# ACCOUNTABILITY AND THE MANAGEMENT OF EXPECTATIONS: THE CHALLENGER TRAGEDY AND COSTS OF DEMOCRACY

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## Abstract

The Rogers Commission investigation of the Challenger disaster was too narrow in its focus and missed an essential lesson of that tragedy; namely, that the accident was the inevitable price of conducting public administration in the American democratic system. In order to operate as a public agency in the pluralistic U.S. political system in the 1980's, NASA had to function under several systems of accountability, each emphasizing different strategies for managing the multiple expectations of democratic institutions. In doing so, NASA was distracted from operating under the type of accountability system most appropriate for its technical tasks, namely, a professional system of accountability that emphasizes deference to the expertise of NASA's scientists and engineers.

A broader institutional analysis was needed in addition to the Commission's focus on the technical and managerial causes of the Challenger accident. Using a theory of public sector accountability, we contend that NASA's managerial and technical problems were the logical result of its efforts to respond to legitimate institutional demands. Once the American consensus in support of space exploration faded with the accomplishment of the moon landings, NASA lost its "carte blanche" for space development. Instead, the agency became only one of many claimants for popular support and federal dollars. In response to these changes, NASA's managers attempted to meet the challenge of waning public support through the adoption of political accountability mechanisms and the challenge of operating under tighter financial constraints by relying more on bureaucratic accountability systems. In doing so, NASA shifted away from what it did very well in its first decade of operation, i.e. solve technical problems under a system of professional accountability.

We argue that the shift away from professional accountability and toward political and bureaucratic accountability was the key cause of the technical and managerial problems that eventually led to the Challenger disaster. Furthermore, we contend that agency reforms now being implemented and considered reflect movement toward a fourth type of accountability, one based on the assertion of legal obligations. Such reforms, it is argued, are just as likely to compound the dilemmas facing NASA as they are to improve the agencies performance.

Our theory of public accountability underscores the diversity of expectations which American public agencies must manage in their efforts to behave responsibly. Under ideal conditions all four types of accountability can enhance the likelihood that responsible behavior will be forthcoming from public agencies. Yet, as the NASA case illustrates, these accountability systems are not without their costs to the agencies operating under them. Our case study of NASA shows how the pursuit of political and bureaucratic accountability distracted NASA from its strength: deference to expertise.

# ACCOUNTABILITY AND THE MANAGEMENT OF EXPECTATIONS: THE CHALLENGER TRAGEDY AND THE COSTS OF DEMOCRACY

On January 28, 1986, the space shuttle Challenger exploded in mid-flight and seven crew members lost their lives. The details of that tragic event are widely known and need not be retraced here. The lessons of that ill-fated expedition, however, are too important to go unexplicated or unexplored.

A great deal of effort and resources have been expended by official and unofficial investigators in attempts to discover just what went wrong that chilly morning in Florida. Some of those investigators sought explanations that could lead to corrections that would reduce the recurrence of another space program disaster. Others seemed to seek nothing less (nor more) than scapegoats upon which the nation's anger and frustrations could be vented.

But the implications of the Challenger tragedy go beyond searches for explanations or scapegoats. Inherent in the situation surrounding efforts of the National Aeronautics and Space Administration (NASA) to launch the space shuttle that Tuesday morning are lessons that go to the very heart of the public enterprise in America today. From the Challenger disaster we can gain insights into the nature of American public administration and the dilemmas it faces today at every level of government.

In this paper some of those insights are made explicit by positing a view of public administration as the <u>management of legitimate expectations</u>. Put briefly, the nature of American public administration lies in the continuous efforts of public sector personnel to contend with a diversity of expectations generated by a democratic, pluralistic society that demands accountability and yet

has no collective sense of the limits to effective government. While somewhat unique among public agencies in both organizational form and mission, NASA was not exempt from this institutional characteristic of American bureaucracies. From this perspective, unexpected program or project failures such as the Challenger disaster seem to be inevitabilities that cannot be avoided.

The "inevitability" of project failure is the principle issue raised by this analysis. We argue that so long as the current institutional configuration of accountability for American public administration remains intact, that propensity to fail is irreversible. The possibility and desirability of redesigning or circumventing those institutional constraints is the subject of the final section.

Prior to that discussion, however, we examine the rationale underlying the need for an institutional perspective on the Challenger disaster and speculate as to why such a viewpoint was ignored or overlooked in the major investigations that followed the tragedy. Next we posit a theory of public accountability that is useful in analyzing what took place both before and after the space shuttle's explosion. This is followed by a direct application of that framework to the Challenger disaster making extensive use of media reports and interviews, official reports and hearings from government investigations, and related materials that appeared during the six month period following the incident at Cape Kennedy. It is from that work that we then draw the lessons of the Challenger disaster for American public administration.

## I. SEEKING AN INSTITUTIONAL PERSPECTIVE

Among the common threads running through the more popular discussions of the Challenger incident are two that gained the immediate attention of those searching for answers to the events of January 28, 1986. The first was the need to pinpoint the technical problems that led to the booster rocket explosion on the shuttle, and the second was to uncover any organizational or managerial problems (or, to use an overworked euphemism, "human errors") that might have caused NASA officials to overlook or ignore those technical flaws. By the time the Presidential Commission on the Space Shuttle Challenger Accident issued its report on June 9, 1986, those two efforts had become the predominant themes of most analyses.

On the first point, the verdict of the Commission was unequivocal:

> The consensus of the commission and participating investigative agencies is that the loss of the space shuttle Challenger was caused by a failure in the joint between the lower segments of the right solid rocket motor. The specific failure was the destruction of the seals that are intended to prevent hot gases from leaking through the joint during the propellant burn of the rocket motor. The evidence assembled . . . indicates that no other element of the space shuttle system contributed to this failure.[1]

Nor were they any less explicit about organizational problems at NASA being a "contributing cause" of the accident:

> The decision to launch the Challenger was flawed. Those who made the decision were unaware of the recent history of problems concerning the O rings [seals] and the joint and were unaware of the initial written recommendation of the contractor advising against the launch at temperatures below 53 degrees Fahrenheit and the continuing opposition of engineers at [Morton] Thiokol after the management had reversed its position. . . . If the decision-makers had known all the facts, it is highly unlikely that they would have decided to launch [the shuttle] on January 28, 1986.[2]

While there was some dissent among commission members regarding

the content and tone of the report prior to its submission to President Reagan,[3] there is no evidence that the search for causes of the Challenger accidents followed any paths other than those leading to these two major conclusions. A path explicitly and actively avoided was one which attempted to traced the decision to launch directly to pressures from the White House. William P. Rogers, chair of the presidential commission, regarded such explanations with open disdain and reacted acrimoniously to statements by Senator Ernest Hollings who suggested such a cause.[4]

The institutional path.

More interesting, however, is a path never followed by the commission or others looking into the space shuttle accident. This is the path that would have led them to ask if the problems at NASA and in the space shuttle program were systemic rather than technical or organizational. It is a perspective often ignored among practitioners and non-academic analysts of American public administration, but it is one quite familiar to students of contemporary organizational theory.

Following the lead of Talcott Parsons, James D. Thompson noted the existence of three levels of organizational responsibility and control: technical, managerial, and institutional.[5] At the technical level, organizations focus on the effective performance of specialized and detailed functions. At the managerial level, an organization provides for mediation among its technical components and between its technical functionaries and those "customers" and "suppliers" in the organization's "task environment." At the institutional level, the organization deals with the need for it to be part of the "wider social system which is the source of the 'meaning,' legitimation, or

higher-level support which makes implementation of the organization's goals possible."[6]

Applying this framework to the work of the Rogers Commission and others analysts, it is obvious that the Challenger disaster has been thoroughly investigated for problems that arose at the technical and managerial levels of NASA, but has yet to be examined with institutional considerations in mind. The efforts made by NASA and other public agencies to contend with the "wider social system" of which they are part is worthy of attention for a number of reasons, but the space shuttle accident seems to beg for a study focused on institutional level factors.

There are a number of reasons which might explain why institutional factors were not considered by the commission and others investigating the Challenger accident. First and foremost is the possibility that once the two major themes of the investigation were established -- i.e., that the causes of the disaster were technical and managerial -- then additional perspectives were effectively dismissed and ignored.

A second explanation builds on the fact that institutional questions are perhaps too basic and too dangerous to raise. As we see in the analysis which follows, an institutional perspective raises some fundamental issues about the effective operation of major public enterprises in the United States and about the very nature of the American political system. According to this argument, a commission composed primarily of individuals committed to the enterprise under investigation[7] and to the political system in general[8] is unlikely to open up the Pandora's Box of institutional level factors.

Still a third possibility is that institutional factors were in fact considered by investigators but were dismissed early in the process as relatively insignificant as a cause for the Challenger accident. While this explanation seems plausible, there is no evidence that institutional factors were given due consideration, at least not by the commission. In fact, public comments made following issuance of the presidential commission's reports indicate that institutional questions remained just below the surface in most of the panel's deliberations.

Whatever the reasons for overlooking the institutional dimensions of the Challenger accident, there is much to be gained by examining them at this juncture. While they might not add to the list of "causes" for the disaster itself, they can provide insights to enhance our understanding of what occurred at the launching site, in NASA, and in American public administration during the 1980s.

## II. A THEORY OF PUBLIC ACCOUNTABILITY

### Some General Assumptions

Once the need to develop an institutional level analysis of the Challenger disaster is established, the next step is the selection of an appropriate model to apply in that endeavor. There are several possible approaches to this task, each depending on the assumptions one makes about NASA itself.

For example, one may start with the assumption that NASA is indeed unique with idiosyncracies unlike any other organization, public or private. There is some justification for this approach, for NASA has been truly distinctive in its missions and a pioneer in applying innovative techniques to the resolution of its problems.

Emerging from the wreckage of America's early efforts to compete with the Soviets in space, NASA took advantage of the high priority of its mission and access to financial and political resources to develop a governmental unit built on "radical administrative, psychological and organizational departures" from other agencies.[9] Its management approach -- termed "systems structure" by its creators and advocates[10] and described by Peter F. Drucker as a "relations-focused design"[11] -- has been studied in great detail and touted as a model of success during the 1960s to be emulated by all.

The uniqueness of NASA for its place and time is not to be doubted. Drucker, however, is quick to point out that NASA's systems structure approach (based on the close interaction and coordination of several autonomous organizational units to accomplish a clearly stated task) had been in use in Japan for over a century and was unconsciously evolving as an managerial form within several major multinational corporations.[12] Furthermore, once it was perceived as a source of NASA's early successes and defined as an alternative to traditional bureaucratic approaches, the systems structure approach was adopted by public and private organizations throughout the country.[13] Whatever claim to institutional level uniqueness NASA had at first was soon lost to the faddish nature of American management.

An additional factor working against the view of NASA as an institutionally unique organization is its more recent history. It is widely accepted that NASA's special standing among America's public agencies deteriorated significantly after the lunar landings of 1969 and 1970. "As the rise of NASA had heralded the Golden Years" of federal programs devoted to scientific research, "so its decline stood

as a symbol of change. In 1969 NASA achieved its goal of a lunar landing. Within a few years its budget was only half of what it had been at its mid-1960s peak."[14] By the mid-1970s the U.S. space program had been (figuratively) brought down to earth where it had to compete for limited resources with other agencies.

> NASA was able to launch innumerable programs during the 1960's when it had a constituency that included the President, most of Congress, a host of industrial contractors, university grantees, the communications media, and its foreign competition, the Russians. When that constituency atrophied and NASA found itself with a smaller base from which to market its programs, NASA had to choose. It tended to concentrate its diminished power behind certain key projects, such as the Space Shuttle, and to allow others . . . to be terminated by the pressure of outsiders . . . .[15]

Whatever claim to distinctiveness NASA had during its early years was considerably diminished by the mid-1980s.

A second possible assumption upon which to develop this analysis is that NASA can and should be studied as a generic organization without reference to its "public" standing. This approach denies the significance of any differences between private and governmental organizations. At most it regards governmental agencies as a type of service organization or one among many different types of specialized social arrangements. "In the society of organizations," states Drucker, "government becomes one special-purpose institution rather than ~~the~~ institution."[16]

The immediate implications of this perspective for an institutional level analysis of NASA are two-fold. First, the generic organizational approach fails to give credibility to the substantive uniqueness of the roles played by those who interact with NASA. For example, the generic approach necessarily eliminates or minimizes the attention analysts would devote to the differences between public and

private sector task environments. What differences did exist would be found in the specific identity of those who populated that environment. Thus the crucial distinctions between customers and citizens, between shareholders and legislators, between competitors and critics would be lost.

Second, and as a consequence of the first point, the institutional level analysis would necessarily be reduced to one focusing on managerial level factors and behavior. What makes the institutional levels of organizations analytically important is that they vary in significant ways from one another. By minimizing the impact of those variations, the generic perspective forces analysts to concentrate on how seemingly "different" organizations contend with relatively similar challenges from their task environments. Whatever differences are found are bound to be rooted in the managerial levels of the organizations under investigation. In short, this approach to an institutional level analysis of NASA would inevitably lead us to the same conclusions that were reached by the President's Commission on the Space Shuttle Challenger Accident.

If, as is the case here, we wish to go beyond those conclusions, then it is necessary to begin with the assumption that NASA is in fact a "public" organization with <u>institutional characteristics</u> that are similar in very important ways to other public sector agencies. While this assumption does not deny that NASA has been and remains a unique organization both technically and managerially, it does assert that the U.S. space agency and the programs it administers are a definite part of America's public enterprise system and share the institutional identity that special status embodies. In the following pages a

theory of public accountability is posited as a means for examining that common institutional identity and its implications.

Diversity of Expectations

A basic premise of this study is that modern public administration, especially in democratic states, is characterized by efforts to live up to diverse sets of legitimate expectations. Historical studies indicate that public administration emerged as an identifiable institution throughout the ancient world in the form of what are termed "bureaucratic empires."[17] In most ancient and medieval societies, those performing administrative functions for their rulers were indistinguishable from other members of the royal court. There was no single group of individuals whose job was to carry out the policies and programs of government. In bureaucratic empires, however, governmental administration achieved a distinctive identity and a degree of autonomy that differentiated it from other institutions in the political system.

In one important respect, these bureaucratic empires were similar to other pre-modern political systems: the ultimate political authority in society remained in the hands of a few people. Public administrators in bureaucratic empires were responsible only to the ruling family. It wasn't until the legitimate authority of governments passed from kings to representatives of the people,[18] from reliance on traditions and customs to legal systems based on positive law,[19] that the practice of modern public administration as we know it today emerged. In modern societies, public administrators moved from positions emphasizing service to traditional rulers to positions stressing deference to the demands and needs of society at-large.

Loyalty to the royal family was replaced by the need to live up to expectations generated by the social, culture, and political milieu that characterized the modern nation-state.[20]

It is possible to articulate some of those expectations more clearly if we focus our attention on those modern nation-states which are generally regarded as operationally "democratic" or, in Robert Dahl's terms, polyarchical.[21] Typically, polyarchies are defined in structural or institutional terms with emphasis placed on constitutional rule, the frequent and fair election of public officials with the right to vote and run for office open to practically all adults, freedom of political expression, freedom to seek out and have access to alternative sources of information, and the right to organize and join "relatively independent associations or organization, including independent political parties and interest groups."[22] Using these broad parameters one can generate a long list of countries which, in general terms, can be classified as polyarchical.[23]

There have been a number of studies of these modern pluralistic democracies focused on the tendency for polyarchical political systems to generate two sets of expectations for those who administer government programs, one substantive and the other procedural.[24] On the substantive side, polyarchies posit a diverse set of responsibilities for public sector workers composed of various commitments and obligations; on the procedural side they generate a long list of ethical standards[25] for public administrators to adhere to in their daily efforts. These multiple responsibilities and ethical standards are at the heart of our theory of public

accountability.

Responsibilities: Table 1 provides examples of the kinds of responsibilities associated with American public administration. The term "responsibility" is often used quite loosely in discussions of public administration, but for present purposes we narrow the concept to mean those commitments and obligations which public administrators are expected to assume in the official capacities and positions. By "commitments" we mean that form of responsibility which impresses upon the public administrator a need to serve some group or cause; by "obligations" we mean the responsibility to perform certain tasks or achieve certain objectives. As two sides of the responsibility "coin," commitments and obligations are closely related.

What is important to note about the examples of responsibilities provided in Table 1 is the number and diversity of expectations under which public administrators and public agencies labor. Efforts to be responsive to this broad array of commitments and obligations are destined to result in some degree of perceived slippage in responsibility. While under some fortuitous circumstance several of these responsibilities might overlap, such occurrences are rare and unstable at best. In short, under most conditions no one agency or administrator can be expected to accomodate this vast array of responsibilities completely or simultaneously.

TABLE 1. Examples of Responsibilities for Public Administrators

| Commitments (Responsibility to): | Obligations (Responsibility for): |
|---|---|
| 1. Morality | 1. Upholding of human rights and integrity. |
| 2. Constitution | 2. Upholding of the regime and regime values. |
| 3. Citizenry | 3. Creation and maintenance of public environment conducive to promoting the rights and duties of citizenship. |
| 4. Democracy | 4. Maintaining openness and public access to government. |
| 5. Laws | 5. Obedience to and enforcement of all legitimately passed laws. |
| 6. Organization | 6. Fulfilling goals and objectives of agency, as well as protecting or enhancing its position. |
| 7. Profession | 7. Upholding the standards and integrity of the profession. |
| 8. Clientele | 8. Providing services efficiently and effectively. |
| 9. Political leadership | 9. Achieving programmatic ends of those in power. |
| 10. Supportive groups | 10. Satisfying demands of active supporters. |
| 11. Public interest/opinion | 11. Seeking to discover and achieve the "public good." |
| 12. Self | 12. Achievement of personal goals and career objectives. |

Ethical standards: The procedural demands placed on public administration in democratic (polyarchical) regimes are no less diverse than the substantive responsibilities outlined in Table 1. As noted above, these procedural demands typically take the form of ethical standards -- that is, norms of behavior which are applied to

the work of public servants for purposes of guiding and assessing their behavior. As applied by individual administrators, such standards have three functions: (1) as guides for one's own behavior, (2) as measures for one's own performance, and (3) as a basis for judging the behavior and performance of others.

Table 2. Some Ethical Standards Relevant to Public Administration

| Standard: | Meaning: |
|---|---|
| 1. Efficiency | 1. Maximize benefits while minimizing costs. |
| 2. Economy | 2. Operate at lowest possible cost. |
| 3. Effectiveness | 3. Get the job done, at any cost! |
| 4. Responsiveness | 4. Satisfy a specified reference group, e.g. clientele, some politician. |
| 5. Representativeness | 5. Actively reflect the needs and interests of population segments. |
| 6. Majoritarianism | 6. Do what the majority wants. |
| 7. Equality | 7. Same treatment or same outcome for all who are eligible. |

The world of public administrators is defined in part by these diverse expectations for behaviors which accomodate these responsibilities and ethical standards. American public administrators must function under the pressures of diverse sets of responsibilities and ethical standards. These pressures take the form of expectations with which, like other parts of the unique political and economic environments of public organizations,[26] the administrator or agency must contend if they are to succeed or even survive.

## Managing Expectations

There are a variety of approaches public administrators can take

to deal with this challenge of diverse expectations. At one extreme, they can attempt to live up to the commitments, obligations and behavioral standards generated by the political system. This approach would be feasible where responsibilities and ethical standards were few in number, clearly articulated, mutually consistent, and supported with sufficient resources. An explicit mandate to serve an agency's well defined clientle group efficiently given appropriate access to needed resources would be ideal, but the potential for that occurring in the context of the American polyarchical system is not likely.

At the other extreme an agency might elect to ignore the pressures of multiple and diverse expectations, but the peril of such a course is too well known by administrators to become a viable option. If an agency acts indifferently to the constant pressures of responsibilities and ethical standards generated by America's political institutions, then it is choosing to give up any control over its own destiny.

It is at this point that we can best grasp the essence of public administration in the United States, for it is the ability of public agencies to manage those expectations that is central to the nature of the enterprise. This management of expectations manifest itself in the structuring and implementation of four alternative systems of public accountability, each based on two critical factors: (1) whether the ability to define and control expectations is held by some specified entity inside or outside the agency; and (2) the degree of control that entity is given over defining those agency's expectations (see Figure 1).

Regarding the first dimension, the management of agency

expectations through accountability mechanisms calls for the establishment of some authoritative source of control. Internal sources of control rely on the authority inherent in either formal hierarchical relationships or informal social relationships within the agency. External sources of control reflect a similar distinction, for their authority can be derived from either formalized arrangements set forth in laws or legal contracts or the informal exercise of power by interests located outside the agency.

A second central ingredient in any accountability system is the degree of control over agency choices and operations being exercised by those sources of control. A high degree of control reflects the ability of the controller to determine both the range and depth of actions a public agency and its members can take. A low degree of control, in contrast, provides for considerable discretion on the part of agency operatives.

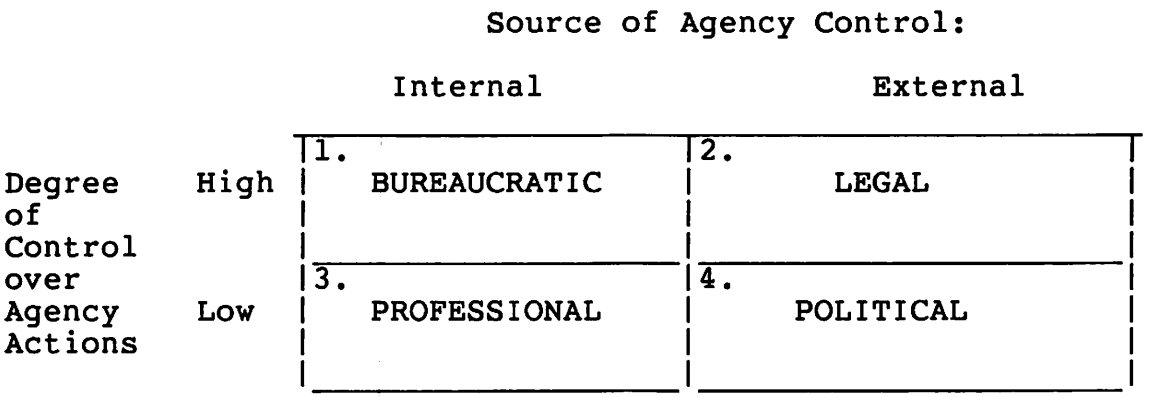


Figure 1. TYPES OF ACCOUNTABILITY SYSTEMS

The interplay of these two dimensions generates four types of accountability systems (Figure 1).

Bureaucratic accountability systems (cell 1) are widely used

mechanisms for managing public agency expectations.[27] Under this approach, the expectations of public administrators are narrowed and defined by focusing attention on the priorities of those at the top of the bureaucratic hierarchy. At the same time, supervisory control is applied intensively to a wide range of public administration activities. In its most basic form, the ideal functioning of a bureaucratic accountability system involves two simple ingredients: first, an organized and legitimate relationship between a superior and a subordinate in which the need to follow "orders" is unquestioned; and second, close supervision.

Close supervision is the fundamental method used in a system of bureaucratic accountability, although it is not the only one applied. The use of close supervision assumes that the superior and subordinate are in close proximity and that an intense, face-to-face relationship is possible. Because this method is often infeasible (there may be too many people to supervise) or impractical (due to long distances between the supervisor and supervised individual), the relationship may be based on the establishment of standard operating procedures or the enforcement of rules and regulations intended to govern the work of subordinates.[28]

Legal accountability[29] (cell 2) is similar to the bureaucratic form in that it involves the frequent application of control to a wide range of public administration activities. However, it differs from bureaucratic accountability in three fundamental ways. First, it is based on a relationship between a controlling party outside the agency and those inside the organization. That outside party is not just anyone; it is the individual or group that is making the laws and

other policy mandates which the public administrator is to enforce or implement. The outsider, in other words, is the "lawmaker," while the public administrator has the role of "law enforcer."

Second, the two accountability systems differ because the relationship between the controller and the controlled is different. In the bureaucratic accountability system, the superior has direct authority over the subordinate. The relationship is based on the ability of the supervisor to reward or punish that subordinate. In legal accountability, however, the relationship is between two relatively autonomous parties: those who make the law and those who enforce it. In a sense, the relationship between the two parties involves a binding contract between the public administrator and whoever is playing the role of lawmaker. For example, Congress passes laws and holds a federal agency accountable for its implementation; the federal district court orders a school board to desegregate its classrooms and holds members of the board accountable; the local city commission passes a sign ordinance and holds the city staff accountable for its enforcement.

Third, while bureaucratic accountability relies on methods such as close supervision and rules and regulations, legal accountability depends on monitoring, investigating, auditing, and other forms of "oversight" and evaluation. An agency can be monitored by requiring it submit reports to the controlling party on a regular basis. At other times, Congress or some other legislative body might hold hearings to investigate the activities of an agency. Legal accountability oversight also takes less formal forms. Sometimes it is done through the work of legislative staff who are following up on

a constituent's complaints. At other times it is the result of an unofficial request for information, a surprise visit to a facility, or some other informal means.

Professional accountability[30] (cell 3) occurs with greater frequency as governments deal more and more with some technically difficult and complex problems. Under those circumstances, public officials must rely on skilled and expert employees to provide appropriate solutions. Those employees will expect to be held fully accountable for their actions and insist that the agency head trust them to do the best job possible. If they fail to do their job, or do it in a less than satisfactory fashion, it is assumed they can be reprimanded or fired. Otherwise they expect to be given the necessary degree of discretion they need to get the job done.

Thus, professional accountability is characterized by placing control over administrative activities in the hands of the employee who has the expertise or special skills to get the job done. The key is deference to the expert within the agency. Typically the professional accountability organization will look like any other public agency with a manager in charge of a set of workers, but the relationship between them is much different. Under a bureaucratic accountability system, the key relationship would be that of close supervision. In contrast, under professional accountability the central relationship is similar to that found between a layperson and an expert, with the agency manager taking the role of the layperson and the worker making the important decisions that depend on his or her expertise.[31]

Political accountability (cell 4) is central to the democratic

pressures imposed on American public administrators. If "deference" is the key word used to characterize professional accountability, "responsiveness" is the term most appropriate for political accountability systems (cell 4).[32] The key relationship under these systems is similar to that between a representative (in this case, the public administrator) and his or her constituents (those to whom he or she is accountable). Under political accountability, the primary question becomes, "Who does the public administrator represent?" The general public? Members of the legislature? The president, governor, or mayor? The leaders of the political party in power? The head of the agency? His or her agency's clientele? The attentive public? Some special interest group? Future generations? Each of these constitutes a potential constituency for the public administrator under this accountability system. Regardless of which is adopted, it is expected that the administrator be responsive to their policy priorities and programatic needs.

The most explicit use of political accountability occurs in governments where administrators owe their positions to patronage appointments by elected officials. Less explicit is the political accountability that develops in agencies where the emphasis is on service to a specific clientele. The U.S. Department of Agriculture, for example, is well known for its responsiveness to America's farmers.

While political accountability often seems to promote favoritism and even corruption in the administration of government programs, it also serves as the basis for a more open and representative government. The urge for political accountability is reflected in the

movement toward greater openness in government, e.g. mandated by "open meetings," "freedom of information," and "government in the sunshine" statutes that have been passed by many state and local governments.

Table 3 provides a summary of the principle features of the four general types of accountability systems. Under the bureaucratic system, the management of expectations is accomplished through a hierarchical arrangement based on supervisory relationships; the legal accountability system manages agency expectations through the establishment of a contractual relationship; the professional system relies on deference to expertise; while the political accountability system promotes responsiveness as the central means for managing the multiple expectations.

Table 3. RELATIONSHIPS WITHIN ACCOUNTABILITY SYSTEMS

| Type of Accountability System | Analogous Relationship (Controller/Administrator) | Basis of Relationship |
|---|---|---|
| 1. Bureaucratic | Superior/subordinate | Supervision |
| 2. Legal | Law maker/law enforcer | Contract |
| 3. Professional | Layperson/expert | Deference to expertise |
| 4. Political | Constituent/representative | Responsiveness |

Preferences for accountability systems.

Given these alternative means for managing expectations, what determines the preference that one accountability approach receives over the others in any particular situation? Why are some agencies

more likely to establish bureaucratic mechanisms to manage expectations rather than political, professional, or legal means? Why are others more likely to select a political or professional approach? The appropriateness of a specific accountability system to an agency is linked to three factors: the nature of the technical task performed by the agency; the management strategy adopted by those heading the agency; and the institutional context of agency operations.

On the technical and managerial levels, research by organization analysts indicating that organization structure and management is related to the nature of organizational tasks provides some insight into the preference given to one form accountability system by an agency. In public agencies where organizational goals are clearly stated and organizational tasks are simple, large-scale, and capable of being structured (e.g. the Social Security Administration; the U.S. Postal Service), bureaucratic accountability mechanisms are likely to prove most appropriate. In agencies where goals are clearly stated, but where tasks involve more complex processes depending on the skills and expertise of employees (e.g., Army Corps of Engineers, public universities), a professional accountability system seems more relevant. In situations where the organization's goals are ambiguous or subject to challenge and where organizational tasks are loosely defined and flexible, the agency is a candidate for either a legal accountability approach which attempts to provide greater goal clarification and more narrow tasks (e.g., Environmental Protection Agency), or a political accountability system which calls for the adaptation of organizational goals and task structures to the wishes of the dominant political coalition to which the agency responds

(e.g., Department of Agriculture).

At the institutional, however, the determination of which accountability system is likely to get preference depends on the orientation of the political system toward each form of accountability. To use extreme examples, in a political system which values efficiency and obedience, bureaucratic accountability mechanism may be deemed quite acceptable. In a system that values expertise, the deference of a professional accountability system would be accepted. In a society where the rule of law is valued and where contractual relationships are given priority, a legal accountability approach would be most desirable. Finally, a political accountability system would be preferred in a pluralistic social context where governmental responsiveness is highly valued.

In the American political system all four types of accountability are potentially legitimate means for managing expectations.[33] Under current institutional norms, no one type of accountability system is any more inherently acceptable or effective than any other. In theory, each of the four accountability systems can be used to insure agency responsibility. Thus, in theory it is reasonable to expect an agency to manage its expectations using that accountability system which is most appropriate in both technical/managerial and institutional terms.

In reality, most public agencies in the U.S. tend to adopt two or more types of accountability systems at any point in time depending upon the nature of existing environmental (institutional) conditions as well as their technical organizational tasks. Institutional pressures generated by the American political system, however, are

often the predominant factor. Thus, as institutional conditions change, the challenge of managing expectations changes as well. If the environmental changes are drastic enough, they may trigger a different type of accountability system, one that attempts to reflect those new institutional conditions. Given this dynamic, over the course of time it is possible to find all four types of accountability operating for any one agency.

## III. ACCOUNTABILITY UNDER DIFFERENT CHALLENGES: THE CASE OF NASA

The case of NASA illustrates how this dynamic operates and its implications for American public administration in general. The history of NASA reveals a classic pattern of accountability systems changing in response to shifting institutional contexts. While the nature of the technical tasks performed by the agency has not change radically since NASA's establishment in 1958, the institutional context has change significantly. As the circumstances in its institutional environment changed, some organizational structures and tasks assumed more importance to the survival and functioning of the agency, thus reflecting shifts in the type of accountability systems relevant to NASA's activities.

The pattern we find is sequential. NASA emerged in an institutional context which supported a professional accountability system. Over time, however, the institutional pressures to develop a politically responsive agency strategy became salient, followed by conditions leading to a bureaucratization of NASA's accountability mechanisms. We will see how these responses to changing institutional conditions created the organizational setting that spawned (or at least failed to prevent) the Challenger disaster. We will also see

how institutional reactions to the Challenger tragedy itself are creating new pressures that are moving the agency toward a greater reliance on legal accountability methods for managing expectations.

The Professionalization of the Space Program[34]

Prior to NASA's establishment in 1958, America's space research and development was scattered throughout several branches of the military. Coordination of these activities was the responsibility of the National Advisory Committee for Aeronautics (NACA). The ineffectiveness of this early arrangement was manifested most clearly in the fact that the Soviets took an early lead in the U.S. - U.S.S.R. "space race." While the Soviets launched Sputnik successfully in October 1957, the United States' much less ambitious effort to launch a satellite in December 1957 resulted in failure.

NASA was an organizational initiative born in the midst of a national crisis and nurtured in the relatively protective shelter of an institutional consensus that lasted until 1970.[35] That nurturing consensus had two important characteristics. First, it focused attention on a single goal made explicit at the highest levels of government (President Kennedy's mandate to land an American on the moon by the end of the 1960s). Second, that consensus was based on the belief that achieving that objective required complete deference to those experts who could get the job done.

That early consensus had a significant impact on the development and management of NASA. The agency's structure and recruiting practices reflected an institutional willingness to honor the technical nature of NASA's programmatic tasks. NASA's form of organization emphasized deference to expertise and minimized the

number of political appointments at the top of the administrative structure (in this case, two political appointees).[36] NASA's initial staff consisted almost entirely of individuals with the relevant substantive knowledge, primarily aeronautical engineers.

The unique circumstances of NASA's birth and nurturing afforded it the opportunity to become one of the most innovative organizations (public or private) in recent American history. NASA inherited an on-going research capacity from the National Advisory Committee for Aeronautics. Its organizational challenge was to harness this research capacity with its practical application through technology development. To accomplish this, NASA developed a matrix form of organization in which technicians were assigned to project teams based on what expertise they could offer to the particular task at hand. Individuals were expected to report to two different supervisors: their line supervisor in the administrative framework and the manager of the project to which they were temporarily assigned. The emphasis under this arrangement was clearly on the project team and its deference to expertise (professional accountability) was the principle means used by the agency to manage the expectations it had to contend with at the time.

In summary, the nurturing consensus of NASA's early years, the technical nature of its tasks, and its innovative management strategy combined to support NASA's claim for resources and autonomy to pursue its mission with a minimum of interference. The result was the reliance on a professional type of accountability system. Deference to expertise was the basis for NASA's accountability to the broader political system. The locus of control over agency activities was

internal and the degree of control over NASA activities was low (cell 3). In other words, the technical experts in NASA were expected to make decisions based upon their expertise. The relationship NASA had to outside sources (including Congress, the President, and the general public) was that of expert to layperson.

While NASA operated predominantly under a professional system of accountability, this does not imply that the other types of accountability systems were irrelevant. NASA did have to contend with critics in the scientific community and military who believed it was receiving too much funding. In response, NASA worked hard to develop and maintain political ties with the White House and appropriate committees and subcommittees in Congress.[37] Internally, the demands of managing a large matrix organization soon led to some initial movements toward bureaucratic structures. Overall, however, it was professional accountability which remained a salient characteristic prior to the 1970s.

The Politicization and Bureaucratization of Accountability

As noted earlier, the technical tasks performed by NASA have not changed significantly over the past 28 years. It still faces the challenge of developing technology that will allow for the effective and safe exploration of space. What has changed, however, was the institutional context within which NASA operates. Ironically, it was the very success of NASA that generated that contextual change.

In 1969 NASA accomplished its first major assignment: to land an American on the moon by the end of the decade. Having accomplished that objective in brilliant fashion, NASA was able to bask in the glory of its achievements for only a very brief period. Normally the

clear-cut accomplishment of an agency's chief mandate is a cause of celebration; logically such an achievement would seem to enhance the chances that the agency will continue to receive good support in budgetary considerations. For NASA that was not the case; its success bore the seeds of a serious downturn in its fortunes.

It soon became clear that NASA's apparent victory in the "space race" would mean an end to the nurturing consensus that permitted the agency to rely almost exclusively on professional accountability for managing expectations. With America's attention turned increasingly toward Vietnam and economic issues, the space program no longer took priority. A new consensus had to be built around some new programmatic mission, and this meant NASA had to become more responsive to key actors in the political system. In other words, NASA needed to be more sensitive to the highly volatile and competitive institutional context of the early 1970s.

Under the highly politicized atmosphere of the early 1970s, the space shuttle program had to be sold rather than proclaimed. The need to sell the space shuttle effort to the White House, Congress, and the American public led NASA to enter into political coalitions with groups that it had previously ignored or fought in the policymaking arena, as well as with its traditional supporters in government and among its contractors. The new program, for example, was designed to attract the support of those who might take advantage of the shuttle program's capacity to launch satellites and conduct unique scientific and technological experiments in space. Aided by the military, the scientific community, and parts of the business community, NASA was able to get President Nixon's backing for the program in 1972 despite

opposition from the Office of Management and Budget and other key decision makers.[38] Political accountability was no longer secondary or peripheral to NASA. It became a critical ingredient in guaranteeing its maintenance as a viable agency.

Perhaps the best known and most recent of NASA's efforts to use political accountability to manage expectations is the highly publicized inclusion of non-astronauts in space shuttle flights. Senator Jake Garn and Representative Bill Nelson, two influential members of two congressional committees relevant to NASA, were the first non-astronauts to travel aboard the space shuttle. Christa McAuliffe, one of the Challenger crew, was selected with much fanfare in the "teacher in space" program after an intense nation-wide competition. The selection process for the "journalist in space" program was put on hold in the aftermath of the Challenger explosion. These "civilian in space" programs represented explicit efforts on the part of NASA to broaden its appeal for the support of "significant others." The cultivation of these groups was calculated to increase the ability of the agency to generate support in the form of budgetary allocations.

Late in the decade of the 1970s, another important (and related) set of institutional constraints emerged in the form of budget cutbacks and pressures for privatization. From the height of its support in the late 1960's to the mid-1970's NASA's budget was cut in half. Recent estimates indicate that NASA went through a staff cut of 40 percent from the big-budget days of Apollo, and that NASA's safety and quality control staff alone were cut by 70 percent in recent years.[39] Operating with fewer resources, the agency had to economize;

it became just like most other agencies in Washington. NASA experienced a new found interest in efficiency and thus became more willing to use bureaucratic means for dealing with its financial problems. NASA has "had to pinch pennies to protect the shuttle, accepting lower-cost technologies and making what seem to have been extravagant claims for its economic potential."[40]

Thus, changes in the management strategies used by NASA officials over the past 15 years have been inextricably linked to changes in the institutional context within which NASA operated. When NASA landed a man on the moon in 1969, it dramatically altered its ability to command attention and resources as a public agency. It suffered a tremendous loss of public attention and came out poorly in the budget tightening that the national government underwent in the 1970's. As the conditions of NASA's institutional environment changed, so too did its previous primary reliance on professional accountability systems.

Those changing institutional conditions altered the locus of control over NASA's activities as well as the degree of control over agency activities. The result was a shift in the types of accountability systems relevant to NASA's operations. In effect, the push was toward political and bureaucratic types of accountability systems and a decline in the emphasis placed on professional accountability mechanisms. It was under these conditions that decisions regarding the general schedule of space shuttle flights and specific launch times were being made when the Challenger lifted from its Kennedy Space Center pad on January 28, 1986.

## The Case of the Challenger

Evidence gathered by the Rogers Commission Report and through the

mass media illustrate the various forms of accountability in operation in NASA preceeding the launch of the Challenger. The possibility of political accountability operating at NASA was widely rumored just after the Challenger accident, particularly stories about pressure to launch from the White House. The Rogers Commission was emphatic in its denial of the truth of such rumors.

> . . . during the Commission's hearings all persons who played key roles in that [launch] decision were questioned. Each one attested, under oath, that there had been no outside intervention or pressure of any kind leading up to the launch. . . . No evidence was reported to the Commission which indicated that any attempt was ever made by anyone to apply pressure on those making the decision to launch the Challenger.[41]

The specific instance of political pressure denied by the Rogers Commission was a rumor that the White House had pressed for a launch on the morning of January 28 in conjunction with the President's State of the Union Message which was scheduled for national broadcast that evening. Whether or not the Commission was correct on this point, sources within NASA and on the Rogers Commission point to political pressures of another sort that were of NASA's own making. NASA felt the need to set a very ambitious launch schedule to serve its military and private sector "customers" who were important actors in the agency's supportive political coalition. It was not pressure aimed specifically at the Challenger launch, but rather a pressure felt throughout the organization.

> The [agency's] culture changed, one official said, though he asked not to be identified, when NASA felt itself under pressure to demonstrate that the shuttles were operational vehicles in a "routine" transportation system.[42]

Space agency officials "were bent on proving to Congress and potential shuttle customers that the vehicle was operational."[43] The Commission

reported that as a result of this pressure,

> The [launch] capabilities of the system were stretched to the limit to support the flight rate in winter 1985/1986. Projections into the spring and summer of 1986 showed a clear trend; the system, as it existed, would have been unable to deliver crew training software for scheduled flights by the designated dates. The result would have been an unacceptable compression of the time available for the crews to accomplish their required training.[44]

Those pressures were aggravated by the long-term policy decision to put all of NASA manned flight resources into one program.

> The nation's reliance on the Shuttle as its principal space launch capability created a relentless pressure on NASA to increase the flight rate.[45]

Additional pressures on NASA were due to the widespread reporting of shuttle delays in the mass media, another group NASA had been cultivating for political accountability purposes. Richard Smith, the director of the Kennedy Space Center

> said the press, in giving great coverage to numerous shuttle delays over the past year, had "pressured" the agency to jeopardize flight safety. "I don't think it caused us to do anything foolish," he said. "But that's where the pressure is. It's not from anywhere else."[46]

In these and other instances NASA's efforts to maintain credibility with its politically powerful "customers" and attentive publics generated pressures that further pushed aside professional accountability concerns.

The fact that NASA had moved toward a bureaucratic form of accountability was illustrated time and time again in the testimony given before the Rogers Commission. NASA officials noted that individuals higher up in the agency had not been informed about the reservations of the engineers at Morton Thiokol concerning weather conditions and the O-rings. For example, Lawrence Mulloy, Solid Rocket Booster Project Manager at the Marshall Space Flight Center,

was asked why he had not communicated the Thiokol engineers' concerns about the seal to Arnold Aldrich, Program Manager of the National Space Transportation System. His answer pointed to the reliance on a hierarchical view of responsibilities and organizational reporting relationships characteristic of bureaucratic forms.

> And we work on many problems at the Orbiter and the SRB [Solid Rocket Booster] and the External Tank level that never get communicated to Mr. Aldrich or Mr. Moore [both Level II managers]. It was clearly a Level III issue that had been resolved.[47]

Other testimony supported this view of how NASA operated according to a bureaucratic norm stressing hierarchical responsibility. Clearly launch decision-makers did not know about the engineering reservations because such matters were a Level III responsibility.

> Those who made that [launch] decision were unaware of the recent history of problems concerning the O-rings and the joint and were unaware of the initial written recommendation of the contractor advising against the launch at temperatures below 53 degrees Fahrenheit and the continuing opposition of the engineers at Thiokol after the management reversed its position. They did not have a clear understanding of Rockwell's concern that it was not safe to launch because of ice on the pad. If the decisionmakers had known all of the facts, it is highly unlikely that they would have decided to launch 51-L [The Challenger] on January 28, 1986.[48]

Supervisors did not pass recommendations of their subordinates on up the hierarchy because they felt it was their responsibility to deal with such problems. Thus, NASA's managers made decisions about the launch that were contradicted by the available data. For example, the Rogers Commission testimony cites

> failures in communication that resulted in a decision to launch 51-L based on incomplete and sometimes misleading information, a conflict between engineering data and management judgements, and a NASA management structure that permitted internal flight safety problems to bypass key Shuttle managers.[49]

Discussions between NASA representatives and Thiokol engineers on

the night before the launch underscore the reliance upon a bureaucratic type of accountability. In the testimony of Roger Boisjoly, Morton Thiokol engineer, on the discussion at Morton Thiokol during the off-line caucus (the "hold" period during the discussion between Thiokol and NASA prelaunch review officials) we see stark evidence of a bureaucratic system of accountability.

> . . . Mr. Mason said we have to make a management decision. He turned to Bob Lund and asked him to take off his engineering hat and put on his management hat. From this point on, management formulated the points to base their decision on. There was never one comment in favor, as I have said, of launching by any engineer or other nonmanagement person in the room before or after the caucus. . . I was never asked nor polled, and it was clearly a management decision from that point. . . . This was a meeting where the determination was to launch, and it was up to us to prove beyond a shadow of a doubt [to Thiokol management and NASA] that it was not safe to do so. This is in total reverse to what the position usually in in a preflight conversation or a flight readiness review. It is usually exactly opposite that.[50]

Further testimony by R.K. Lund, Vice President of Engineering at Morton Thiokol, corroborates this emphasis on accountability to organizational superiors rather than deference to expertise.

> We have dealt with Marshall for a long time and have always been in the position of defending our position to make sure that we were ready to fly, and I guess I didn't realize until after that meeting and after several days that we had absolutely changed our position from what we had been before. But that evening I guess I had never had those kind of things come from the people at Marshall. We had to prove to them that we weren't ready, and so we got ourselves in the thought process that we were trying to find some way to prove to them it wouldn't work, and we were unable to do that. We couldn't prove absolutely that that motor wouldn't work. . . . Well, that is the kind of mode we got ourselves into that evening. It seems like we have always been in the opposite mode. I should have detected that, but I did not, but the roles kind of switched. . . .[51]

In Chapter 7 of the Rogers Commission Report, entitled "The Silent Safety Program," the Commission returns repeatedly to the question of hierarchical reporting relationships in the Commission

hearings as they relate to safety.

> At Marshall, the director of Reliability and Quality Assurance reports to the director of Science and Engineering who oversees the development of Shuttle hardware. Again, this results in a lack of independence from the producer of hardware. . .[52]

Ambiguities about what type of safety problems were to be reported up to Level II of NASA underscore the increasing reliance on hierarchy in decision-making and bureaucratic accountability.

> Prior to 1983, Level III was required to report all problems, trends, and problem closeout actions to Level II unless the problem was associated with hardware that was not flight-critical. Unfortunately this requirement was substantially reduced to include only those problems which dealt with common hardware items or physical interface elements. . . . Mr. Raines [director of Safety, Reliability and Quality Assurance at Johnson] wrote a memo in which he explained that the documentation change was made in an attempt to streamline the system since the old requirements <u>were not productive for the operational phase of the Shuttle program.</u>[53] (Italics added.)

<u>After Challenger: Turning to Legal Accountability</u>

Since the Challenger tragedy there have been major investigations of the accident by the Rogers Commission and by NASA itself. As more became known about the details of the accident, questions raised in the press, Congress, and even the courts[54] began to focus on two concerns: the need to find those specific persons responsible for the mishap and the desire to reform the space program so that the Challenger disaster is not repeated. Members of Congress criticized the Commission investigation for not going deeply enough into the question of which individuals bore direct responsibility for the accident.[55] Given the technical and managerial focus of the investigations, it is not surprising that those two concerns became interwoven. As a result, the call for reforms is leading to the imposition of more structured and formalized decision making

procedures that represent a move toward legal accountability mechanisms to manage the agency's expectations.

The emphases in many of the proposed reforms are on establishing independent or external oversight bodies that would, in effect, be capable of vetoing decisions by agency personnel regarding issues of safety. For example, the Rogers Commission called for the creation of an independent Solid Rocket Motor design oversight committee which should:

> *Review and evaluate certification requirements.
> *Provide technical oversight of the design, test program and certification.
> *Report to the Administrator of NASA on the adequacy of the design and make appropriate recommendations.[56]

In a similar vein, the Commission called for the establishment of a separate Office of Safety, Reliability and Quality Assurance which would report directly to the NASA Administrator. The Office should have responsibility for:

> *The safety, reliability and quality assurance functions as they relate to all NASA activities and programs.
> *Direction of reporting and documentation problems, problem resolution and trends associated with flight safety.[57]

In both instances, actors outside the agency would oversee key decision-making points within NASA dealing with the design and launch of future manned space flights.[58] While not seeking to give these bodies direct control over the day-to-day operations of NASA's space shuttle program, such bodies would have jurisdiction over a wide range of agency actions.

It is also evident that congressional oversight of NASA activities is likely to focus a great deal more on the details of technical and managerial matters than in the past. In the past, the role of Congress in regard to NASA was that of patron rather than

overseer. For the most part, congressional concerns about NASA were limited to the general priorities of the agency and its potential as a source of pork barrel projects (e.g. the Kennedy Space Center is in Bill Nelson's district and Morton Thiokol's plant is located in Jake Garn's Utah). In the near future, at least, members of relevant congressional committees and their staff will become more involved in the details of NASA's operations.[59]

Other suggested reforms (some already being implemented) attempt internal changes in NASA that would complement this movement toward legal accountability. For example, recommendations for reorganization of the shuttle management structure include a redefinition of the program manager's responsibilities aimed at enhancing that official's decision-making role. In addition to establishing a separate Office of Safety, Reliability and Quality Assurance, units within NASA are being reorganized in order to improve intraorganizational communications. Suggestions also include providing management positions for NASA astronauts so their perspective is added to the decision-making process at critical points.[60] Operationally, suggested reforms include a call for refinement of decision criteria used in equipment maintenance, landing safety, and launch abort procedures. Each of these changes has the effect of reinforcing or legitimizing the influence of bureaucratic structures within NASA through a formalization of organizational relationships and operation procedures. In form and function, they are an attempt move the bureaucratic structures of NASA closer to a centralized system that can more easily be held legally accountable for the agency's future actions.

## Analysis

A major theme of the Rogers Commission report is the failure of management and NASA's decision-making systems. We maintain that the accident was a result of efforts by NASA's leadership to manage changing institutional expectations. In doing so, they developed political and bureaucratic forms of accountability which eventually overwhelmed (and, in effect, replaced) the professional system of accountability that characterized the agency during the 1960s.

In attempting to manage the diverse expectations generated by the institutional environment of the 1970s and 1980s, NASA was actually operating under several accountability systems. Initially in its Mercury and Apollo missions heyday, NASA operated under a professional system of accountability which emphasized deference to expertise. In the period following its lunar landings, NASA had to adjust to a decline in its institutional support. Its workforce and funding levels were cut substantially. As the institutional context changed, NASA shifted toward political and bureaucratic forms of accountability. Political accountability was manifested in NASA's quest for greater support among Congress, the President, and the general public. Bureaucratic accountability was manifested in NASA's quest for greater efficiency and effectiveness in the face of budget cuts. In the process of developing these accountability mechanisms, NASA did not discard professional accountability patterns completely. However, political and bureaucratic accountability systems eventually negated the effectiveness of professional accountability mechanisms.

Evidence of the use of political accountability by NASA are most obvious in the pressures to develop and maintain a regular launch

schedule. By establishing an ambitious schedule of frequent shuttle flights, NASA was able to retain a high degree of control over its own affairs while trying to be responsive to external sources. Of course, NASA set its own launch schedule; but it did so with a careful consideration of the expectations of external actors. NASA wanted to convince its "customers" that the shuttle could be a routine transportation vehicle. In due time there were deadline pressures.

In the specific case of the Challenger, the mission had been postponed three times already, causing a general scheduling problem for NASA administrators who wanted to keep their customers satisfied. Furthermore, Congress, the public, the media, and NASA's customers had high expectations of the agency's performance, including that it had mastered the physical problems adequately enough to come close to a its own announced shuttle launch schedule.

There were more general political pressures as well. While the Rogers Commission was quick to report its finding that NASA had not received any direct pressure from the White House to launch the Challenger, the fact that all federal agencies, including NASA, are currently under pressure to justify their existence in these tight budgetary times is difficult to ignore.

The political accountability pressures of NASA spilled over to its contractors. The assent of Morton Thiokol management (and the silence of their engineers) to the Challenger launch recommendation was influenced in part by the importance of NASA as a primary customer -- a customer who was in the process of reviewing its contracts with the firm. The contractual relationship between NASA and Thiokol was still another barrier to reliance on professional accountability under

the shuttle program, for it imposed a barrier of legal and political expectations between the experts at Thiokol and NASA's decision-makers at the launch site. Having to deal with its own set of accountabilities rooted in institutional demands, Thiokol's management made some key decisions that made the Challenger disaster even more likely. Rather than emphasizing deference to the experts who worked for them, Thiokol deferred to the demands of NASA's top manager who, in turn, were under a self-imposed, politically derived launch schedule.

Indications of the preference given to bureaucratic rather than professional forms of accountability in NASA can be seen in the functional operations of the agency. The decentralized organization of NASA's responsibilities -- a legacy of its Apollo project days -- was originally designed to enhance professional accountability, for it permitted deference to the experts on project teams located throughout the agency. But that decentralization eventually became bureaucratized and manifested in the establishment of separate agency facilities in Texas, Alabama, and Florida as well as contractor facilities such as Thiokol's Utah operation. The more professionally-based management model developed by James Webb and other agency officials early in NASA's history soon disappeared.

By the early 1980s agency managers were having difficulty coordinating their projects.[61] They came to rely increasingly on hierarchical reporting relationships, a clear manifestation of bureaucratic accountability. Responsibility for specific aspects of the overall program were allocated to supervisors at lower levels in that reporting hierarchy, and the burden for giving the go ahead to

launch decision-makers shifted from the engineers and experts toward those supervisory personnel. As scheduling and other pressures increased, so did the reluctance of those supervisors to be the individual who threw a monkey wrench into the shuttle program machinery. Thus it is not surprising that lower level managers tried to cope on their own instead of communicating their problems upward.

The failure of NASA's management system is one of the fundamental themes of the Rogers Commission. Supervisors were criticized for not passing on up the hierarchy recommendations of their subordinates. Managers were criticized for judgements that were contrary to those suggested by the available data. The Commission reported that its investigation revealed

> failures in communication that resulted in a decision to launch 51-L based on incomplete and sometimes misleading information, a conflict between engineering data and management judgements, and a NASA management structure that permitted internal flight safety problems to bypass key Shuttle managers.[62]

But what the Rogers Commission perceived as a failure of the agency's management system was, in fact, an inherent and desirable characteristic of the bureaucratic accountability system adopted by NASA in order to meet the institutional expectations of the post-Apollo era.

Under the management system used in the days of Mercury and Apollo, NASA's top managers estimated that they spent close to two-thirds of their time in meetings and conferences, often contending with seemingly unimportant problems or issues only remotely related to their formal responsibilities. Given the nurturing consensus surrounding NASA at the time, such a management approach was as feasible as it was appropriate for the agency's technical tasks. But

as NASA's managers became increasingly involved in generating political support and meeting demands for greater efficiency, they began to adopt more traditional management approaches based on the characteristics of bureaucracy. The intent was to be responsive to new institutional pressures by cutting back on the organizational costs that characterized NASA in the "old days" when external support and the availability of resources were not major concerns. In that regard, NASA's bureaucratic accountability system was a success rather than a failure. It did what it was intended to do. It was, however, that success which may have been a primary contributor to the Challenger tragedy.

Another example of the increasing reliance upon bureaucratic forms of operation, and hence, bureaucratic system of accountability, can be seen in NASA's use of contractors for its technology. The role of contractors has been the focus of considerable attention since the Rogers Commission issued its report in June. Specifically, congressional investigations have called for much closer scrutiny of the contractual performance of Morton Thiokol in the design and building of the booster rocket.[63]

The government-wide trend toward contracting out and "privatization" was part of NASA's experience as well. The increasing use of contractors was, to a certain extent, still another manifestation of NASA's efforts to establish political and bureaucratic accountability systems as a means for managing changing institutional expectations. Politically, contractors can prove very helpful in establishing support for agency programs and annual funding requests. (It is perhaps more than a mere coincidence, for example,

that Thiokol's major shuttle facility is located in Senator Jake Garn's Utah.) Bureaucratically, contracting out established the ultimate superordinate/subordinate relationship between NASA's top managers and those carrying out the specific parts of the shuttle program. A contract establishes clear responsibilities and gives top management considerable leverage to apply pressures for better performance. It also allows top management to avoid the problems and costs associated with directly maintaining professional accountability mechanisms. Thus, contracting out not only enhanced the bureaucratization process at NASA, but it also tended reduced the reliance on deference to expertise characteristic of professional accountability systems.

Of course, there were criticisms from the Rogers Commission that implied a breakdown of the professional accountability system as well. These were rooted in charges about faulty design of the O-ring seals. The major criticisms seem to focus on the fact that the design was not better. However, the failure to design a better rocket joint seal was not irresponsible behavior. If it was possible to design a better seal and the engineers in charge of the task have simply not been up to the task, then we have a question of competence and not a question responsibility. If the engineers had known about the technical limitations of the design and recommended in favor of the launch anyway, then that would have been a failure of professional accountability. The fact is, the professional engineers had behaved responsibly to the extent that they recommended against launch when the launch conditions were beyond the engineering limits of the design.

The contrast between bureaucratic and professional forms of accountability is not trivial. That NASA officials and agency contractors were also aware of this distinction can be seen in such quotes as "take off your engineer hat and put on your management hat." If NASA had still relied exclusively on professional system of accountability, there would have been deference to the technical expertise of the engineers. Their recommendation against launch would never have been challenged by Lawrence Mulloy, Project Manager for Solid Rocket Booster at Marshall Space Center. When Mulloy was informed of the doubts that Thiokol engineers had concerning plans to launch the Challenger in such cold weather, he responded impatiently: "My God, Thiokol, when do you want me to launch, next April?"[64]

Since the Challenger tragedy the prevailing response has been in the direction of imposing legal forms of accountability, with calls for increased monitoring and oversight by various panels. The filing of a wrongful death lawsuit by the family of one of the Challenger astronauts is only the latest example of efforts in this direction. Most of the post-Challenger recommendations for reform have been thinly veiled efforts to constrain managers with threats of legal accountability. There have been many recommendations for increasing bureaucratic forms of accountability which are actually a blending of legal and bureaucratic. For example, the proposal for placing ex-astronauts in management positions at NASA. At first glance this looks like a bureaucratic form of accountability but bringing in the former astronauts as managers into NASA is really a veiled attempt to blend external oversight with internal decision-making.[65] Similarly, the recommendations for refined launch criteria are really efforts to

develop checklists to follow in making future launch decisions. Such checklists reflect a trend away from deference to professional engineering judgements and toward imposing bureaucratic accountability that carries with it threats of legal liability if such checklists are not properly followed.

Conclusions

The central conclusion of the Rogers Commission was that "flaws" in NASA's decision-making and management systems were a contributing cause to the Challenger disaster. The Commission concluded that NASA's organizational form and management techniques were not sufficient to deal with serious technical problems before making the launch decision, especially in light of powerful pressures to maintain a questionable launch schedule. Our analysis leads us to question the wisdom of the Commission's conclusions.

It is our primary contention that the Commission was shortsighted to focus on the "failure" of NASA's management systems. The problem was not necessarily in the failure of those systems, but rather in the inappropriateness of the political and bureaucratic accountability mechanisms which characterized NASA's management approach in recent years. The agency's emphasis on political and bureaucratic accountability were relevant responses to changing institutional expectations in NASA's environment, but they were inappropriate for the technical tasks at hand. We believe that if the professional accountability system had been given at least equal weight in the decision-making process, the decision to launch probably would not have been made. Instead, the Thiokol engineers' initial recommendation against launch was challenged by their hierarchical

superiors. Decision-makers relied upon supervisors to make the decision rather than give deference to their professional experts.

The question of whether the push for greater emphases on the legal and bureaucratic forms of accountability will improve NASA's ability to be successful in pursuing its mission is important and unavoidable. Our best guess is that it will not. As NASA gets drawn further away from what it can do best -- namely, mobilizing the expert resources needed to solve the technical challenges of space exploration -- its chances for organizational success are diluted. Ideally, NASA needs to get back to what it does best, using the form of accountability that best suits its organizational mission, i.e. a professional accountability based on deference to expertise. To adapt a current popular political maxim, what America needs to do is to "Let NASA be NASA."

In light of the Challenger tragedy, it is inevitable that efforts will be made to reform NASA with the intent of making the agency "more accountable" for its actions. In considering those reforms, we should keep in mind the irony that previous efforts to make NASA more accountable -- more politically responsive and more cost-efficient -- were the very same ones that distracted NASA from its reliance on the professional accountability mechanisms which were at the heart of the agency's technical successes in the past. Thus, the accident that resulted when NASA ignored the recommendations of its technical experts may be the force behind imposing even more layers of inappropriate accountability systems on the agency.

## IV. ACCOUNTABILITY IN AMERICAN PUBLIC ADMINISTRATION

Accountability is a fundamental concept in American public

administration. We have explored the concept of accountability in American public administration using the case of NASA as an illustration. We find implications in this case for the future of the country's space program, but even more importantly we find some basic lessons about the nature of the American democratic system and its impact on the practice of American public administration.

Our examination of NASA's accountability systems in light of the Challenger accident has important implications for the future of the country's space program. The recommendations of the Rogers Commission and congressional investigations have both contributed to a general shift toward the emphasis of legal forms of accountability with some recommendations for modified bureaucratic forms of accountability as well. Very little emphasis is being placed on returning NASA to an emphasis on professional accountability. If this pattern is allowed to continue, we see the prospect for future failures in NASA operations. Because NASA's task remains an essentially technical one, the de-emphasis of the professional accountability system's deference to expertise has a tremendous potential to result in other accidents like Challenger. If reforms in NASA operations return a professional accountability system to at least an equal footing with legal and bureaucratic forms of accountability, then the agency's chances for effectiveness and mission success are improved somewhat. If a professional system of accountability is given primary emphasis, then chances for agency success are much improved over its recent past.

What are the chances of reestablishing the primacy of professional accountability systems in NASA? Our answer to that question is closely tied to more general observations about the role

of public administration in the American political system. We have emphasized throughout this paper the considerable influence of institutional factors in determining the types of accountability systems public agencies like NASA use to manage legitimate expectations. With few exceptions, technical considerations play (at best) a secondary role in shaping the accountability systems adopted by an agency.

NASA was lucky in its early years, for the nurturing consensus characterizing its founding permitted its managers the luxury of adopting the most "technically" appropriate form of accountability. After the lunar landings it lost that advantage and was quickly thrown into the institutional turbulence that is characteristic of the American political system. It is unlikely that NASA will ever extricate itself from its current institutional surroundings and return to the nurturing consensus of its days of glory and success. In that sense it has become just another public agency, suffering from all the dilemmas facing all those who work in the field of public administration.

At the heart of that dilemma is that fact that in the American political system, exclusive reliance on one form of accountability by an public agency is not likely. All four forms of accountability -- bureaucratic, legal, professional, and political -- are viewed as legitimate means for managing legitimate expectations. And, given the distrust of government and public administrators inherent in America's democratic ethos, multiple systems of accountability are seen as desirable. Public agencies are expected to be accountable under each of these systems as circumstances warrant it. That is one of the

least acknowledged costs of American democracy -- a cost paid by those who attempt to effectively administer the collective will of the American people as expressed in public policies and programs.

Under ideal conditions all four types of accountability can enhance the likelihood that responsible behavior will be forthcoming from public agencies. Yet, these accountability systems are not without their costs to the agencies operating under them and the different types of accountability may sometimes have conflicting implications for agencies. Our case study of NASA shows how pursuit of political and bureaucratic accountability distracted NASA from its strength: deference to expertise. Being accountable under one system may not be too difficult. Trying to behave responsibly under two or more systems of accountability, whether simultaneously or sequentially, will be very challenging for public agencies. With multiple systems of accountability, it is possible that the systems of accountability may conflict with each other and may conflict with the technical/managerial task at hand.

In brief, the price for downplaying multiple expectations for public accountability may be the undermining of democracy. Yet, the price for requiring public agencies to manage multiple expectations may be program failure. Challenger was a spectacular program failure -- due in part to NASA's efforts to manage the diverse, multiple expectations the American political system presented to it. Other public agencies also face the same challenge of managing diverse expectations. Their failures may be just as likely; the difference may be that their failures do not occur when the whole nation is watching on television.

## ENDNOTES

[1]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT (Washington, DC: June 6, 1986), p. 40.

[2]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT (Washington, DC: June 6, 1986), p. 82.

[3]The MacNeil/Lehrer News Hour, "Report on Disaster," June 10, 1986, (transcript #2791).

[4]Philip M. Boffey, "Shuttle Panel Is Faulted For Not Naming Names," NEW YORK TIMES, June 11, 1986, p. 16.

[5]James D. Thompson, ORGANIZATIONS IN ACTION: SOCIAL SCIENCE BASES OF ADMINISTRATIVE THEORY (New York: McGraw-Hill Book Co., 1967), p. 10-11.

[6]Thompson, ORGANIZATIONS IN ACTION, p. 11.

[7]For example, besides current astronaut Sally Ride and former astronaut Neil Armstrong, the commission membership included: Eugene Covert, an MIT professor and frequent consultant to NASA who received the agency's "Public Service Award" in 1980; Robert W. Rummel, an aerospace engineer and private consultant who was also a recipient of a NASA public service award; and Major General Donald J. Kutyna, director of the U.S. Air Force's Space Systems program and former manager of the Defense Department's space shuttle program.

[8]For example, commission chair Rogers held a variety of major positions in previous administrations, including Attorney General for President Eisenhower and Secretary of State for Richard Nixon. David C. Acheson, a well known Washington lawyer, had previously served as a U.S. Attorney, counsel for the Atomic Energy Commission, and the senior vice president of COMSAT.

[9]See Paul R. Schulman, LARGE-SCALE POLICY MAKING (New York: Elesvier North Holland, Inc., 1980), pp. 22-41.

[10]See James E. Webb, SPACE AGE MANAGEMENT (New York: McGraw-Hill Book Co., 1968); also Leonard R. Sayles and Margaret K. Chandler, MANAGING LARGE SYSTEMS (New York: Harper and Row, Publishers, 1971).

[11]Peter F. Drucker, MANAGEMENT: TASKS, RESPONSIBILITIES, PRACTICES (New York: Harper and Row, Publishers, 1974), chapter 47.

[12]Drucker, MANAGEMENT, pp. 593-595.

[13]See Frederick C. Thayer, AN END TO HIERARCHY AND COMPETITION: ADMINISTRATION IN THE POST-AFFLUENT WORLD, 2nd edition (New York: New Viewpoints/Franklin Watts, 1981), p. 13. Also Grover Starling, MANAGING THE PUBLIC SECTOR, revised edition (Homewood, IL: The Dorsey Press, 1982), pp. 326-327.

[14]W. Henry Lambright, GOVERNING SCIENCE AND TECHNOLOGY (New York: Oxford University Press, 1976), pp. 21-22.

[15]Lambright, GOVERNING SCIENCE AND TECHNOLOGY, p. 134.

[16]Drucker, MANAGEMENT, p. 360.

[17]S. N. Eisenstadt, THE POLITICAL SYSTEMS OF EMPIRES: THE RISE AND FALL OF THE HISTORICAL BUREAUCRATIC EMPIRES (New York: The Free Press, 1969), p. 11.

[18]See Reinhard Bendix, KINGS OR PEOPLE: POWER AND THE MANDATE TO RULE (Berkeley CA: University of California Press, 1978).

[19]See Charles Rembar, THE LAW OF THE LAND: THE EVOLUTION OF OUR LEGAL SYSTEM (New York: Simon and Schuster, 1980).

[20]The exception might have been the public administrative systems of ancient Athens. See William C. Beyer, "The Civil Service of the Ancient World," PUBLIC ADMINISTRATION REVIEW, 19, no. 4 (Autumn 1959): 243-249.

[21]See Robert A. Dahl, DILEMMAS OF PLURALIST DEMOCRACY: AUTONOMY VS. CONTROL (New Haven, CT: Yale University Press, 1982), pp. 7-11.

[22]Dahl, DILEMMAS OF PLURALIST DEMOCRACY, pp. 10-11.

[23]See Arend Lijphart, DEMOCRACIES: PATTERNS OF MAJORITARIAN AND CONSENSUS GOVERNMENT IN TWENTY-ONE COUNTRIES (New Haven, CT: Yale University Press, 1984).

[24]Broadly defined, the role of public administration and bureaucracy in democratic political systems has been examined in a number of different contexts. For a critical presentation on the historical emergence of bureaucratization in Western societies, see Henry Jacoby, THE BUREAUCRATIZATION OF THE WORLD (Berkeley, CA: University of California Press, 1973); also see Guy Benveniste, THE POLITICS OF EXPERTISE, 2nd edition (San Francisco, CA: Boyd and Fraser Publishing Co., 1977). On a more empirical level, see Joel D. Aberbach, Robert D. Putnam, and Bert A. Rockman, BUREAUCRATS AND POLITICIANS IN WESTERN DEMOCRACIES (Cambridge, MA: Harvard University Press, 1981). On the increasing role of government in democratic economies see Andrew Shonfield's study of MODERN CAPITALISM: THE CHANGING BALANCE OF PUBLIC AND PRIVATE POWER (New York: Oxford University Press, 1969), especially Part 4. For a discussion on the role of bureaucracy in American democracy, see Douglas Yates, BUREAUCRATIC DEMOCRACY: THE SEARCH FOR DEMOCRACY AND EFFICIENCY IN AMERICAN GOVERNMENT (Cambridge, MA: Harvard University Press, 1982).

[25]The term "ethical" is used here in a behavioral rather than a normative sense. Thus, an ethical standard is one that is regarded as an appropriate and legitimate criterion upon which a person or group can select a course of action or judge the action of others. George A. Graham uses such a perspective when he posits ethical guidelines as

"rules of the game"; see his "Ethical Guidelines for Public Administrators: Observations on Rules of the Game," PUBLIC ADMINISTRATION REVIEW, 34, no. 1 (January/February, 1974): 90-92. For an analysis using a more normative approach which equates ethical behavior with moral behavior, see Dennis F. Thompson, "The Possibility of Administrative Ethics," PUBLIC ADMINISTRATION REVIEW, 45, no. 5 (September/October, 1985): 555-561.

[26]See Gary L. Wamsley and Mayer N. Zald, THE POLITICAL ECONOMY OF PUBLIC ORGANIZATIONS: A CRITIQUE AND APPROACH TO THE STUDY OF PUBLIC ADMINISTRATION (Bloomington, IN: Indiana University Press, 1973).

[27]See Max Weber, ECONOMY AND SOCIETY: AN OUTLINE OF INTERPRETIVE SOCIOLOGY, edited by Guenther Roth and Claus Wittich (Berkeley, CA: University of California Press, 1978), Chapter XI.

[28]See Alvin W. Gouldner, PATTERNS OF INDUSTRIAL BUREAUCRACY (New York: The Free Press, 1954), pp. 159-162.

[29]Philosophically and ideologically, the basis of legal accountability is found in the "rule of law" concept; see Friedrich A. Hayek, THE ROAD TO SERFDOM (Chicago, IL: University of Chicago Press, 1944), chapter VI; also see Theodore J. Lowi's call for "juridical democracy" in THE END OF LIBERALISM: THE SECOND REPUBLIC OF THE UNITED STATES, 2nd edition (New York: W.W. Norton and Co., 1979), chapter 11.

[30]See Carl Joachim Friedrich, "Public Policy and the Nature of Administrative Responsibility," in C. J. Friedrich and Edward S. Mason (eds.), PUBLIC POLICY, 1940 (Cambridge, MA: Harvard University Press, 1940), pp. 3-24.

[31]For a classic case study of a professional accountability system, see the story of the Manhattan Project offered in Peter Wyden, DAY ONE: BEFORE HIROSHIMA AND AFTER (New York: Warner Books, 1985).

[32]See Emmette S. Redford, DEMOCRACY IN THE ADMINISTRATIVE STATE (New York: Oxford University Press, 1969); also see works by Paul Appleby and Herman Finer.

[33]See Robert C. Fried, PERFORMANCE IN AMERICAN BUREAUCRACY (Boston, MA; Little, Brown and Co., 1976).

[34]On the early history of NASA by an "insider", see John D. Young, "Organizing the Nation's Civilian Space Capabilities: Selected Reflections," in Theodore W. Taylor, ed., FEDERAL PUBLIC POLICY: PERSONAL ACCOUNTS OF TEN SENIOR CIVIL SERVICE EXECUTIVES (Mt. Airy, MD.: Lomond Publications, Inc., 1984), PP. 45-80.

[35]Some analysts have defined that "nurturing consensus" as little more than a "political vacuum" in which the agency got to define its own programmatic objectives. See John Logsdon, THE DECISION TO GO TO THE MOON, cited in Lambright, GOVERNING SCIENCE AND TECHNOLOGY, pp. 41-42.

[36]Young, "Organizing the Nation's Space Capacities," p. 47.

[37]Grover Starling, MANAGING THE PUBLIC SECTOR, revised edition (Homewood, IL: The Dorsey Press, 1982), p. 44.

[38]Lambright, GOVERNING SCIENCE AND TECHNOLOGY, p. 43. Also see Starling, MANAGING THE PUBLIC SECTOR, p. 52.

[39]W. Henry Lambright, GOVERNING SCIENCE AND TECHNOLOGY (New York: Oxford University Press, 1976), p.21-22; and John Noble Wilford, "Nasa May Be a Victim of Defects in Its Own Bureaucracy," NEW YORK TIMES, February 16, 1986, p. 18e.

[40]John Noble Wilford, "NASA May Be a Victim of Defects in Its Own Bureaucracy," NEW YORK TIMES, February 16, 1986, p. 18e.

[41]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 176.

[42]John Noble Wilford, "NASA Chief Vows to Fix Problems," NEW YORK TIMES, June 10, 1986, p. 22.

[43]David E. Sanger, "A Space Agency on Disaster's Edge," NEW YORK TIMES, June 10, 1986, p. 22.

[44]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 176.

[45]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 201.

[46]William J. Broad, "NASA Aide Assails Panel Investigating Explosion of Shuttle," NEW YORK TIMES, March 16, 1986, p. 23.

[47]Lawrence Mulloy, testimony before the Rogers Commission, REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 98.

[48]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 82.

[49]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 82.

[50]Roger Boisjoly, testimony before the Rogers Commission, REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 93.

[51]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 94.

[52]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 153.

[53]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE

CHALLENGER ACCIDENT, p. 154.

[54]In July, 1986, the family of shuttle pilot Michael Smith filed a "wrongful death" suit against NASA and some of its top managers.

[55]Philip M. Boffey, "Shuttle Panel is Faulted for Not Naming Names," NEW YORK TIMES, June 11, 1986, p. 16.

[56]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 198.

[57]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 199.

[58]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, pp. 198-199.

[59]Philip M. Boffey, "NASA Challenged on Notification That Rockets Met Requirements," NEW YORK TIMES, June 12, 1986, p. 18.

[60]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, pp. 199-201.

[61]Laurie McGinley and Bryan Burrough, "Backbiting in NASA Worsens the Damage from Shuttle Disaster," WALL STREET JOURNAL, April 2, 1986, p. 1.

[62]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 82.

[63]Philip M. Boffey, "NASA Challenged on Notification That Rockets Met Requirements," NEW YORK TIMES, June 12, 1986, p. 18.

[64]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 96.

[65]REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, p. 199.

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