	INCREMENTAL FUNDING COMPLETED BY DIFFERING BUDGET CYCLES STRUCTURED TO MINIMIZE EFFECTS OF FUNDING CHANGES	SAME WORKED FUNDING CHANGES AS THEY AROSE
1.3 INTERAGENCY CONFLICT	RESOLVED PRIMARILY BY STEERING GROUP ACCORDING TO POLICY GUIDANCE	RESOLVED BY NATIONAL PARTICIPANTS ON CASE BY CASE BASIS
1.4 DECISION DELAY	DECISIONS TAKE UP TO TWICE AS LONG AS UNILATERAL PROGRAM	SAME
2.0 <u>INTERNATIONAL ENVIRONMENT FACTORS</u>		
2.1 GEOGRAPHICAL PROXIMITY	WEAKLY ASSOCIATED	
2.2 LANGUAGE/CULTURAL DIFFERENCES		WEAKLY ASSOCIATED
2.3 MANAGEMENT/SYSTEMS ACQUISITION PHILOSOPHY	HIGHER LEVELS OF PROGRAM MGR. AUTHORITY; LESS ADHERENCE TO DETAILED CONTROL OF CONTRACTOR BY PROGRAM MANAGEMENT	US SYSTEMS ACQUISITION/MANAGEMENT PHILOSOPHY DOMINATES
2.4 NATIONAL TECHNOLOGICAL CAPACITY	SAFEGUARDS AGAINST UNCOMPENSATED US TECHNOLOGY OUTFLOW; JOINT TECHNOLOGY PRODUCTION	NET TECHNOLOGY OUTFLOW FROM US EXPLOITED BY PARTNERS
3.0 <u>PROGRAM FACTORS</u>		
3.1 MEMORANDUM OF AGREEMENT OR UNDERSTANDING	GENERAL GUIDELINES, COMPREHENSIVE COVERAGE OF POTENTIAL PROGRAM AREAS, AMENDABLE	DETAILED PROCEDURES
3.2 POLICYMAKING	BY ACTIVE, DEDICATED STEERING GROUP; UNANIMOUS DECISIONS ON IMPORTANT QUESTIONS	BY STEERING GROUP SHARED WITH OTHER, SAME PARTICIPANT PROGRAMS; BY US BUREAUCRACY; BY MULTILATERAL AGREEMENT
3.3 CONFLICT RESOLUTION	ESTABLISHED BY AGREEMENT, CARRIED OUT BY STEERING GROUP	PARTIALLY PROVIDED BY AGREEMENT; BY-PASSED ON IMPORTANT ISSUES
3.4 MANAGER PERCEPTIONS	PROGRAM ORIENTATION - ENHANCED BY FULL PARTNER PARTICIPATION IN PROGRAM OFFICE, VIEWS OF PROBLEMS AS STEMMING FROM OWN NATION'S POLITICAL AND ECONOMIC MILIEU	NATIONAL ORIENTATION-ENHANCED BY "CUSTOMER" VICE PARTNER VIEW OF PARTICIPANTS; VIEWS OF PROBLEMS STEMMING FROM PROGRAM'S "FOREIGNNESS"
3.5 MANAGER ACTIONS	PROBLEMS CALL FOR ORGANIZATIONAL/STRUCTURAL SOLUTIONS - EXPECTED RECURRENCE	PROBLEMS CALL FOR PROCEDURAL, SITUATION SPECIFIC SOLUTIONS - RECURRING PROBLEMS TREATED AS NEW PROBLEMS
4.0 <u>TECHNOLOGY FACTORS</u>		
4.1 NATURE	INDETERMINATE	INDETERMINATE
4.2 COMPLEXITY	INCREMENTAL, SYSTEMS INTEGRATION, MINIMUM STATE OF THE ART ADVANCEMENTS JOINT TECHNOLOGY PRODUCTION	MAJOR AND MULTIPLE ADVANCEMENTS TO STATE OF THE ART, ONE SIDED TECHNOLOGY PRODUCTION
4.3 STAGES	RESEARCH, EXPLORATORY DEVELOPMENT, PRODUCTION	ADVANCED, ENGINEERING DEVELOPMENT

technology programs bear directly on the body of knowledge of inter-organizational relations.

Theoretical Context

Researchers and other contributors to the body of knowledge concerning inter-organizational relations have focused their attention on the conditions which give rise to such relationships-- specifically the motives, costs, opportunities and barriers to the establishment of interorganizations (Aiken and Hage, 1968, Schermerhorn, 1975) and on the types of interorganizational structures (Warren, 1972).

Warren (1972) offers a fourfold typology of interorganizational structures: The first, "social choice," describes interorganizational relationships where interdependencies are chance, isolated or even competitive occurrences and as such represent a very low level of interdependence. The second, "coalitional" relationships exist when organizations have opportunities to pursue joint goals without giving up any authority or sovereignty; several of the less successful programs studied herein might be so classified. The third type of relationship is called "federative" by Warren. Within each federative relationship a special organization is established by the participants for concerted decisionmaking about a particular issue for an extended time; the remainder of programs studied in this dissertation might fall in this category. The final type of arrangement is called "unitary" in which a supreme authority exists over the

cooperating organizations, such as the authority of a corporation over several interdependent profit centers.

A major effort in the study of inter-organizational relationships is devoted to the reasons organizations agree to cooperate in the pursuit of joint goals. On one hand "exchange" interorganizational relationships form when decisionmakers from two or more organizations perceive mutual benefits from cooperating and jointly agree that each will better achieve certain individual goals from cooperation than from autonomous action (Levine and White, 1961; Aiken and Hage, 1968).

On the other hand, when the motive to interact is asymmetrical, or when one party wants to interact with another who is reluctant, and the first has the power to force or induce interaction, a "power-dependency" relationship obtains. Schmidt and Kochan (1977) describe the conditions and motives for power-dependency. They conclude that both exchange and power-dependency may be combined in a mixed-motive model. They found that the greatest frequency of repeated interaction occurred where high levels of interdependence occurred between participants.

Schermerhorn (1975) observes that exchange relationships are motivated by resource scarcity, performance distress, positive value of cooperation per se, or presence of organizational norms of cooperation. Power dependencies derive from a powerful extra-organizational force demanding interorganizational cooperation.

Within the theoretical context of interorganizational relationships most of the effort deals with the motivations and processes involved in establishing such a relationship; little effort has gone into how the relationship is maintained or how relationships are actually used to achieve joint goals. Also, although Warren's typology addresses interorganizational relationships in which new organizations are established to manage the relationship, little attention is focused on how such an organization operates to most effectively achieve joint goals in specific environments. The inferences discussed below are directed at clarifying these issues.

Inferences

Looking at the factors listed in Table VI.1 and their dynamic interactions, eleven inferences were developed relating the factors to high or low program success. The inferences form three groups: The first group of three inferences deals with the ways programs were governed by the participants. The second group of five inferences focuses on the program office--program management structure and psychosocial factors of program office members. The third group of three inferences deals with technology related factors.

Steering Groups and Program Success

Steering Groups Versus Other Governing Designs. Guidance by participating governments of international cooperative technology programs is frequently accomplished through a board of directors or steering group.

(1)--International cooperative technology programs guided by steering groups are more likely to be successful than programs guided by parent bureaucracies or other, ad hoc organizations.

Steering groups performed better as supra-program guidance entities than did individual parent bureaucracies, ad hoc groups representing parent governments, key individuals or other hybrid forms. This inference was developed from factors 1.1, 1.2, 1.3, 3.1, 3.2, and 3.3 in Table VI.1. Programs with steering groups performed better than programs having other supra-program designs because almost all high level decisionmaking about a program was concentrated in a single group to which a program manager reported. Program policymaking, conflict resolution between participants, budget approval, review of program managers' decisions and assurance of program adherence to the letter and spirit of the memorandum of understanding, were all the prerogative of the program's steering group. The resulting unity of direction, despite sometimes fierce internal squabbles, isolated the program from the vagaries of parent bureaucracies and provided increased status to those program managers operating under steering groups.

A close functional parallel to steering groups in international cooperative technology programs are corporate boards of directors. A look at US corporate boards of directors may give some insight as to why programs performed better with a similar, supra-corporate group than others without such a group.

According to Vance (1968), corporate boards in the US were set up to give the legal appearance that management, specifically a

company's chief executive officer, was responsible to the wishes of the stockholders as represented by the board. Vance traced the evolution of the board of directors as an institution since the post-Civil War years, showing an increasing authority of the board in corporate decisionmaking. In recent years, however, the ideal functions of the board of objective setting, policymaking, developing strategy, performing trusteeship functions, and reviewing top management performance (Koontz, 1967; Conference Board, 1967; Drucker, 1973), has been undermined by two trends.

The first trend is due to the failure of the board members to take their role seriously by their accepting membership on too many boards, viewing themselves as figureheads or crisis managers, and being reluctant to probe into controversial areas (Mace, 1971; Drucker, 1973).

The second trend undermining the ideal functioning of boards, also pointed out by Drucker (1973), is the desire by corporate chief executives not to have an effective board. They tend to believe that their own power to run the company would be seriously constrained by an effective board. Mace's (1971) study of corporate boards show that corporate executives failed to provide outside directors with sufficient or timely information on which to base informed decisions. Chief executives also insured that board compensation was insufficient to demand the quality of attention from outside directors necessary to perform tasks as specified in corporate charters.

Apparently responding to that tide of criticism and an increasing climate of public liability of outside directors, corporate boards have recently worked to increase their effectiveness. In recent years they have demanded independent audit authority and have made increasing use of committees within the board to specialize on areas of strategy, financial policy and executive hiring and compensation (Bacon and Brown, 1977; Thomas, 1979).

The steering groups addressed in this study did not appear to undergo the problems identified by Mace and Drucker, except in isolated cases. As a possible explanation it is important to note that one key difference between steering groups and boards of directors lies in the lack of parallel to the concept of the outside director within steering groups. As a result parent governments had control over the number of steering groups on which one representative could serve. As representatives of their home governments, steering group members saw very clearly the importance of their roles in setting policy, resolving inter-participant conflict, and dealing with budget issues. Even more important, as single points of contact concerning their programs for their home governments, they were forced to probe into all aspects of their program's performance. Their stake in their program was very high. Thus, the joint nature of a program lent strength to the role and function of the steering group.

Also important is the relative rank of the program office manager (as compared to the members of the steering group), information flows and compensation. Usually program managers were one military

or civilian rank lower than steering group members; in a few cases several ranks separated the two positions. Information flows to insure timely and adequate data on which to base decisions was often required by the memoranda of understanding or supporting documents; problems did arise occasionally, but the steering group usually was able to replace the program manager who failed to provide desired data. Compensation was out of the control of either program managers or steering group members because of their government status.

In the literature on interorganizational relationships, Walton's (1972) conclusions concerning the "stakes" of a program's partners are especially important to the understanding of the success of those programs having steering groups. Walton describes the goals and processes in such a relationship in terms of "instrumental stakes" and "expressive stakes." Instrumental stakes are the goals which a participant holds which he expects to be fulfilled by the joint venture. Instrumental stakes call for two kinds of processes to achieve the goals: problem solving and bargaining. Problem solving processes are viewed by participants as resulting in variable joint gain while bargaining processes are viewed as having a fixed joint gain with participants' shares being variable.

Expressive stakes are those in which participants "express" the roles they wish to play and the relationships they wish to establish within the new organization. Expressive stakes can either reinforce participants' identities or conflict with them.

In the federative model (Warren, 1972) of interorganizational relationships, a new, operating organization is established to provide

concerted decisionmaking about a joint issue. Such an organization would deal with both instrumental and expressive stakes of partners. Since a basic conflict arises between the satisfaction of instrumental, problem solving stakes and bargaining and identity processes (Walton, 1972), an organization designed to separate the two might tend to reduce conflict.

An operating organization divided into a relationship oriented steering group and a task oriented program office has the advantage of such a separation. The steering group deals primarily with bargaining processes between the partners. Within the steering group partners are allowed to pursue expressive stakes; handled properly, expressions lead to identity reinforcement for each partner. Much of the problem solving process leading to partner instrumental stakes is accomplished by the program office with only the most important questions raised to the steering group level. Interference with program office problem solving processes by partners trying to get a larger relative share of benefits or to express their identities, is minimized under such a "division of labor" by steering groups and program offices.

One or More Programs Per Steering Group. Programs whose steering groups did not oversee other programs performed with greater success than programs which were included with others under a single steering group.

I(2)--International cooperative technology programs whose steering groups oversee single programs are more likely to be successful than programs whose steering groups oversee multiple programs.

A one-to-one correspondence between programs and steering groups is inferred from a combination of three factors in Table VI.1--3.1, 3.2, and 3.3. Steering groups, legitimized by corresponding memoranda of understanding (MOUs), were tasked to fulfill the terms of their MOU as representing joint policy concerning a program or programs of the participant nations. Bargaining and compromise took place within steering groups as they traded off contributions, benefits and other considerations within their authority during a program's conduct. The range of tradeoffs available to the steering group members remained within their program, if there was a one-to-one correspondence of steering groups and programs. Since stated goals were shared among the participants and tradeoffs remained within the program, a program was likely to be strengthened by bargaining. Where a one-to-one correspondence did not exist, steering group members had greater latitude to agree to tradeoffs--between, rather than within, programs. As a result, a given program in a set had the potential of having resources and interest reduced to the extent the program was no longer viable. Termination then often resulted.

Policymaking and conflict resolution between partners within single program steering groups was conducted according to rules established in MOU's. Actions were normally taken by vote of steering group members. In earlier programs steering group members voted in proportion to their nation's funding contributions to the program. Later, programs moved away from proportional voting,

first to single-vote-per-participant, majority decisions and then, on two programs, to unanimity of all steering group members. A requirement for unanimity was arrived at on one program by steering group members themselves, viewing anything less as a potential for long term conflict. In some single-programs-per-steering group structures evidence exists revealing a program commitment by steering group members and a development among them of a trust relationship that they would do their best in their own bureaucracies for the good of their program.

Very little appears in the literature concerning a single board of directors-multiple joint project organizational model. Alder and Hlavacek (1976), in their study of 23 new product joint ventures in the chemical industry, concluded that joint venture boards of directors should be designed to insure proportional representation for that project.^{*} A more recent study of 166 joint ventures implies that within chemical industry joint ventures, several were conducted between the same sets of partners at the same time (Pfeffer and Nowak, 1976). Pfeffer and Nowak conclude that a major reason for entering into joint ventures within an industry is to reduce competitive uncertainty. It seems likely that ventures between the same partners were overseen by a joint board of directors, but effectiveness of such an arrangement is unknown. However, if management of competitive uncertainty is a goal of such joint ventures,

^{*}Emphasis mine

a board over all common joint ventures would allow boards increased latitude in tradeoffs.

Competing objectives by participants is a threat to international cooperative programs; competing objectives appear more likely under single steering group-multiple program arrangements.

Multiple Decision Review Levels. US military and civilian bureaucracies responsible for and associated with military research, development and weapons acquisition are extensive and powerful (Fox, 1974); although not as extensive, non US bureaucracies are deeply involved in these same processes (see Table V.1 on p. 127). The following inference concerning the role of steering groups in protecting programs was derived from factors 1.1 through 1.4 and 2.3 in Table VI.1.

I(3)--International cooperative technology programs in which managers' decisions are subject to multiple review levels are less likely to be successful than programs in which program managers' decisions are reviewed by a single steering group.

Programs which faced bureaucratic review of most decisions were associated with lower success. Since programs were international, more attention was given them within bureaucracies; increased attention resulted in more agencies requesting information and coordination from program offices than from single nation programs. Some respondents estimated that international program decisions took over twice as long to get approved as single nation program decisions.

Steering groups isolated programs from much of the US bureaucratic review process by fulfilling in one level the same roles as

several levels of parent bureaucracies. Funding processes were separated on several programs from funding for unilateral programs; reprogramming of funds from international to unilateral programs was not possible (though one finance officer who tried was severely reprimanded). Steering groups were forums for interagency conflict resolution, and only occasionally were steering groups' decisions overturned. The increased status afforded steering groups allowed them access to virtually any level within the relevant bureaucracies for the solution of program problems. Some evidence exists to show that as a result of all of these actions by steering groups their programs experienced less decision delay than others who had no steering groups or whose steering groups did not provide for review of program decisions.

Among the problems involved with multi-level review of management decisions are those involved with communications and decisionmaking in a bureaucracy. Downs (1967), discussing Tullock's Model of Hierarchical Distortion, concluded that in a seven-tiered organization almost 99 per cent of original data gathered on a problem by the bottom level is eliminated by the time it reaches the top. Ways of avoiding some of the loss and improving its quality is to establish redundant reporting channels. Downs also concludes that relatively more stable organizations develop better internal communications systems than those which are constantly changing. Although federal bureaucracies may be relatively stable, international cooperative program offices generally are not, as evidenced

by the kinds and numbers of problems discussed in previous chapters. As a result it would be expected that communications between international cooperative technology programs and higher echelons of military and civilian bureaucratic structures would be poor. Bypassing intermediate echelons is another device used by effective officials to obtain clear and useful information (Downs, 1967). Steering groups performed this function on a permanent basis.

Steering groups which allow review by various bureaucratic levels risk exacerbating problems inherent in partners' competing instrumental and expressive stakes (Walton, 1972). For example, after approval by a program manager a decision was submitted for review to the program manager's civilian hierarchy, ostensibly for review of his problem solving process. A member of the program office from another participant nation who dissented on the decision contacted his own hierarchy where identity conflict arose between individuals there and members of the program office. When the decision reached the final approval level, it was subjected to immediate bargaining by the second participant country. Since such behavior was unexpected at the final approval level, the decision was returned to the program manager because of incomplete work and the program delayed significantly.

Steering groups having decision review authority represent a single level above their programs where the impact of the four processes described by Walton is contained. More direct information

is available to steering group members about a program problem, and less involvement of groups with low stakes in the outcome is assured. Reviews may be more detailed, clearly understood at the final approval level, and rapidly disposed of allowing minimum delay in implementation.

Program Management and Success

Five inferences are derived from the factors identified in Table VI.1 and deal with program manager authority, the degree of program orientation of program office members, and their perceptions of sources of program problems.

Program Manager Authority. US single nation program managers are subject to extensive and detailed systems acquisition procedures and regulations which limit their authority to conduct programs. As a result their responsibility of effectively obtain specific program goals may be diffused in that they are able to lay the blame for performance shortfalls and cost and schedule growth on restrictive regulation (Fox, 1974). Various European systems acquisition philosophies require program managers to pay less attention to detailed rules and procedures and more to personal judgment and expertise (Perry, 1971). Increased dependence on program manager competence is coupled with increased authority in such a European approach. International cooperative technology programs which followed a European authority and control structure, placing a

greater burden directly on program managers, were rated higher than programs bound by existing US procurement regulations.

I(4)--International cooperative technology programs in which program managers are granted high levels of authority are more likely to be successful than programs in which program manager authority is more limited.

This inference is derived from Factor 2.3 in Table VI.1. Hochmuth (1974) points out the importance of a full time management agency with a single, strong leader. Split authority, such as occurred on the MBT-70 tank program leads to failure, in part because compromise is required between the managers resulting in fewer and fewer joint goals being met by the program. Lower authority, such as that perceived attributable to most US program managers, was not necessarily associated with failure however, implying that other factors might make up for lower program manager authority. In a study of inter-agency project management, Walton (1969) concluded that the most important factor in improving interagency project management would be to increase the power of the program manager. Walton found that marginal authority increases had little effect on improved performance. Only when major organizational moves were undertaken to strengthen the authority of the project manager, or when the project manager had control over the large majority of resources, did project performance improve. Hochmuth (1974) also points out that the program manager should have authority over the reward system of the program office members so that program orientation and individual performance may be recognized and rewarded.

Little reference to leader authority occurs in the inter-organizational theory literature. Within other literatures increased authority appears related to success. Steiner and Ryan (1968) point to increased program manager authority in achieving very high levels of success on unique programs. Fiedler (1970) points out that as authority of a leader increases successful leadership styles change from task orientation to relationship orientation for moderate levels of authority then back to task orientation for high levels of authority. Considering the federative context of Walton (1972), where organizations are divided into relationship oriented steering groups and task oriented program offices, either very high or very low levels of leader authority are called for in the program office.

Program Orientation and Success. Program orientation, as distinguished from parent government orientation, occurs when program managers and their team members internalize the goals and value structures of programs to the extent that when faced with a decision benefiting either their program or their parent government, but not both, they would favor their program. Where program managers and team members were program oriented, programs were rated more successful.

I(5)--Where program managers and team members are more program oriented than parent oriented, resulting programs are more likely to be successful.

Inferences concerning program orientation were derived from factor 3.4 in Table VI.1. Program orientation is characterized by

the degree to which people internalized the goals and value structure of the organization and by the degree of criticism of their parent organization revealed when parents took actions to impede the progress of their program. Such an orientation, believed common to single nation programs (Fox, 1974), is perceived as personally very risky to program managers in the international context. Several respondents pointed out that becoming a program manager of an international cooperative technology program forced a program manager outside the "normal" career progression. Where decisions were made which were unpalatable to influential members of the US bureaucracy, program managers reported isolation and non-promotion. Unpalatable decisions resulted from conflict between joint goal attainment and parent government goal attainment.

Interorganization relations literature deals with decision conflict between participants, not with conflict between federative model program managers and their parent organizations. Such conflict does not appear to fall in the category of expressive stakes of partners, more specifically in identity conflict processes. As these processes are intertwined with others, conflict resolution only seems possible in a steering group context where program orientations may be rewarded.

Two other inferences are also derived from factor 3.4, Table VI.1 and are related to I(5) and program orientation. The first deals with tasks of program office team members; the second deals with perceptions of problem sources.

I(5a)--The degree of program orientation of program office team members is associated with the primary functions performed by those members. Program orientation is higher when members perform substantive functional tasks and lower when they perform mainly liaison tasks.

If other partners than the lead or sponsoring partner were not represented in the program office organization, programs were perceived as less successful. Where they were represented by liaison officers, the officers were primarily parent government oriented. Lower program orientation resulted in lower perceived success. Such liaison officers were considered outsiders--not coworkers and, hence, detractors rather than contributors to program success.

Conversely, where representatives performed functional tasks, such as engineering, configuration control or logistics, they developed an attachment to the organization and its other members and internalized program office goals and value structures. Where conflict arose between benefits to their parent government or to the program, interviewees indicated that such program oriented members used what power they had to benefit the program and the long term goals of their parent as a result.

Hochmuth (1974) stresses the program orientation of management in overcoming important cultural and interpersonal barriers to the solution of certain problems. He cautions, however, that managers should not over-emphasize program orientation, pointing out the importance of cultural and interpersonal ties in maintaining vital communications with parent governments.

Barth (1973), discussing similar orientations of engineers in a project setting, found that the greater the difference between the value structure of the individual and that of the organization, the lower the individual's commitment to the organization. Litwin and Stringer (1968) showed that a positive organizational climate, represented by variables such as structure, risk and team spirit, contributed to better organizational performance. A close parallel exists between value structure and "climate" structure, according to Barth. Thus minimizing the differences between the program office goals and values and those of the members should lead to better program success. Minimizing these differences seems to occur when members perform functional, rather than liaison activities.

I(5b)--International cooperative technology program office members who view program problems as stemming from their own country's political and economic milieu are more likely to be highly program oriented than those who view program problems stemming from other participating countries' political and economic milieu.

How the program office members viewed the source of non-technology problems is also associated with program or parent/national orientation. Those who demonstrated a program orientation viewed problems primarily originating in their own country's political and economic environments and military bureaucratic structures. Such a view reflects both an understanding of and a willingness to point out problem sources in their own environment relevant to their program. They avoided blaming the "foreignness" of the program for problems

and demonstrated a willingness to contribute their understanding of their own environment to make their program more responsive to environmental displacement.

On the other hand, those who demonstrated a parent government or national orientation viewed problems primarily stemming from the other participants' political and economic environments and military bureaucratic structures. They revealed a distrust of foreign participants or viewed a program's international nature as a major complicating factor over which they had no control. Several US program office members stated that they recognized the need to conduct international cooperative technology programs but were very reluctant to "give away" technology which had been developed in the US.

Aldrich (1975) addresses program orientation indirectly through cooperation and conflict in interorganization relations. Aldrich postulates a relationship between dimensions of interorganizational environment and the degree of cooperation and conflict between partners. Two of these dimensions are particularly important to the attitudes of members of international cooperative technology programs: (1) Stability--the degree of turnover in the elements of the task environment, and (2) Turbulence--the extent to which the environments of the focal organization are being disturbed or changed by other organizations. Perceptions of environmental stability and lack of turbulence by members of the focal organization are thought to be related to cooperation between the focal organization and other members of the interorganization. Those perceiving an

unstable task environment of changing technological goals and a turbulent international environment resulting from actions by parent governments would tend to exhibit less cooperative, greater conflictual behavior and, as a result, less of an orientation toward the program.

Where program office members held program orientations, perceived program success was higher; where they held parent government/national orientations; perceived program success was lower. Causality is not necessarily implied; whether programs were rated higher because respondents held a program orientation or because a program orientation helped members deal with problems more effectively, which led to higher program performance, is not clear. Program orientation and individual performance have not been related in other studies except under special conditions (Barth, 1973; Champion, 1975).

Problem Perceptions and Success. Compared to procedural problems, organizational problems were perceived by respondents on the highest rated programs in far greater frequency. On lowest rated programs the reverse occurred with respondents perceiving procedural problems far more often than organizational or structural problems. The following inference was derived from Factor 3.5 in Table VI.1

I(6)--International cooperative technology programs in which managers perceive the nature of program problems mainly as organizational or structural are more likely to be successful than programs in which managers perceive the nature of problems mainly as procedural.

In programs where the kinds of problems dealt with by management were viewed primarily as organizational or structural in nature, higher success was achieved. Where management saw problems primarily in terms of program processes or procedures lower success obtained. Qualitative analysis further indicates that managers of more successful programs designed general ways of modifying their organization to deal with problems--ways which were out of the ordinary, avoiding procedural channels which unilateral programs were often forced to use because of regulation.

The different levels of success achieved by the program managers who relied on different problem views appear on the surface to contradict the work of Hunt (1970). Hunt distinguishes between organizations which are performance oriented and those which are problem solving oriented. Performance oriented organizations, such as a mass production factory or commercial bank, tend to routinize problem solving processes. In performance organizations most problems which arise fit into one of several standard operating procedures; if not, new procedures are established to deal with them on the assumption that there will be others similar to them in the future. Problem solving organizations, however, deal with one-of-a-kind output; typical of problem solving organizations are R&D laboratories. In these organizations management deals almost entirely with exceptions; problem solving modes are usually unroutinized. Hunt, however, focuses on the processes within organizations for dealing with problems,

not on changes to organizations resulting from different classes of problems. There was no indication that problem solving processes were routinized by higher rated programs' managers. Instead, managers of more effective programs adapted their program organization to better deal with major kinds of problems.

Managers' perceptions of problems as organizational reflect this continuous attempt by them to adapt their organization to its environment either through changing the organization or influencing elements of the environment. Kast and Rosenzweig (1973) predict that such programs, reflecting an "open/adaptive/organic" organizational model, should perform better in the dynamic and uncertain environment characteristic of international programs.

Another aspect of manager's perceptions of problems as organizational or structural is the degree to which organizations influence their environments. Aldrich (1975) terms this "mutability," defined as the extent to which the environment is believed to be open to manipulation and change by organizational activities. According to Aldrich, where managers feel they are able to adapt the organization to account for changes in the environment and even to change elements in their environment to benefit their program, goal conflict is reduced between participants and greater success achieved.

Technological Strategy

The technological approach or strategy employed by partners in an international cooperative technology program was a third major area where distinctions between high and low rated programs were found. Three inferences are drawn from the factors identified in Table VI.1 which deal with elements of technological strategy: (1) extent and degree of technological advances sought by partners in a joint program, (2) program's technology stages, and (3) the relative direction and balance of flows of technology between parent governments.

Technological Advance and Success. Factor 4.2 of Table VI.1 was used to derive the following inference concerning the complexity of technological advances sought by parent governments.

I(7)--International cooperative technology programs which attempt few and modest advances to the state-of-the-art are more likely to be successful than programs which attempt multiple and major advances.

Technological goals of parent governments at the beginning of an international cooperative technology program may be thought of in terms of the degree of the state-of-the-art advance sought in each major technology and the number of technologies in which significant advances are required for technical success. Relationships described by RAND Corporation analysts (Harman and Henrichsen, 1970; Perry, Smith, Harman and Henrichsen, 1971) between increasing degree of state-of-the-art advance sought and increasing failure to meet performance, cost and schedule goals are extremely important to international cooperative programs. Failure to meet objective, stated

goals in such programs generates widespread tensions in the program among all partners. Although the US may hedge the international program by a similar unilateral program, most other partners, with smaller budgets can ill afford to do so. Tensions are also increased because of an expansion in the number of agencies within the parent bureaucracies which are interested in the program. They generate interbureaucratic forces to either increase their control over the program or obtain resources for other activities through the demise of the international program.

Large programs are relatively more important, financially, to smaller parent governments. If major cost overruns occur as a result of attempting a large state-of-the-art advance, smaller national partners might be forced to drop out, increasing the burden on those remaining.

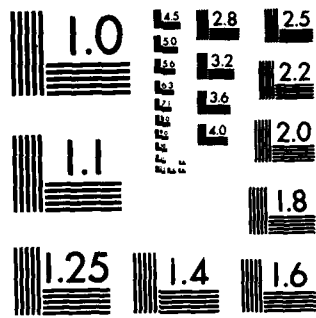
Even with more modest attempts at stretching the state-of-the-art, programs which require several technology advances for overall success, as most US weapons system programs tend to do (Perry, et al, 1971; Fox, 1974) run the risk of a single advance delaying the program, or causing a cost escalation beyond the capability of some partners. A technological strategy combining several major attempts to stretch the state-of-the-art was associated with perceived program failure in this study. The most successful programs used existing technology in new ways or used only one or two modest technological advances to accomplish program goals. One of the least successful

programs tried to make several major advances and failed in at least one critical attempted advance.

Technology Stages and Success. Another aspect of a program's technological strategy, the technology stages in which a program was conducted, was also associated with success. The following inference was drawn from Factor 4.3 in Table IV.1.

I(8)--International cooperative technology programs in research, exploratory development and production are more likely to be successful than programs in advanced and engineering development.

Of the stages of research and development discussed in Chapter Two, research, exploratory development and production stages were associated with more successful programs, while advanced and engineering development stages, especially the latter, were associated with the least successful programs. Zaltman, Duncan and Holbek (1973) point out that one of the most important characteristics of innovations is that they must deal with various kinds of conflict. One of the main tasks of the steering group is to resolve conflict over technological means of achieving program goals. When the program innovation is minor or in the early stages of development, relatively little conflict over technological means arises during the program because little real change is required in parent government systems or procedures. As the innovation progresses to more advanced stages the potential for affecting other systems, tactics, or military procedures increases. The final design decision is made late in engineering development; at that point, fitting a final design to be



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

produced to the evolving military requirements of the parent governments, as well as unstated industrial and technical goals, may cause the potential conflict to be the greatest. In cooperative production programs, however, all partners have agreed on a selection for the final design (except for "minor," nation-specific changes). Thus, at the production decision the potential for conflict over the technological design decreases significantly.

In one sense, technological "degrees of freedom" are removed as initiatives proceed from exploratory development to production. However those remaining take on more importance because of increasing investments and expectations of the partners. At the point of a production decision, no degrees of freedom remain. Thus, the management of conflict over technological means appears to take on increasing importance up to the point of an agreed commitment to production. In the programs studied which were terminated early the increasing technological conflict was added to the other elements of conflict and exceeded the programs' conflict resolution capacities. Inability of the program structure to deal with technological conflict could result in its termination, high levels of stress, or over-compromise resulting in a significantly less valuable program to participants.

Technological Contributions and Benefits and Success. A partner's technological contributions to and expected benefits from engaging in an international cooperative technology program constitute his main instrumental stakes (Walton, 1972) in the program. Whether

a partner sees a variable joint gain from the program or a variable share of a fixed joint gain, he judges the program's success in part by a general notion of equity in technological contributions and benefits. Factors 2.4 and 4.2 of Table VI.1 were used to derive the following inference:

I (9)--International cooperative technology programs in which partners' shares of joint technological benefits are perceived as being in proportion to their contributions are more likely to be successful than programs in which shares are not so perceived.

If partners perceive that a venture is truly a joint production of technology and that each partner has made a substantial technological contribution to the venture, it has a higher likelihood of success. Technology was perceived by respondents as not necessarily having a monetary value. If partners contributed only funding to a program, then shared the technology developed, that program tended to be rated lower.

Technological contributions include a national technological base brought to a program as well as the scientists, engineers and technicians, the facilities and other technological resources applied to the program. Government, university, and industrial resources are included. Technological benefits from the program include the system the program was to produce as well as data rights, patent access, licensing rights and experience of national scientific and technical personnel which could be applied to other programs. In both of the development programs rated lowest, specific issues of technological benefits arose after the programs were terminated. US respondents

felt that the US had contributed the preponderance of the technology for both programs. After termination, European partners had continued one program as a single nation effort and had used a major technology of the other on a joint European effort. Although payment had been made to the US contractors and government for data rights, the attitude remained among US officials that the US had lost important technological advantages. Conversely, on the two development programs rated highest, technological contributions and benefits were perceived as balanced. In one program the source of the key input technology was from one partner while the technological resources of people and facilities came from the other partner. On the other program care was taken to insure that major subsystems were contributed from each partner to be integrated through the program into a single weapons system. No technologies were involved which were critical to any partner such that disclosure of the contributed technology to a potential enemy would make that partner particularly vulnerable.

Schmidt and Kochan (1977) in analyzing the two competing approaches to the study of interorganization relationships (exchange and power-dependency) found that when perceived benefits of inter-organizational cooperation were essentially equal between partners (an exchange relationship), frequencies of interaction were highest. When benefits were asymmetrical (power-dependency), the partner receiving the lower level of benefits perceived mutual goals other than those associated with the interaction. High frequencies of

interaction were also associated with asymmetrical benefits if the partner receiving the most benefit were perceived as very important by the other partner. Their conclusions closely parallel the inference described above. If frequency of interaction may be thought of as a measure paralleling perceived success of the international cooperative program, the exchange relationship seems to explain the ratings for the top three programs. The ratings of other higher rated programs may be partially explained by the importance of the NATO alliance (to the US) under whose auspices the programs were conducted.

Implications

The study reported in this dissertation has shown that success in international cooperative technology programs is neither impossible nor accidental. Success in this context may be achieved by development of an appropriate technology strategy, careful selection and employment of team leaders and members, and appropriate design of structures within which to manage both the programs, themselves, and the linkages between partners. The implications of this study concern researchers into the characteristics and dynamics of interorganizational relationships, national and industrial policymakers, and officials charged with the management of international cooperative technology efforts.

Implications for Researchers Studying Interorganizational Relationships

The findings of this study suggest that in federative inter-organizational contexts, new organizations established to manage interdependent activities are more effective at achieving joint and individual goals if such organizations are divided into two organizations having different roles. The first, a supra-organizational authority, would be structured as a forum for bargaining and identity expression by each participant organization. The second, a subordinate operating organization, would be structured to apply resources contributed by each participant to accomplish joint goals; its internal structure and operations would be separate from but subject to review by the supra-organizational authority.

The findings of this study also suggest that individuals with certain characteristics and viewpoints perform more effectively than others in interorganizational relationships. Those that maintain loyalties to their original organization appear to have more difficulty adjusting to interdependent activities and joint goals. Because of such difficulty, they develop value non complementarity (Barth, 1973) and are less effective.

The study also implies that jointly developed strategies for achieving interorganizational goals are more effective if they address modest objectives, limit the impact of participants on the approach chosen to accomplish goals, and return benefits to participants commensurate in quantity and kind to their contributions. Modest

objectives are suggested because the potential for conflict between participants, alone, tends to occupy much of the management effort of interdependent activities. Limited impact by participants on the general approach is suggested because in interorganizations it appears much easier to agree on joint goals than on joint means; also, greater risk to successful goal accomplishment seems to occur with increasing resources used, importance of goals to and involvement by participants in interdependent activities. Returning benefits in proportion to participant contributions maintains a sense of "fairness" among participants; fairness is increased if a partner's contribution of very important or scarce resources is recognized by other partners and benefits are returned which replace or enhance those resources.

Implications for Government and Industrial Policymakers

The results of this study show that there is no reason for government or industrial decisionmakers to avoid international cooperative technology programs because of potential management difficulties posed by their joint, international nature. Cooperating governments have overcome the most difficult problems by:

- carefully designing structures of joint operating organizations to divide activities directed at accomplishing program goals (program office activities) from activities directed at determining shares of joint benefits (steering group activities) and to avoid national legal and bureaucratic regulation inappropriate to joint or international efforts.

- isolating operating organizations from control by individual partners or partner bureaucracies by granting managers special authority based on their programs' needs to operate in turbulent international environments.
- developing technology strategies to insure all partners contribute significant technologies to their programs, to select goals which are technologically modest, and to recognize increasing risk associated with nationally sponsored or favored alternative technological approaches.

In addition the study points out the need for a long range policy viewpoint, developing perpetual cooperating entities to make use of the joint experience of past efforts and to take advantage of expertise and trust relationships built over several years.

Implications for International Cooperative Technology Program Managers

Program managers of international cooperative technology programs operate in environments which are more complex and personally risky than are found in equivalent single nation programs. Increased complexity results from the two additional dimensions of uncertainty with which they must cope: international and cooperative. Also, because most such programs tend to be isolated from typical single nation systems acquisition processes, program managers are perceived as outside the mainstream of program management and as a result suffer career setbacks and non-promotion.

The findings of this study suggest three areas in which program managers may enhance their program's chances for success and deal with such complexity and risk: (1) relationship with a program steering group, (2) program office composition and structure, and (3) problem solving processes.

The study indicates that the program manager/steering group linkage is one of the most important relationships in a program. The steering group may hire and fire the program manager in most cases, and he is usually directly subordinate to the steering group in successful programs. A program manager who supports the steering group relationship gains its support in getting action on his problems within parent bureaucracies. Strengthening the program manager/steering group relationship tends to increase the authority of the program manager especially in areas of selection of program team members and in support for his budget and technical decisions.

The composition and structure of the program office is also important. Program offices composed of team members who, on program issues, are more loyal to their program than to cognizant parent bureaucracies, tend to be very successful. Such loyalties or program orientations are reflected in team members' willingness to put program goals before those of parent bureaucracies. Developing program loyalty is a major task of the program manager. He may develop it in part by: (1) constructing a single, relatively small program office so that all those responsible for the program's management grow to

know and communicate with each other well and have the opportunity to develop trust relationships with each other; (2) selecting team members who hold an "open systems" viewpoint so that they recognize and respond to the multiple environments with which they must deal; (3) insisting on controlling the reward system for team members to recognize and reinforce competence and program orientation; (4) insuring that team members from each participating country perform important functional tasks and are fully integrated into the program office--not used only to fill liaison roles; (5) insisting that selected contractors manage their own international cooperative arrangements under general guidelines of the program steering group; (6) tailoring an internal program office structure which is adaptable to the phases of the program, the expertise in the program team, and the uniqueness of the program task, itself.

The results of this study also indicate that program managers should recognize the importance of developing problem solving structures in dealing with the different kinds of problems presented by the technological, international and cooperative dimensions of program environment. Attempts to standardize problem solving should be avoided except in the most routine circumstances, and program managers should develop information gathering functions and buffers to increase the amount of time between a problem's detection and its necessity for solution. Prior to responding to major problems, program managers should carefully assess whether the problem significantly affects a

partner's share of the joint benefits or partner status or identity; if so, the problem should be addressed at the steering group level.

Recommendations for Further Research

One of the most fruitful areas for further research suggested by the study reported in this dissertation is in the area of inter-organizational relationships, analysis and behavior. Other areas for additional research are suggested by the limitations of the study resulting from its scope and exploratory nature.

Interorganizations. In both the theory and application of the management of one-of-a-kind joint endeavors, additional information is needed concerning the kinds of management organizations established and their effectiveness in achieving joint goals. In interorganization theory and behavior further investigation is needed in the following: (1) supra-organizational authority, (2) policymaking roles, and (3) individual behavior and performance in interorganizational settings. Research into supra-organizational authorities should focus on: Under what conditions in interorganizational relationships does a supra-organizational authority arise? Does satisfaction of joint and individual goals depend at all on the presence or absence of a supra-organizational authority? Do patterns emerge in interorganizational relationships which separate, organizationally, problem solving processes from bargaining and identity expression of participants? Finally, how do other kinds of interorganizational patterns, such as

social choice, coalitional and unitary, structure themselves to handle joint and individual participants goals?

Additional information is also needed concerning the role of policymaking in interorganizations. Although recent interest has focused on the function of boards of directors in business organizations, a more general phenomenon seems likely to exist in other kinds of organizations. If so, how do policymaking roles differ between single organizations and joint or inter-organizations? If the policymaking role can be clarified in other organizational types, a comparative analysis of single company and joint venture projects should be useful to distinguish bargaining processes and expressive stakes in interorganizations from interpersonal behavior in single organizations. Additionally, do policymaking designs exist which provide for "outside directors" in interorganizations?

Individual behavior and performance in interorganizations appears to be neglected by current research efforts, yet the findings of this study indicate that such factors may be very important to the attainment of joint goals of partners. What kinds of characteristics do members of interorganizations have which enables them to be effective in such multi-dimensional environments? Do different coping mechanisms of individuals yield different abilities to meet stresses imposed by the kinds of uncertainty potentially present in inter-organizations? Do similar stresses arise between interorganizations and other multiple authority organizations such as a matrix design?

In the management of one-of-a-kind joint efforts more systematic investigation of joint ventures is needed addressing specific designs of supra-corporate and operating organizations in business and non-profit settings. What kinds of designs are specifically effective in dealing with conflict between partners in a non-international context? Does program loyalty or orientation occur in joint business ventures? What are the determinants of program orientation? Is there some level of intensity of program orientation where it becomes counter-productive?

Study Limitations and Further Research. This study is necessarily limited by several constraints. First, as an exploratory study, and one which drew mainly from subjective data, its inferences require verification through replication. Second, the measure of success used was necessarily subjective and unidimensional. Further research should investigate dichotomized, ordinal and multidimensional success measures on which to base conclusions. This is especially important if the results are to be used by practitioners on which to base policy; many of the study's conclusions impact US Congressional prerogatives.

Third, the scope of the study was limited to programs in which the US was a major participant, and the majority of respondents were US government officials. A European perspective is required to increase generality. Also, how programs in which the US participated differ from European programs would add depth and clarity to the generalizations.

Fourth, the role of industry was not included to any great degree. The effect of individual contractors (including a possible "experience curve" phenomena), national groups of contractors or differing kinds of intercontractual relationships would be an important area for further investigation. Increasingly, contractors are being required to form partnerships with contractors in other participating countries as a condition for award of contracts at the prime and subcontractor levels. How these required interorganizational relationships affect program success has only been given limited attention.

Fifth, personal and leadership variables were not explicitly addressed by the study. Additional information is needed to determine the most effective kinds of leaders in the unstable, heterogeneous and turbulent task environment of the international cooperative technology program.

Finally, international technology policy was not specifically addressed because it was deemed to be beyond the scope of the study; instead, the study was directed at middle range management issues, between high level policy on one hand, and day-to-day procedure common to unilateral programs, on the other. Presently, US technology policy is undergoing significant changes and challenges. A threefold approach to NATO weapons collaboration by the US Department of Defense seeks to improve the standardization and interoperability among NATO forces and reduce the duplication of effort existing among NATO technological

initiatives. This approach is under fire from US Congressional committees (Perry, 1979; Subcommittee on Rationalization, Standardization and Interoperability in NATO, US House of Representatives, 1979).

APPENDIX A: THE QUESTIONNAIRE

DEPARTMENT OF THE AIR FORCE
AIR FORCE BUSINESS RESEARCH MANAGEMENT CENTER (HQ USAF)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433



SUBJECT: Research Survey Cooperation

1. This office is operating under a charter to make improvements to the acquisition process as outlined in AFR 20-5. In fulfillment of this charter, we are sponsoring a research project by Major Nils B. Ohman, a Ph.D. student at the University of Texas, Austin, who is conducting his dissertation in the area of international cooperative research, development and acquisition. A brief background of his subject is included on the attached information sheet with the survey. You have been selected to respond to this particular survey since you have participated in one manner or another on an international cooperative program in the past few years.

2. This research has been cleared for use within the Air Force and carries a survey control number 76-44. Under the recently enacted Privacy Act, you should be aware that your response to this survey is anonymous and can no way be traced to you individually unless you so wish so in the space provided on the last page of the survey. Your cooperation is voluntary and failure to respond will not result in any adverse action.

3. You are requested to respond not later than 5 December 1975. If you find that you are unable or unwilling to respond, it is professional courtesy to return the blank form to the researcher. This allows him to know precisely his "percentage of sampling responding" and allows him to start his analysis.

4. The survey should take about 20 minutes of your time. I realize your time is limited and valuable; however, your contribution to research will assist us in gaining important knowledge and pave the way for future improvements. Foreign military business, or cooperative development production programs, continues to be a way of life in order to effectively utilize our national resources. Our ability to understand and manage these types of programs effectively will contribute to our overall national defense. Any questions you may have regarding the survey may be directed to me at Area Code 513 257-2851 or Autovon 787-2851. Questions may also be directed to Major Ohman at the address and phone number given on the attached data sheet.

Thomas J. Michalowski
THOMAS J. MICHALOWSKI
Major, USAF
Deputy Director

1 Atch
Survey

Your assistance is requested for a study of the management of technology projects in international environments. The purpose of the study which this questionnaire supports is to identify and explore factors affecting performance of government sponsored international cooperative technology projects or programs.

Several benefits are potentially available to participant countries in international cooperative technology projects: Cost savings through sharing R&D costs, standardization of allied weapons systems, avoidance of duplication of technological effort, sharing of technology and better relations with allies. However, many cooperative technology projects have terminated early or failed to meet the original goals of the participants.

A cooperative technology project, as referred to in this questionnaire, is defined as (1) a joint effort by two or more countries (2) directed at fulfilling a common stated requirement through research, development or production activities (3) with each participating nation sharing the cost (and often the work and management) in predetermined ratios (4) and receiving agreed upon technical, production, and marketing rights and/or hardware items.

Although primary emphasis of the study will be on cooperative technology projects, as defined above, your experience in any advancement or transfer of technology which includes other countries will be very useful to the study.

The questionnaire will be analyzed as part of a doctoral dissertation effort at the University of Texas by an Air Force officer and is being administered under the auspices of the Air Force Business Research Management Center, Wright Patterson Air Force Base, Ohio.

All responses to this questionnaire will be kept anonymous and will be treated so as not to judge specific programs, groups, or individuals. Since your experiences and judgements are valuable, however, my intent is to provide summary results of this survey to its participants.

If there are questions concerning this survey, please call Major Nils B. Ohman at 512-345-2859 commercial, or 685-1110 autovon (Bergstrom AFB) with a patch to 345-2859. When you have completed this questionnaire, unless special arrangements have been made to personally pick it up, please mail it in the enclosed envelope to:

Professor of Aerospace Science
AFROTC Detachment 825
The University of Texas at Austin
Austin, Texas 78712

ATTN: Maj. Nils B. Ohman

NOTE: DO NOT INCLUDE CLASSIFIED INFORMATION IN THIS QUESTIONNAIRE!

USAF SCN 76-44

PART A: INTERNATIONAL TECHNOLOGY EXCHANGE EXPERIENCE

The following questions concern your experience in the exchange of scientific and technical information with other countries. Please place an X or a check where indicated.

1. Have you ever been involved in monitoring, assessing or participating in Data Exchange Agreements (DEA's)? YES NO
2. Have you ever presented a paper or participated in discussions or working groups at meetings of any of the following organizations (Please check those applicable)?
- AGARD--Advisory Group for Aerospace Research and Development
 - TTCP--The (Tripartite) Technical Cooperation Program
 - SHAPE Technical Center
 - NATO Ad Hoc Mixed Working Groups
 - Other NATO Advisory Groups
 - Other Foreign Military Technology Exchange Groups (Please specify to left)
-
-
3. Have you ever participated in a Scientist/Engineer Exchange Program with another country? YES NO
4. Have you ever participated in a cooperative (cost-shared) research, development or production program or project with another country? YES NO
5. Have you ever participated in any other kind of technology exchange program with another country? Please identify the program, if yes. YES NO
-
-
6. Please indicate your assessment of the worth to the United States of technology exchange programs with other countries.
- Of highest value
 - Of great value
 - Of some value
 - Of little value
 - Of no value



PART B: INTERNATIONAL COOPERATIVE COST SHARED PROJECTS

7. Several international cooperative technology projects are listed below. Please show your association with each program/project in the following manner:

If you have ever been a member of the program office or project team for an international cooperative effort, please indicate this by circling the (1) to the left of the title.

If you have ever been officially associated with or related to the program office or project team in any other way (higher level command or staff, contract administration, legal services, ad hoc working groups, etc.), please indicate this by circling the (2) to the left of the title.

If you have not been officially associated with the program office or project team, but you feel qualified to comment because of some other reason, please indicate this by circling the (3) to the left of the title.

1 2 3 NATO ATLANTIC	1 2 3 MALLARD
1 2 3 NATO HAWK	1 2 3 US/France Reliable Acoustic Path Sonar
1 2 3 NATO MADGE	1 2 3 US/FRG Main Battle Tank(MBT-70)
1 2 3 NATO PATROL HYDROFOIL SHIP	1 2 3 US/FRG UPD-5 SLAR
1 2 3 NATO SEASPARROW	1 2 3 US/FRG UPD-X SLAR
1 2 3 NATO SIDEWINDER	1 2 3 US/FRG V/STOL Fighter
1 2 3 NATO STARFIGHTER	1 2 3 US/FRG V/STOL Development Program
1 2 3 US/UK Planar Array Sonar	1 2 3 F-4 <u>Coproduction</u> Programs
1 2 3 US/UK Skybolt	1 2 3 F-5 <u>Coproduction</u> Programs
1 2 3 US/UK XJ-99 Lift Engine	1 2 3 F-16 <u>Coproduction</u> Program
1 2 3 US/Canada Air Cushion Landing System	1 2 3 Other Cooperative <u>Research</u> Programs (Please List)
1 2 3 US/Canada Bare Base Projects	_____
1 2 3 US/Canada Digital Scan Converter	_____
1 2 3 US/Canada Dispersion Strengthened Nickel Chromium Alloys	_____
1 2 3 US/Canada GRC-103 Band IV	1 2 3 Other Cooperative <u>Development</u> Programs (Please List)
1 2 3 US/Canada Multimode Matrix Display	_____
1 2 3 US/Canada Polar Cap III	_____
1 2 3 US/Canada Room Temperature Injection Luminescence in Wide Band Semiconductors	1 2 3 Other Cooperative <u>Production</u> Programs (Please List)

PART C: ASSESSMENT

IF YOU DID NOT CIRCLE 1, 2, OR 3 FOR ANY OF THE PROJECTS LISTED ABOVE---GO TO QUESTION 15; SKIPPING QUESTIONS 8 THROUGH 14.

IF YOU DID CIRCLE 1, 2, OR 3 FOR ANY PROJECT LISTED ABOVE, PLEASE FOLLOW THE EXAMPLE BELOW SHOWING THE PROJECT PHASES YOU ARE MOST FAMILIAR WITH AND YOUR ASSESSMENT OF PROJECT SUCCESS.

8. First, write the title of the project in the space provided; then, to the right, mark an X in the blocks that most nearly correspond to the Program/Project Phases in which you participated or are most familiar. Finally, rate the success of the program/project (by your own definition of success) by marking an X in the block representing most nearly your assessment of the project.

You Worked On:
Program/Project Title

You Worked In:
Program/Project Phases

Your
Assessment of Program

EXAMPLE: NATO V/STOL
Submarine

(1) _____

(2) _____

(3) _____

Initial Planning	International Negotiations	Early Stages	Middle Stages	Final Stages	Program Termination
X	X				X

Highly Successful	Just Acceptable	Highly Unsuccessful
		X



PART D: FACTORS AFFECTING COOPERATIVE PROGRAM/PROJECT MANAGEMENT

9. Think back over the course of your association with the program you listed first in question 8. What were some of the problems with which you had to deal? Please estimate what fraction of the program's/project's total problems fell in each of the categories listed below. Express the fraction as a percentage totalling 100% for all categories. Repeat for up to three programs/projects.

FIRST program listed in question 8:

- ()% Political and Economic Factors External to the Program/Project Office--United States
 - ()% Political and Economic Factors External to the Program/Project Office--Foreign Countries
 - ()% Technological Uncertainty
 - ()% Organizational and Structural Factors
 - ()% Personnel and Staffing Factors
 - ()% Factors Concerning Program Processes
 - ()% Other Factors
- 100 % TOTAL



10. SECOND program listed in question 8:
(If applicable)

- ()% Political and Economic Factors External to the Program/Project Office--United States
 - ()% Political and Economic Factors External to the Program/Project Office--Foreign Countries
 - ()% Technological Uncertainty
 - ()% Organizational and Structural Factors
 - ()% Personnel and Staffing Factors
 - ()% Factors Concerning Program Processes
 - ()% Other Factors
- 100 % TOTAL



11. THIRD program listed in question 8:
(If applicable)

- ()% Political and Economic Factors External to the Program/Project Office--United States
 - ()% Political and Economic Factors External to the Program/Project Office--Foreign Countries
 - ()% Technological Uncertainty
 - ()% Organizational and Structural Factors
 - ()% Personnel and Staffing Factors
 - ()% Factors Concerning Program Processes
 - ()% Other Factors
- 100 % TOTAL

NOTE: Clusters of some of the factors included in each category are listed on the next page, if you wish to refer to them.



12. For the program/project you listed FIRST in question 8:

For each of the categories of factors listed above, what specific incidents came to mind? Please specify the single most important incident or item which caused you to weight the category as you did. (For example, under "Factors Concerning Program Processes" you might write: "attempt at instituting quality assurance plan was taken as a personal affront to craftsmen, and the plant shut down for a week" or, under "Political and Economic Factors External to the Program/Project Office---Foreign Countries" you might write: "anti-US sentiment in Country X caused that country to withdraw from the program increasing unit cost to remaining participants by twenty per cent.") Please avoid single word descriptions such as good, poor, excellent, fair, etc. Use reverse of page if necessary.

Political and Economic Factors External to the Program/Project Office---United States

Political and Economic Factors External to the Program/Project Office---Foreign Countries

Technological Uncertainty

Organizational and Structural Factors

Personnel and Staffing Factors

Factors Concerning Program Processes

Other Factors



DO NOT COMPLETE THIS PAGE IF YOU LISTED ONLY ONE PROJECT IN QUESTION 8.

13. For the program/project you listed SECOND in question 8 (if applicable):

For each of the categories of factors you weighted in question 10, please specify the single most important incident or problem which caused you to weight the category as you did. Please avoid single word descriptions such as good, poor, excellent, fair, etc. Use reverse of page if necessary.

Political and Economic Factors External to the Program/Project Office--United States

Political and Economic Factors External to the Program/Project Office--Foreign Countries

Technological Uncertainty

Organizational and Structural Factors

Personnel and Staffing Factors

Factors Concerning Program Processes

Other Factors



DO NOT COMPLETE THIS PAGE IF YOU LISTED ONLY ONE OR TWO PROJECTS IN QUESTION 8.

14. For the program/project you listed THIRD in question 8 (if applicable):

For each of the categories of factors you weighted in question 11, please specify the single most important incident or problem which caused you to weight the category as you did. Please avoid single word descriptions such as good, poor, excellent, fair, etc. Use reverse of page if necessary.

Political and Economic Factors External to the Program/Project Office--United States

Political and Economic Factors External to the Program/Project Office--Foreign Countries:

Technological Uncertainty

Organizational and Structural Factors

Personnel and Staffing Factors

Factors Concerning Program Processes

Other Factors



PART E: RECOMMENDATIONS

Please indicate your agreement or disagreement with the following statements:

15. Government management of international cooperative research efforts is essentially no different than government management of US-only research efforts.
- () Strongly disagree
 () Moderately disagree
 () Uncertain or don't know
 () Moderately agree
 () Strongly agree
16. Government management of international cooperative development projects is essentially no different than government management of US-only development projects.
- () Strongly agree
 () Moderately agree
 () Uncertain or don't know
 () Moderately disagree
 () Strongly Disagree
17. Government management of international cooperative production programs is essentially no different than government management of US-only production programs.
- () Strongly agree
 () Moderately agree
 () Uncertain or don't know
 () Moderately disagree
 () Strongly disagree
18. Despite potential advantages to the United States from international cooperative, cost shared technology programs, experience indicates that problems of cooperation are too great for the United States to participate.
- () Strongly disagree
 () Moderately disagree
 () Uncertain or don't know
 () Moderately agree
 () Strongly agree
19. From your experience, if you could make a single recommendation to a new program manager of an international cooperative technology program, what would it be?
-

Optional Open-ended Question: What do you really think about international cooperation in research, development, and production? Feel free to attach any references, papers, memos, etc. which might be useful for illustrating your point. Use the back of the page if necessary.



PART 8: PERSONAL DATA

YEARS EXPERIENCE IN R&D/SYSTEMS ACQUISITION/PRODUCTION ACTIVITIES _____

JOB TITLES/YEARS OF DUTY (i. e., Assistant Project Engineer, Program Control Staff):
(list up to 3)

TRAINING COURSES RELEVANT TO R&D/PROGRAM MANAGEMENT:

- DSMS YEAR
- SPO School YEAR
- Project Engineer's Course (Please specify) YEAR
- _____
- OTHER (Please specify) YEAR
- _____

RANK/CIVIL SERVICE RATING/TITLE _____

OPTIONAL--(to be used only to contact respondents for clarification and to
feedback the results of the survey)

NAME _____

PHONE NUMBER _____

MAILING ADDRESS _____

THANK YOU FOR FILLING OUT THIS QUESTIONNAIRE.

PRIVACY ACT STATEMENT

In accordance with paragraph 30, AFR 12-35, the following information is provided as prescribed by the Privacy Act of 1974:

a. This survey information is authorized for solicitation under Title 10, United States Code, Section 8012; Executive Order 9397; DOD Instruction 1100.13; and AFR 178-9.

b. The purpose of this survey is to identify and explore factors affecting performance of government-sponsored international cooperative technology projects or programs.

c. Response to this survey will be analyzed to project and establish more effective policy guidance in the field of cooperative development.

d. Furnishing the information is entirely voluntary.

e. No adverse action may be taken against any person who elects not to complete this survey.

INTERVIEWEES

Richard Adams
General Manager, F-16 Program
General Dynamics Fort Worth

Sidney J. Altman
Deputy Director
NATO Seasparrow Project Office
Washington, D.C.

Marshall Beck
Canadian Department of Defence Liaison Officer
Aeronautical Systems Division (ASD)
Wright Patterson AFB, Ohio

Captain W. L. Britton, USN
Director
NATO Seasparrow Project Office
Washington, D.C.

Peter Browning
Finance & Accounting
NATO Seasparrow Project Office
Washington, D.C.

Eugene Bryant
Deputy Director
F-5 Systems Program Office
ASD, Air Force Systems Command (AFSC)

Wallace Buzzard
Project Director
US-Canadian Air Cushion Landing System
Flight Dynamics Laboratory, AFSC

Lt Colonel Calbi
International Programs
USAF/DCS (Deputy Chief of Staff) R&D

Major Ronald Carlburg
USAF/DCS Logistics
F-16 Program Monitor

Benjamin Carrol
Manager of Program Review, F-16
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Nils Bonesteel Ohman was born in Honolulu, Hawaii, on February 22, 1941, the son of Eleanor Bonesteel Ohman and Nils Olof Ohman. After graduating from Arlington Heights High School, Forth Worth, Texas, in 1958, he entered the United States Air Force Academy north of Colorado Springs, Colorado. In 1962 he received a Bachelor of Science in Basic Sciences and was commissioned in the United States Air Force. During the period 1962 to 1968 he served with the Strategic Air Command in assignments in the United States and Southeast Asia as an Electronic Warfare Officer. In 1968, he entered the Air Force Institute of Technology, Wright Patterson Air Force Base, Ohio. He was awarded the Master of Science Degree in Systems Analysis in 1970. During 1970 and 1971 he served in Thailand, and in 1971 he became an Instructor in Economics and Management at the United States Air Force Academy, Colorado. In 1973 he entered the University of Texas at Austin under Air Force sponsorship. In 1976 he was assigned to Eielson Air Force Base, Alaska, where he became a Crew Commander and Electronic Warfare Officer. He was a Military Fellow at The Hoover Institute at Stanford in 1978 and 1979. He was married in 1962 to Nancy Jean Parker of Forth Worth, Texas, and has one son, Nicholas Parker Ohman, born in 1968, and one daughter, Nannette Bonesteel Ohman, born in 1979.

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