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Activity Theory and the Analysis of Organizations

G. RICHARD HOLT and ANTHONY W. MORRIS

This article summarizes activity theory as advanced by Finnish organizational analyst Yrjö Engeström, with particular attention paid to antecedents of activity theory in the work of Vygotsky, Leontyev, Luria, and others identified with the Soviet sociohistorical approach to psychology. Activity theory is illustrated through a retrospective analysis of activity systems operating in events leading up to the Challenger shuttle catastrophe, comparing the approach to the theory of "normal accidents" advanced by Perrow. Implications for the study of organizations and organizational actors, as well as issues related to use of activity theory to conduct retrospective analyses (as against its use as an intervention strategy) are discussed.

Key words: activity theory, Challenger shuttle accident, organizational activity, Soviet sociohistorical school

ACTIVITY THEORY, as developed by Yrjö Engeström (1987b), is a means of both analyzing and intervening in organizational process. Engeström posits that the unit of analysis in accounting for emerging institutions is neither that which occurs in the individual mind (the cognitivist position), nor the structure of the organization (the functionalist position), but the activity through which both are continuously generated. "The pressing theoretical and practical problem of our time is the very indirectness of institution building, i.e., the indirect or even hidden influence of individual actions on the creation and reproduction of activity systems" (Engeström 1987a:4).

This is not to say that individual cognitive processes and organizational structure are unnecessary or uninteresting. Engeström's theory does claim, however, that before these two necessary elements can be explicated, activity must first be recognized as having a generating role, and then be adequately conceptualized to determine how it serves as an antecedent to mind and structure.

In this paper, we will summarize the philosophical assumptions underpinning activity theory, describe the activity system (the unit of analysis which stems from these assumptions) and illustrate how activity theory works by applying its principles to a well known recent instance of organizational dysfunction, the space shuttle Challenger disaster. We will conclude our paper with recommendations for further application of activity theory to the persistent problems of culture and organizational behavior.

G. Richard Holt is Assistant Professor in the Department of Speech Communication, University of South Dakota. Anthony W. Morris is a PhD student at the Center for the Ecological Study of Perception and Action (CESPA) at the University of Connecticut. *The authors would like to thank Janet Keller for defining a "zone of proximal development" in their early stages of learning about activity theory and for her comments on an earlier draft of this paper.*

Philosophical Assumptions of Activity Theory

The story of activity theory begins in the 1930s with the research of Lev Vygotsky, whose profound influence upon Soviet psychology has been noted by several authors (Bruner 1985b, Wertsch 1985). The tradition emerging from this foundation is often referred to as the cultural-historical school of Soviet psychology. As Michael Cole (1985:148) explains Vygotsky's contribution,

> Central to [Vygotsky's] effort was an approach that denied the strict separation of the individual and its social environment. Instead, the individual and the social were conceived of as mutually constitutive elements of a single, interacting system; cognitive development was treated as a process of acquiring culture.

Vygotsky's work constitutes a challenge to what Sylvia Scribner (1985:199) has called "the spectre of Cartesianism," that is, that mind and behavior are two "distinctly different modes of life." Likewise, David Bakhurst (1988), in his analysis of the cultural-historical school, is careful to position activity theory vis-à-vis Cartesianism. Descartes' dualism is frequently characterized as an incommensurability between mind and body. This anthropocentric reading of dualism, however, can be equivalently rewritten to highlight Cartesianism's broader implications in separating the "mind world" from the "object world."

In contrast, Bakhurst (1988:31) explains that the cultural-historical school, from within a different world view, conceptualizes as *a priori* the interaction of minds and world. According to Bakhurst, the cultural-historical school can broadly be characterized by four theoretical insights. First, the higher mental functions of the human individual "exist in, and are mediated by, language" and person/object interaction. Second, language, comprised of a set of societally shared media that complement activity, presupposes "a set of shared social meanings" historically constructed by the community. Third, cultures are real and comprised of shared social meanings brought into existence by the collective's activity. Finally, the human child/individual progressively becomes a full participant in the generation of a society's institutions via exposure to a community's activity and internalization of its culture. It follows, then, that higher mental functions are internalized forms of the activity of the community in which an individual acts. Since activity is the antecedent of culture and thus of language, activity should be a unit of investigation in the explanation of emerging minds and institutions.

To help clarify these ideas, let us turn to an example from A. A. Leontyev (1981). Suppose that we are asked to explain a relatively common phenomenon: a child's learning to point indicatively at an object too far away to be reached. Leontyev maintained that this learning process begins with the child making a grasping movement in the presence of the object. As the parent aids the child by comprehending the movement as an indicator, s/he imputes to the action an intent: namely, that the child wants the object. The parent (a member of the community in which the child exists) is the one who introduces the primary meaning for the object ("this is a member of the set of objects that the child wants"). From this mutual interaction, there follows assignment of meaning on the part of the child for the *gesture* ("this is something one does to indicate an object one wants"). The important point is that the higher mental functions (indication, want, desire, purposeful gestures, and so on) exist in the environment prior to the child's existence as a member of the community. Nevertheless, it is also clear that the child has had a hand in constructing that community by means of its action.

The Activity System as a Unit of Analysis

Of the several authors who have advanced in some form Vygotsky's original ideas (Bruner 1985a, Ilyenkov 1977, Leontyev 1978, Luria 1976), it remained for Yrjö Engeström (1987b) to go beyond individuals in relationship (in our previous example, parent and child) and move to the larger activity system. Engeström explicitly conceptualizes "activity" as a minimal unit of analysis. As a unit of analysis, activity refers to an actual, identifiable activity as opposed to a generic notion of human activity. Leontyev (1981:46) gives the following clarifying definition: "The real function of this unit is to orient the subject in the world of objects. In other words, activity is not a reaction or aggregate of reactions, but a system with its own structure, its own internal transformations, and its own development." Activity, defined as "systems of collaborative human practice" (Engeström 1988:30), becomes the generator of a continuously emerging context. This formulation rejects any view that holds context as a "given," that is, preset conditions to which participants respond. Engeström's "model of the basic structure of activity" is reproduced in Figure 1 (Engeström 1987b:78).

Keeping in mind that Figure 1 is a generalized model, and that the meaning of its components are to be determined in application only, one may still get a rough idea of the principal parts of the model. One must realize, however, that Engeström might object to the exegesis of his model by "parts," since doing so implies an unwarranted fractionalization of activity. "The essential task is always to grasp the systemic whole, not just separate connections" (Engeström 1987b:78). Nevertheless, for the sake of discussion, we will provide a brief definition for each of the principal nodes of the model.

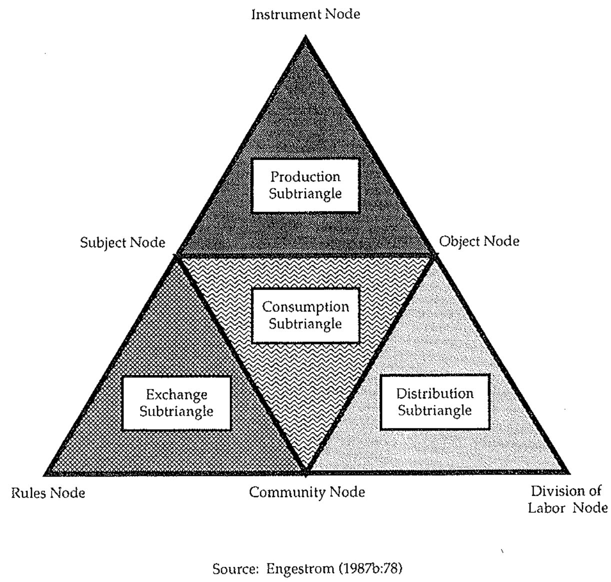


FIGURE 1. THE ACTIVITY TRIANGLE (Source: Engeström 1987b:78)

First, notice the sub-triangle at the top, with corners labeled "subject," "instrument," and "object." The "subject" is either an individual or aggregate of individuals seeking to fulfill goals or motives through action (if individual) or activity (if groups). "Instruments" can be defined as means (concepts, theories, physical apparatuses, logical reasoning, to name only a few that Engeström has employed) that mediate the subject's activity toward the object. "Objects" are modifiable ends toward which activity is directed and from which an outcome is expected (indicated in the above diagram by the arrow pointing right from "object"). This sub-triangle is a rough analog to Vygotsky's notion of mediation, and in contrast to the complete triangle, shows the limitations of his work. Vygotsky experimentally included only the individual and sometimes an instructor in trying to formulate the origin of higher mental functions. The influence of the community remains largely undeveloped and implicit in Vygotsky's work.

The contribution of Engeström's activity model is in his expansion of Vygotsky's "subject ↔ instrument ↔ object" triangle to include the "community," "rules," and "division of labor" as necessary elements. "Community" may be defined as an interdependent aggregate of individuals who (at least to some degree) share a set of social meanings. "Rules" are inherently incomplete guides for action or activity prescribed by the community. "Division of labor" represents task specialization by individual members or groups contained within the community.

The primary triangle is composed of four smaller triangles, labeled in Figure 1 as "production," "consumption," "exchange," and "distribution." These terms represent the higher order functions that arise from the mutual relations among components or nodes of the sub-triangles. These functions are not to be understood as the nodes, but as the relations existing among mutual components. To define these terms, Engeström relies on the following definition provided by Marx (1973:89):

> Production creates the objects which correspond to the given needs; distribution divides them up according to social laws; exchange further parcels out the already divided shares in accord with individual needs; and finally, in consumption, the product steps outside the social movement and becomes a direct object and servant of individual need, and satisfies it in being consumed.

It is important to recognize that these mutualities are not the result of separate nodes interacting. They are best modelled by a mathematical duality: an operation that establishes a non-transitive, isomorphic correspondence between structures (Shaw and Alley 1985).

As Marx intimates in the above citation, the total activity system contains a paradox. While the total activity triangle is geared toward production, the parts of the triangle (i.e., the four sub-triangles) simultaneously produce (thus contributing to the ongoing production of the entire system) and consume. If the smaller activity systems that comprise the societal activity are to produce, they require energy, in the form of things produced for them to consume. The paradox is that production is not only production, but is also consumption.

An example will serve to illustrate this paradox. Suppose we have a band of hunters. The motive of their activity system is the production of food in the form of game. In order for them to survive the hunt, however, they must *consume* food that has already been produced. Their overall activity system, which is geared toward food production, must therefore consume in order to produce.

The point of this paradox is far from trivial: it provides the *raison d'etre* for the basic unit of activity theory—namely, activity itself. In our previous example, the production of the hunting band's food supply has come about to fulfill the needs of its members. These needs are the result of production, because production—which must consume in order to produce—generates the need. This is the motive force driving all activity systems: *were it not for the paradox that consumption necessitates production, and vice versa, activity would not exist.*

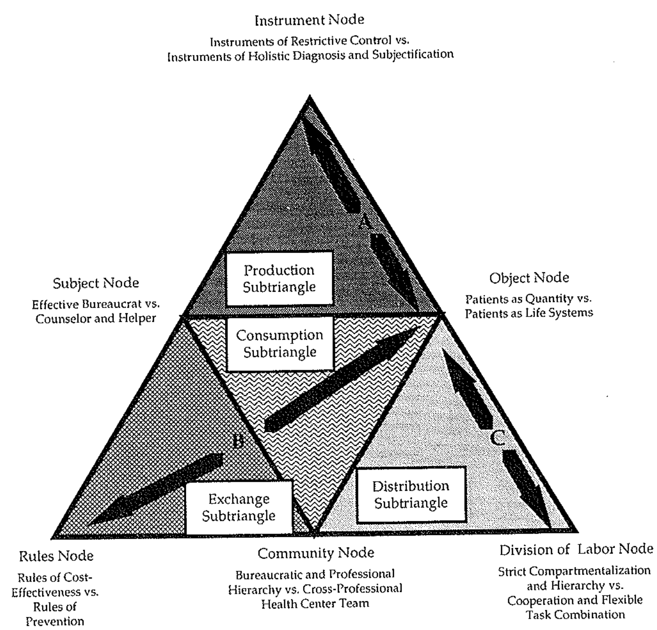
How does one see evidence of this dynamic tension between production and consumption? Primarily, it is manifest through *contradictions* within and among the components of an activity system; between it and other systems; or between a system and its emerging, more advanced version. If a need were to arise that the traditional forms of production could not satisfy, then a system would demand a change in its ways of producing. For example, if a mammoth were unexpectedly to attack our band of hunters, their weapons and tactics, which worked perfectly well against rabbits, might be useless in the face of such an adversary. In Engeström's terms, the hunters' activity system would require expanding to accommodate the changing situation.

When it becomes clear that, under the extant activity system, a need cannot be satisfied, what Engeström calls a "need state" comes into existence. The key to the holistic nature of activity theory, however, is in Engeström's argument that such need states are not merely "possible," or even "likely." Because all activity systems are the result of the dynamic interplay of contradiction, *need states are inevitable.*

Engeström holds that the impetus to system change arises from four types (levels, or "layers") of contradictions: *primary* (within each constituent component of the activity); *secondary* (between the constituent components of the activity); *tertiary* (between the activity itself and a culturally more advanced form of the activity); and *quaternary* (between the central activity and its neighboring activities) (Engeström 1987b:89). For simplicity's sake, we will deal only with the primary, secondary, and tertiary contradictions. While the fourth kind of contradiction, the quaternary, is certainly essential to the accurate description of the organizational environment, its elaboration is beyond the scope of this essay.

As an empirical example to further explicate the primary and secondary contradictions within an activity system, we will now focus on Engeström's (1987a) work with a Finnish health center. Through an historical analysis of the center, as well as through empirical data, Engeström constructed the activity triangle depicted in Figure 2. The complexity of this system, as in much of Engeström's research, resists any brief summation. To highlight the salient points, however, it is worth knowing the climate faced by general practitioners in the health center:

> The general practitioner is under direct daily pressure from four sides: (1) the national and municipal administrative bureaucracies which demand more output and effective adherence to a growing amount of rules and regulations . . . and simultaneously more satisfied patients, (2) the patients and the general public demanding more time and better care per patient and—paradoxically—shorter lines and waiting periods, (3) the nurses demanding independent professional status and refusing to be subordinated by physicians, while also criticizing physicians for inability to cooperate and to take a holistic view of the patient care, (4) the hospital specialists demanding that really serious cases (e.g., cancer) be screened and found earlier and more reliably, while on the other hand the flow of patients sent by the general practitioners to specialists should be restricted (1987a:11).



Source: Engestrom (1987a)

FIGURE 2. THE INNER CONTRADICTIONS OF THE WORK ACTIVITY OF GENERAL PRACTITIONERS IN A FINNISH HEALTH CENTER (Source: Engeström 1987a)

As instances of contradictions in the health center activity system, Engeström notes three secondary contradictions (labeled "A," "B," and "C" in Figure 2) which arise from the interrelationship among four of the six primary contradictions. Secondary contradiction "B," for instance, pits the "primary rules contradiction" against the "primary object contradiction." The rules contradiction makes it impossible for one to be both cost-effective and to spend enough time with patients to provide preventative care, given the state of development of the activity system. Likewise, the object contradiction forces the community simultaneously to consider patients as individual life-systems, but also as masses to be processed. These factors, remember, are two of the *primary* contradictions (those within each constituent component of the activity system). The *secondary* contradiction "B" emerges between the two components, in that the rules constrain the community's activity toward the activity's object. In other words, cost-effectiveness prevents patients from being regarded as individual life-systems.

Notice that primary contradictions—and primary contradictions *alone*—give rise to need states. Engeström emphasizes that such contradictions are neither arbitrary nor accidental, but are impelled by the elements of culture and history that underpin the system. Identification of the primary contradictions thus provide the initial step in accounting for the activity system's inevitable expansion. Each primary contradiction represents two opposing forces whose interplay leads to a necessity to choose one element of the contradiction over the other: "patients as life systems" must take precedence over "patients as quantity" (object contradiction); "rules of cost-effectiveness" must yield to "rules of prevention" (rules contradiction); and so on.

While instructive, this example leaves unexplained precisely how the activity system evolves into a culturally more advanced system. To explain this evolution, Engeström turns to the idea of *tertiary* contradiction, or the contradiction between the central form of the activity and a more advanced version of it. Contradictions are "brought to a boil," as it were, and out of the dynamic tension in the system arise what are known as *springboards*, or "new specific instrument[s] . . . for breaking the constraints . . . and for constructing a new general model for the subsequent activity" (Engeström 1987b:189).

Frequently, the springboard involves adapting a tool in the older system for use in constructing the newer system. One of Engeström's examples of the springboard is Mendeleev's discovery of the periodic table of elements. Mendeleev puzzled for *15 years* over the question of how to reorganize the chemical elements into a different, more coherent, pattern; at that time, ongoing discoveries of new elements tended to render each organizational pattern obsolete almost as soon as it was formulated). Then Mendeleev in a *single day* suddenly conceived of the idea for his table as he was playing a game of solitaire! The details of this episode, based on Kedrov's exhaustive analysis of Mendeleev's notes and diaries, can be found in Engeström (1987b:257–266). The solitaire game, which had previously served as a tool for entertainment and amusement, took on a new function as an organizational model for the periodic table.

Having summarized (in a perhaps unforgivably brief form) the approach that Engeström takes toward the analysis of organizations as activity systems, we can further clarify activity theory principles through comparison with some theories of accidents that are perhaps better known in western organizational literature.

One useful way of explicating Engeström's production/consumption paradox is to compare it to the position advocated in what is perhaps the best known work on the subject of catastrophes in complex high-risk technological systems, Charles Perrow's 1984 book, *Normal Accidents.* Perrow takes a systems theory approach to the phenomenon of the conflict between ideal means of solving problems in high-risk complex systems and their real-world implementation. Borrowing terminology from 1970s sociological research, Perrow contends that complex systems such as those operating at NASA are simultaneously "tightly coupled" and "loosely coupled." Tight coupling, according to Perrow, "is a mechanical term meaning there is no slack or buffer or give between two items. What happens in one directly affects what happens in the other." (Perrow 1984:89–90). Loose coupling, on the other hand, is characteristic of a system in which subsystems tend to follow their own lines of development. "Loosely coupled systems tend to have ambiguous or perhaps flexible performance standards" (1984:91), a condition which "allows certain parts of the system to express themselves according to their own logic or interests" (1984:92).

According to one reading of this model, NASA might be seen as a system originally conceived as tightly coupled, but which over the course of its development became more loosely coupled; that is, it began in the 1960s as a relatively self-contained collection of subsystems devoted to research and development, but by the 1980s had fallen victim to the increasing pressures arising from uncontrolled lines of development in its various subsystems: political considerations, decreased resources, increasing inability to communicate critical information with key subcontractors, and so on (Feynman 1988).

Perrow's analysis rests largely on his contention that "normal" (i.e., inevitable) accidents arise when loosely coupled subsystems within larger, more inclusive systems suddenly become tightly coupled. Perrow demonstrates that, due to the increasingly complex nature of modern technological systems that operate with hazardous materials or in extreme environments, subsystems whose participants follow their own standards of decision making are often suddenly forced to acknowledge the decision making rules of other subsystems, and that when the complexity of the system and its component subsystems increases to a certain point, the inevitable subsystem component failure (due to wear, breakage, natural forces, and so on) results in an equally inevitable, or "normal," accident. The catastrophic nature of many highly publicized accidents, Perrow argues, is traceable not to massive system failure, but rather to the inevitable failure of smaller components in subsystems that are, or become, more tightly coupled than people realize. If we know about these "normal accidents," Perrow concludes, we can "stop blaming the wrong people and the wrong factors, and stop trying to fix the systems in ways that only make them riskier" (1984:4).

Perrow's analysis, applied to the development of NASA, provides a neat and precise picture to summarize the events leading up to the Challenger disaster. From a tightly coupled system in the 1960s, driven by an almost obsessive desire to test and retest for component failure, NASA developed in the 1980s into a fragmented collection of warring factions, some answering to the political forces in Washington, others to the scientific test results of contractors, and still others to the space and aeronautics research community, according to the Rogers Commission (PCSSCA 1986). In the loosely coupled environment that characterized NASA in the 1980s, each of these conflicting subsystems was seemingly permitted to develop its own "logic," its own systems of rationality, and its own means of achieving its goals (Holt and Scudder 1988).

When the Challenger exploded, however, the loosely-coupled subsystems were shown to be in fact quite tightly coupled. In the aftermath, many previously "hidden" interdependencies were revealed: limited resources depended on political maneuvering, research and development depended on funding (and hence on decision makers making the right political choices), and contractor test results depended on increasingly limited access to key decision makers.

The Challenger explosion—according to this possible interpretation through application of the Perrow model—revealed that the perception of a NASA composed of increasingly independent subsystems operating according to their own logics was in fact an illusion, a model with which decision makers had deceived themselves into thinking that individually they were capable of solving problems in their own bailiwicks with little thought or attention to the affairs of other subsystems.

Perrow's point, which is peculiarly applicable to the Challenger explosion, is that in any high-risk complex operation, it is the key operations themselves that serve as the focal mechanisms that bring together seemingly disparate system components. To put it more directly: regardless of how much NASA officials, Morton-Thiokol engineers, and politicians bickered among themselves about how to achieve long- and short-term goals in their own subsystems, there came a point where they had to choose whether to launch or not.

An activity theorist might find much to concur with in this analytical scheme. To begin with, Perrow's model does an excellent job of linking the so-called "separate" components of a system, insisting that their divergence is only illusory, in much the same way that an Engeströmian analysis might insist on the interlinkages among the six nodes of the activity triangle. Moreover, Perrow refused to be daunted by the complexity of the systems he analyzes; he is seemingly aware, as Engeström constantly reminds us, that "real" organizational analysis is a most demanding activity, requiring coordination over time of a vast array of different kinds of information. Finally, Perrow clearly has in mind the analysis of critical sociohistorically situated events (which he terms "normal accidents") in terms of their antecedents and consequents in a complex and dynamic (ongoing) system, in much the same way that Engeström chooses to focus on critical images or concepts (which he terms "springboards") that are employed as distressful times during organizational crises to resolve seemingly unsolvable paradoxes in the system. In at least these three situations, then, the theory of "normal accidents" and Engeström's activity theory are in close agreement.

When one juxtaposes an analysis of the same events according to activity theory, however, it becomes clear that Perrow's theory places far too much emphasis on abstraction from systems theory terminology, and focuses far too little on emerging contradictions experienced by the people who make up the system. For example, activity theorists would register strong objections to Perrow's implication that loosely coupled systems suddenly "are seen to be" or "come to be" tightly coupled, and that it is their unaccountable and "mysterious" juxtaposition (1984:10) that leads to "normal accidents." To the activity theorist, the linkage among these various subsystems is, and always has been, not simply present but *inevitably* present. Moreover, activity theory holds that the inability to see these linkages as such arises from the refusal of organizational analysts to consider the omnipresent link between models formulated to apply to a specific moment in time and the possibility of expansive learning that can lead to the evolution of the activity system to some future state or states.

To the activity theorist, there is nothing "mysterious" about these linkages; rather, they are inescapably grounded in the paradox of production and consumption. As the specialization of tasks in an activity system increases, more productive energy must be devoted to the manufacture and distribution of goods demanded by the system. Doing so usually necessitates increased efforts on the part of subsystems to accommodate the system as a whole. Such demands on subsystems inevitably mean increased specialization, which bring in their turn a tendency on the part of individuals in their own subsystems to focus on the affairs of that subsystem alone. With the narrowing of focus comes an increased feeling of alienation, a feeling that things are more out of one's own hands and hence at the mercy of "outside" influences.

To Engeström, this alienation results from the nature of work itself, namely that all work is socially grounded. To say that modern specialists in high-risk or hazardous enterprises are "alienated" is in fact to say that they have been cut adrift from the sociohistorical grounding of their work activity systems. In Perrow's terms, they have been taken from the tightly coupled environment that accompanies mastery of the work task as a whole, and placed into more loosely coupled kinds of jobs, seemingly divorced from other specialists in other subsystems. What Perrow might call "loose coupling," and what Engeström refers to as "alienation from the whole work activity," in fact arises from the same overall difficulty: specialization.

> The increasingly societal nature of work processes, their internal complexity and interconnectedness as well as their massive volumes in capital and capacity, are making it evident that, at least in periods of acute disturbance or intensive change, no one actually quite masters the work activity as a whole, though the control and planning of the whole is formally in the hands of the management. This creates something that might be called "grey zones" . . . areas of vacuum or "no man's land," where initiative and determined action from practically any level of the corporate hierarchy may have unexpected effects (Engeström 1987b:113–114).

One example that illustrates Engeström's point is the refusal of NASA officials to listen to engineers at Morton-Thiokol who warned them repeatedly that there were serious problems with the O-rings. Morton-Thiokol whistle-blower Roger Boisjoly noted that warnings about the O-rings had been voiced as early as 1979: "There is a NASA memo from 1979 rejecting the design of the joint. Management at NASA and Thiokol ignored the flag because it would have meant a huge hit in costs" (Chiu 1988:20). As specialists, the administrators at NASA (many of whom were originally trained as engineers or scientists), found it impossible to adhere to the dual demands of making decisions based on both "pure science" and the exigencies of the organizational "bottom line."

Such specialization problems are of concern to the activity theorists because they reflect decisions that are made in the absence of full information about the implications of those decisions. In the aftermath of the Challenger disaster, there were shown to be a significant number of such "grey zones": engineers unaware of political pressure exerted from business and government; politicians unaware of the scientific implications of what they were demanding of the launch system; and managers who, in trying to balance the power between the scientists and the politicians, ended up alienating both.

The chief difference between Perrow and Engeström is that with Perrow's model, there is little that one can do about the occurrence of "normal accidents." Perrow's suggestion that we "can stop trying to fix the wrong things" tells organizational analysts very little about what they *can* do. Moreover, knowledge of how the various subsystems are coupled reveals very little about the people in these subsystems. In contrast, as we will see, Engeström's activity analysis grounds its conclusions about specialization and alienation primarily in the discourse and associated interactions of the participants. In this sense, the impersonality of the systems theory view of organizations is circumvented: beginning with the organizational actor and continuously reorienting findings about the dynamic evolution of the activity system back to these individuals, Engeström's analysis never lets us forget that entities that are termed systems are in reality *activity* systems, and that the term "activity" always implies *human* activity. By emphasizing coupling of system "components," Perrow is perhaps unconsciously assenting to an inappropriate reification of the activity system as something separate from the people who make it up. After all, a "system" did not make the decision to launch the Challenger; the people who make up the system are responsible for that particular decision. Therefore—particularly in the ongoing interventionist strategy adopted by activity theorists—there is more of a chance to check perceptions of the analysts against the perceptions of social actors within the activity system. Excessive abstractions, such as those found in the Perrow model, are appealing for their neatness and theoretical elegance, but in fact they obscure the real functioning of activity, which is frequently "messy," disorganized, seemingly chaotic, and hence endlessly fascinating. Perrow's model represents a decided advance over the simplistic structural repairs prescribed by the Rogers Commission, but it still fails to recognize the complexity of the activity system as a whole.

It is interesting to note the similarity between the production-consumption paradox as manifested in the shuttle program and that faced by the health delivery personnel in the example cited earlier, particularly if we keep in mind that Engeström and his associates grounded their analysis in the discourse of employees at the health center. In both situations, a limited amount of time in which to make a decision was imposed upon key personnel: NASA had to get the Shuttle up and back down again safely 24 times a year; the doctors had to provide consultation on a sufficiently timely basis for the organization to turn a profit. In both situations, the decision demanded of the professionals was extremely complex: NASA had to achieve the mandated flight plan for a highly complex piece of machinery about which there remained considerable uncertainty; the health care professionals had to advise patients on serious, sometimes grave, health issues. In both situations, professionals faced an organizational environment characterized by increasingly limited resources: NASA was faced with the possibility of decreased funding; the health care professionals were faced with decreased hospital bed space, less time to conduct consultations, and more questions about health care that increasingly exceeded their professional training. It is not surprising that Engeström's judgment about the Finnish health center—that the doctors there had been guilty of a number of behaviors that promote "freezing," including abrupt terminations of consultation, refusal to admit to inadequate knowledge, and clear attempts to diminish patient attempts to probe complex issues in consultations—is equally true of the behavior of NASA officials in the events leading up to the Challenger disaster (Kruglanski 1986).

Activity theory analyses differ from more traditional analyses of organizational production-consumption paradoxes in two important ways. First, activity theory unrelentingly emphasizes the fluidity of the social system under examination; paraphrasing Clifford (1986:10), one could say that organizations, like cultures, "seldom hold still for their portraits." Instead, the human organization is a dynamic entity, fueled by the tensions between the contradictions inherent in its history of production and consumption and continuously evolving toward a number of future states. To analyze any organization "as it is," "at the present moment," as the Rogers Commission attempted to do in the case of NASA, is to involve oneself in "simplification and exclusion, selection of a temporal focus, the construction of a particular self-other relationship, and the imposition or negotiation of a power relationship" (Clifford 1986:10). As Engeström (1987a:7) reminds us, "An activity is not a homogeneous system. It always contains sediments of earlier historical types, as well as buds or shoots of a future type. These sediments and buds are found in and between the different components of the activity system, including the mental models of the subjects."

The second difference between activity theory and other organizational analyses also derives from the notion of the inherent dynamism of the activity system: activity theory is consistently oriented toward the evolving future state of the organization. Such future states are referenced (if at all) in most studies under "suggestions for future work." Engeström's idea about expansion of systems hearkens back to Marx's original conception of the nature of work: "labor is above all a process between man and nature, a process in which man through his actions mediates, regulates, and controls his material exchange with nature" (Habermas 1971:27). When we speak of the Flight Readiness Review as a mediating instrument, we are conceptualizing it as an organizational resource conceived to accomplish work (i.e., to mediate between past and future experience) in anticipation of some future state of the system. One problem with traditional analyses of such resources—particularly those resources connected with decision making—is that they are nearly always oriented toward a fixed view of some past dysfunction of the resource, a kind of "let's-fix-what-went-wrong" mentality that only enhances the tendency to try to justify one's own actions in the wake of an organizational disaster. Often the cacophony of blame obscures the fact that the organizational decision making resource has been conceptualized in a certain, highly specific way: it is assumed *a priori* that the resource is fundamentally sound and that, if "fixed," would perform as originally intended. But surely it is evident that constraints from the past constitute only a part of the overall picture of the decision making resource. It is true that some set of conditions necessitated the formulation of the resource, but it is also the case that the resource originally was created as a new response to some set of conditions, as a break with previous decision making resources. By focusing, as Marx did, on the mediating instrument as occupying a dynamic, unfixed balance point that coordinates both past and future organizational work, activity theory forces the organizational analyst to attend to the future state of the system and to the mediating instrument's potential role in that future state.

With this general description of activity theory in hand, let us now turn to an extended illustration involving a widely-known accident, the explosion of the space shuttle Challenger.

Applying Activity Theory: The Example of the Challenger

In this section of the paper, we will examine the Challenger catastrophe to bring to light some possible applications of activity theory. Probing the Challenger incident is illustrative and analytical of something that happened in the past, whereas activity theory is designed to engage the system *as it is emerging.* The purpose of activity theory is to guide the movement of the system through its various stages of dealing with the contradictions and double-binds, empowering the actors in the system to creatively evolve new solutions with emerging contexts.

We should therefore preface our analysis by offering some caveats. First, we need fully to elaborate the distinction between activity theory as customarily employed and its illustrative use in this essay. We cannot emphasize too strongly that our analysis of the events leading up to the Challenger disaster, conducted some six years after the incident occurred in 1986, operates at a considerable remove from the use of activity theory in the organizational analyses conducted by Engeström and his associates. By definition, activity theoretical interventions may legitimately be conducted only with organizations *in process*, so that with each adjustment in organizational functioning the effects can be observed and factored into the ongoing description of organizational activity. The activity theoretical framework cannot be used to stipulate how organizational intervention "should have been" conducted.

It is certainly no exaggeration to say that the Challenger incident has received more than its share of retrospective interpretations, in both the academic and popular literature. We feel, however, that it is the very *familiarity* of this incident that makes it an ideal candidate for introducing the activity theoretical perspective. By recasting the Challenger incident in terms of activity theory, one is permitted to examine more closely what is known, or assumed to be known, about this event. One is permitted to speculate about what *might* have occurred had an alternative course of action been chosen—much the same strategy as that followed by Allison (1971) in his extended discussion of possible metaphor-frameworks for decision making in the Cuban missile crisis. Nevertheless, it bears repeating that we will not, indeed *cannot*, offer a detailed recommendation for a plan that would have prevented the catastrophe. We do, however, hope to make the activity theory perspective framework more widely available; despite the popularity of the approach in some European countries, there is a relatively small amount of information on activity theory in the United States. We feel that those who analyze human organization may then deepen their knowledge of activity theory through becoming more familiar with Engeström's work and, it is to be hoped, applying his insights to the organizational problems with which they are concerned. Our role, then, is essentially that of mediator between Engeström, whose work we have been fortunate enough to encounter, and over the last three years, to have achieved some familiarity with, and organizational analysts who may benefit from Engeström's insights. Since the new is often best explained in terms of the familiar, we exemplify Engeström's approach by analyzing the Challenger disaster, one of the most widely discussed examples of organizational dysfunction in American history.

We fully realize that such an approach runs the risk of making activity theory appear to be something that it is not, and this leads us to our second cautionary note. It is of course impossible to write about a dynamic process without arbitrarily freezing that process within the constraints of one's language. This general principle is particularly applicable to activity theory, which, as we have seen, maps the complex process of organizational change through various stages, expressing these stages and their interaction as triangular diagrams. The approach leaves itself open to criticism that it accomplishes nothing that other theories of organization have not accomplished, or worse, that it simply substitutes another set of diagrams for others already in use.

There is really no way to counter this criticism. The field of anthropology has experienced a surfeit of debates over whether one can adequately describe social life through language (as assumed in traditional descriptions of culture) or whether any such description unnecessarily reifies culture and fixes its description within the conceptual framework of the describer (as argued by so-called "postmodernist" anthropologists). Just one example of the deep divisions engendered by this controversy is Sangren's (1988) attack on the postmodernist theories of ethnography, and the frequently heated commentaries from leading anthropologists that are appended to that critique. Nevertheless, we feel that summarizing the Challenger incident is a necessary first step in explaining activity theory. Indeed, the technique of analysis of exemplars is often employed by Engeström himself; in his 1987 book (Engeström 1987b), he discusses examples both from history (the evolution of the Manhattan Project [pp. 267–278]), as well as from fiction (expansive activity in Mark Twain's *Huckleberry Finn* [pp. 175–193] and in Kivi's *Seven Brothers* [pp. 194–209]). Clearly, Engeström is "reifying" such situations only in the service of leading the reader to an understanding of activity theory principles. Given the fluidity and dynamic change involved in activity systems, there is hardly any other way Engeström could have proceeded. In similar fashion, we proceed in the awareness that our reading of the Challenger incident might superficially be assumed to be simply another of many examples of comfortable "second-guessing," safe within the confines of an untried theory, about what NASA personnel should have done. We trust it is evident that our analysis represents not an end but a beginning; based upon our recasting this well known example, it is to be hoped that organizational analysts will find stimuli to further exploration, not simply of NASA, but of other organizations as well. Like Schön (1979), we feel that the difficulty with most organizational analysis often lies in how the organizational problems are *set*, rather than with how they are solved. To begin the process of reformulating our views of organizational functioning, we begin with a necessarily "reified" reading of the Challenger catastrophe.

Our analysis will delineate the flight readiness system as one activity system within NASA's shuttle program. To do so, we will employ the following organizational schema: (1) *define the nodes of the activity triangle* that correspond to the shuttle program preparing to launch according to a given timetable; (2) *discuss the production/consumption paradox* inherent in the "24 safe flights per year" mandate; (3) *identify the primary contradictions* arising at each of the activity triangle's nodes; and (4) *demonstrate the emergence of secondary contradictions* from the primary contradictions. We will conclude with a discussion of how the present shuttle flight readiness system has emerged from the older form of the activity, impelled by the springboard of the explosion itself.

Cultural-Historical Grounding of the Challenger Accident

As is now well known, the cause of the Challenger space shuttle explosion was traced to "failure in the joint between the two lower segments of the right Solid Rocket Motor . . . [specifically] the destruction of the seals that are intended to prevent hot gases from leaking through the joint . . ." (PCSSCA 1986, v. 1:104). Precisely *how* the faulty O-ring seals came to be used on the Challenger shuttle is not so clear. Whether through organizational dysfunction or poor technical decision making, however, those who have investigated the Challenger incident (PCSSCA 1986, USHRCST 1987) agree that "both NASA and contractor management first failed to recognize [the faulty rocket booster] as a problem, then failed to fix it, and finally treated it as an acceptable flight risk" (PCSSCA 1986, v. 1:120).

Obviously, in a system as complex as the United States space program, there are available many potential activity subsystems that can be studied through activity theory. For the purposes of illustration in this paper, we have chosen a subsystem in which the primary and secondary contradictions are quite evident. We have labeled this system the "Flight Readiness System" and have depicted it graphically in Figure 3.

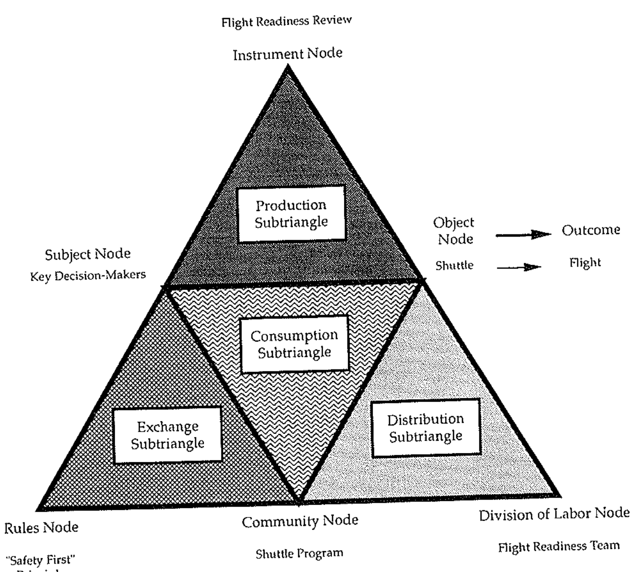


FIGURE 3. COMPONENTS OF ACTIVITY TRIANGLE REPRESENTING IDEALIZATION OF NASA'S FLIGHT READINESS SYSTEM

We have chosen to call this entity the "Flight Readiness System" because of the name given to its primary instrument, "The Flight Readiness Review" (FRR). This review is a kind of checklist that was designed to ensure that components of the shuttle were repeatedly subjected to the most stringent tests under a variety of conditions.

In its ideal form, the FRR would have flagged the defective O-rings for redesign or replacement long before the Challenger explosion, and in fact *did* do so. As the House Committee (USHRCST 1987:5) notes,

> Information on the flaws in the joint design and on the problems encountered in missions prior to [the Challenger explosion] was widely available and had been presented to all levels of Shuttle management. Despite the presence of significant amounts of information and the occurrence of at least one detailed briefing at Headquarters on the difficulties with the O-rings, the NASA and Thiokol technical managers failed to understand or fully accept the seriousness of the problem. There was no sense of urgency on their part to correct the design flaws in the SRB. No one suggested grounding the fleet, nor did NASA embark on a concerted effort to remedy the deficiencies in O-ring performance. Rather, NASA chose to continue to fly with a flawed design and to follow a measured, 27-month, corrective program.

Why would NASA choose such a course? The answer is that the priorities concerning the general direction of the agency had changed from a focus on research and development to a focus on profit. As the House Committee (USHRCST 1987:3) notes,

> . . . NASA's drive to achieve a launch schedule of 24 flights per year created pressure throughout the agency that directly contributed to unsafe launch operations. . . . Congressional and Administration policy and posture indicated that a reliable flight schedule with internationally competitive flight costs was a near-term objective. Pressures with NASA to attempt to evolve from an R&D agency into a quasicompetitive business operation caused a realignment of priorities in the direction of productivity at the cost of safety.

Utilizing this brief cultural-historical background, we can now proceed with the first step, to *define the nodes of the activity triangle* that correspond to the shuttle program (Figure 3). On the upper part of the triangle, the subject node refers to key decision makers, the instrument node to the FRR, and the object node to the shuttle itself. The remainder of the triangle can be specified as follows: the rules node as "safety first principle"; the community node as the shuttle program; and the division of labor node as the flight readiness team.

We should emphasize that Figure 3 depicts an *ideal* representation of our target activity system, an arbitrary starting point within an evolving program. This activity triangle represents how the Flight Readiness Review should have worked, or was designed to work; as the Rogers Commission noted, "It is clear that contractor and NASA program personnel all believed that the O-ring erosion anomaly, and even the launch constraint, were problems that should be addressed in NASA's Flight Readiness Review process" (PCSSCA 1986, v. 1:145). In terms of activity theory, this idealized version of the Flight Readiness

Review (FRR) may be seen as a mediating instrument that supposedly ensures that a large amount of information from the various Shuttle subsystems is evaluated by decision makers in a thorough and timely manner. The FRR is an example of the kind of institutional rationality that is so often designed to compensate for the limited decision making capacities of individual human beings, a process in which ". . . organization permits the individual to approach reasonably near to objective rationality" (Simon 1976:80). The successful flight of the Shuttle can be viewed as a production-oriented outcome (represented in Figure 3 by the arrows pointing left from the Object Node) which occurs as a result of activity generated by the key decision makers (subject node) through the mediating instrument of the Flight Readiness Review. We will further define the system's primary contradictions by elaborating conflicting forces on each of the activity triangle's six nodes.

The second step is to *discuss the production/consumption* paradox in the shuttle program. In this case, the system was to produce a shuttle that flew regularly and safely. To achieve this product, the shuttle program had overspent, i.e., consumed too much. Other sectors of the system therefore demanded that the shuttle program change its consumption practices to make itself at least partially cost-independent. Though rooted in material practices, such contradictions often have the most profound effects in the symbolic/linguistic realm, leading to what Volosinov (1973:86) termed the word's "entirely social orientation" and its inescapable ideological associations. Kruglanski (1986), writing about the Challenger disaster, cites this form of rationality as an example of the power of sociohistorical antecedents to constrain symbolic action in the present, noting that the pressures to prove the value of one's program in a highly competitive funding environment often leads to "freezing," a psychological commitment to a decision even in the face of evidence that the decision is wrong: "Top NASA managers were under great pressure to reach a decision; their desire for cognitive structure encouraged freezing on a decision to launch. Their concern for productivity and cost-effectiveness also made a position decision compelling" (Kruglanski 1986:49). The response of the NASA officials to the paradox of the conflict between NASA-as-consumer of Federal funds and NASA-as-producer of a money-making enterprise is one that is often resorted to by persons in similar situations: they reverted to a decision already settled upon, mistakenly believing that organizational procedure would make up for individual indecision. In activity theory terms, they ignore the fluidity of the activity system in favor of a static picture of how they perceive the system to have performed successfully in the past; thus, it is the ongoing nature of activity evolution that is "frozen."

The third task is to *identify the primary contradictions* emerging from this imbalance between production and consumption. In this phase of the shuttle program's development, the imbalance gives rise to a need state in the old activity system for which a new activity system is required.

Revising the diagram in Figure 3, we obtain Figure 4. Notice that on each of the nodes we have specified a contradiction. On the upper half of the triangle, the *subject* primary contradiction involves the key decision maker as having the safety of the shuttle as the top priority, versus the decision maker who is primarily cost-conscious. The *instrument* primary contradiction is between the FRR as a checklist that NASA follows "to the

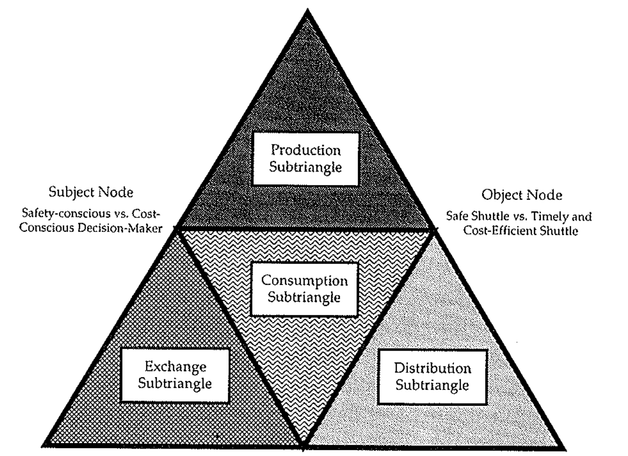


FIGURE 4. PRIMARY CONTRADICTIONS IN ACTIVITY TRIANGLE REPRESENTING NASA'S FLIGHT READINESS SYSTEM

letter" (what one might call the "hard reading"), as opposed to an FRR that NASA follows only when convenient. The *object* primary contradiction depicts a safe shuttle, versus one that flies 24 times a year *and* is cost-effective.

On the triangle's lower half, the *rules* primary contradiction places the traditional "safety first" rule against a new rule mandating a flight schedule of 24 flights per year. The *community* primary contradiction counterposes a shuttle program that depends for its resources on the United States community of defense against a shuttle program that is an emerging, self-sustaining, quasicompetitive commercial enterprise. Finally, the *division of labor* contradiction contrasts a flight readiness team which privileges the FRR in deciding whether to launch, versus one which privileges the "24 flights per year" criterion to make the decision.

Given the existence of these primary contradictions, immediate ruptures (i.e., secondary contradictions) between nodes are evident. It is important to re-emphasize that secondary contradictions are directly attributable to the production-consumption paradox. As the shuttle program was subjected to more pressure, decision makers were told simultaneously that the shuttle program must produce more and consume less; but in order to produce more, the shuttle program had to consume more. This contradiction between nodes is described by Bateson (1972) as the double-bind and applied to expanding activity systems by Engeström (1987b) as the secondary contradiction.

A dramatic example of a double-bind occurred on the night before the Challenger launch. During an argument between NASA officials and Thiokol engineers, NASA SRB head Lawrence Mulloy uttered his now-famous sentence, "My God, Thiokol, when do you want me to fly, next April?" (Anonymous 1986:42). Under the mandate of the new rule "24 flights per year," key decision makers (the subject) had to decide to launch on schedule. The "hard reading" of the FRR, however, also mandated that the decision makers could decide to fly only when the shuttle tested safe, whether such launches were timely or not. Therefore, *at least* three secondary contradictions are identifiable, given these conditions: (1) between the community and the decision makers ("A" in Figure 5); (2) between the decision makers and the instrument ("B" in Figure 5); and (3) between the rules and the object ("C" in Figure 5).

This situation is similar to the Zen parable Bateson (1972) uses to illustrate the double-bind. The story goes that a Zen student was confronted by his master, who demanded that the student state whether a stick the master held was real. The master said, "If you tell me the stick is real, I will hit you with it. If you tell me the stick is not real, I will hit you. If you say nothing, I will hit you."

Similarly, Mulloy (as one of the decision makers, the subject) is reacting to a comparable demand: if you fly without adhering to a hard reading of the FRR, you risk failure (jeopardizing your agency); if you fly only after adhering to the FRR, you risk delay and thus excessive consumption of the system's resources (jeopardizing your agency); if you do nothing, you show your ineffectualness (jeopardizing your agency). All three of these outcomes can be seen as failures.

What we have just done is to elaborate the double-bind conditions recognized within a single secondary contradiction. The astute reader may have noticed, however, that although we have chosen to elaborate only secondary contradiction "B" (between decision maker and instrument), we could equally well have chosen to treat secondary contradictions "A" and "C" in a similar way.

The reader might find it instructive to think through some of the other secondary contradictions that we have not had the opportunity to elaborate. For example, given the amount of time it took for the Discovery to fly successfully following the Challenger accident (more than two years), what might be the implications of a secondary contradiction between the instrument primary contradiction and the object primary contradiction? Is it possible for the shuttle to fly on a timely basis and still adhere to the "hard reading" of the FRR? Or, more to the point, does the choosing of one object over another (timely flight or safe flight) necessitate the choice of a certain degree of adherence to the FRR?

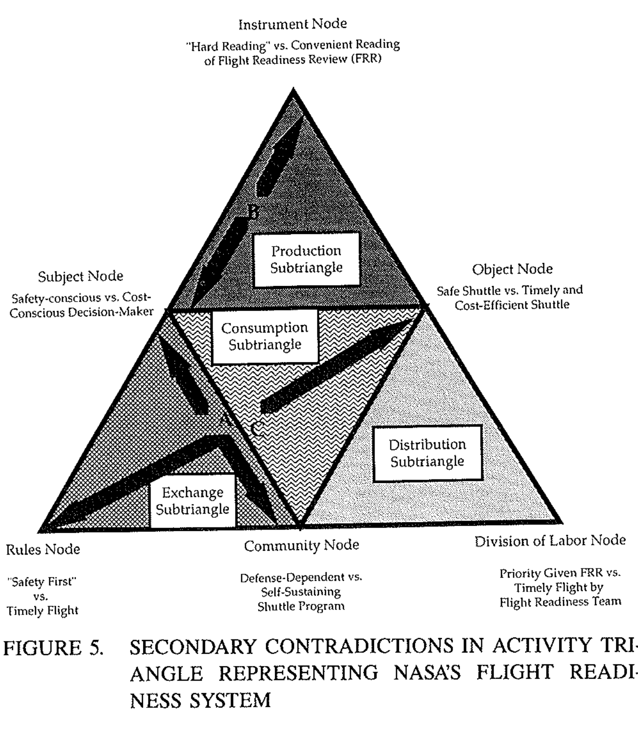


FIGURE 5. SECONDARY CONTRADICTIONS IN ACTIVITY TRIANGLE REPRESENTING NASA'S FLIGHT READINESS SYSTEM

In fact, if one chooses to look at the accident in a certain way, the explosion of the Challenger is tantamount to a *springboard* which, though a tragedy, has nevertheless served as an impetus for positive change in the flight readiness activity system. Before the explosion (that is, under the former, cost-conscious, system) the choice of competing forces on each primary node was dictated by a "bottom-line" mentality: "cost-conscious," not "safety-conscious" decision makers (subject node); "cost-efficient," not "safe" shuttle (object node); and so on.

Following the explosion, a new set of priorities emerged in line with the expanding system. For example, it was no longer possible for safety to take second place to cost-efficiency. Officials in charge of the Discovery launch have frequently asserted that no amount of pressure would compel them to launch until they were certain it was safe, in spite of the fact that the NASA of today is under even more pressure than the NASA which launched the Challenger; two years can be quite a long time for a federal agency that is "under the gun" to show results. In spite of the pressure, the priorities on several of the nodes have been *recreated* in line with the "safety first" attitude upon which NASA had built its reputation in the 1960s. It is worth re-emphasizing that the flight readiness review system is ongoing and emergent. The creation of a new state, similar to the former "safety first" state, is an expansion, because the system has now changed.

In Engeström's terms, the former system has now been placed in tertiary contradiction with a new, emerging system. Even now, one hears officials speaking, not just of the launch of a single shuttle, but of a program of shuttles that would fly regularly between Earth and space stations. Nevertheless, it is highly unlikely that any mission planner will forget the Challenger explosion, and thus, even when increased utilization of the shuttles is contemplated, it will always be with an awareness of the potential for disaster.

Conclusion

In this paper, we have proposed and illustrated by example a new and exciting tool for organizational analysis and intervention, Yrjö Engeström's *activity theory.* We have explained the foundations of activity theory through analysis of its chief antecedent, the Soviet *cultural-historical school*, demonstrating the fundamental challenge that activity theory presents to Cartesianism. Second, we have described in detail the basic unit of activity theory, the *activity triangle.* We saw how each activity system evidences a production-consumption paradox, giving rise to need states which impel system change through four types of contradiction. We saw how new specific instruments, known as *springboards*, may be used both to break the constraints of *double-binds* and to serve as the basis for further system development. Third and finally, we have shown how activity theory may be used retrospectively to conduct an analysis of the Challenger space shuttle accident.

Throughout this essay, we have referred to various aspects of organizational culture in NASA and other organizations, but have not specifically mentioned the implications of activity theory for the study of culture, broadly conceived. Activity theory represents a significant advance over previous anthropological studies of culture, such studies having tended to stress one side or the other of a dichotomy between culture-as-social-practice-and-artifact (external to the social actor) and culture-as-experience-and-interpretation (existing "within" the mind of the social actor).

While such disputes can be valuable and enlightening (D'Andrade 1984:114), the polarization characteristic of the debates between these two positions has frequently obscured the fact that, almost from the inception of cultural anthropology, anthropologists have been aware of, and have wrestled with, the requirement that they account both for the experienced world and the internal mental manifestation of that world. From Tylor's (1874) early attempts to link history with models of human logic, through the instantiation of psychological principles in descriptions of culture by Mead (1937) and the inclusion of both psychological and social categories in the Human Relations Area Files (Murdock 1963), up through the debates of the last two decades over how much of the anthropologist's own interior experience comes to be reflected in descriptions of culture (Clifford and Marcus 1986), the attention of the anthropological world has never strayed far from the problem of how one can reconcile the evident fact that the individual "inherits" culture in ways over which s/he seemingly has little or no control, with the equally evident fact that the inherited aspects of culture must be interiorized and given unique form in the consciousness of the individual (Vygotsky 1978). Efforts to fuse these views have led, not only to relentless re-examination of basic anthropological assumptions (Dwyer 1979), but to some of anthropology's most inspirational and memorable metaphors; one thinks of Benedict's (1934) "great arc" of human potential, of Kroeber's (1987) "coral reef," or of Geertz's (1973:5) "webs of significance [humans have] . . . spun."

Nevertheless, a frequent response to explicitly metaphoric descriptions of culture is precisely that they *are* metaphoric and thereby suspect for being "literary" and insufficiently rigorous to quality as science (Meyer 1984, Strauss 1990). In some sense at least, this criticism replicates the debate over whether culture is primarily internal (subjective, metaphorical, creatively generated) or external (objective and faithful-to-fact). Activity theory, combining systematic methodology to obtain the "brute facts" of organizational life with provocative and generative metaphor (best exemplified by the activity triangle itself), may offer hope for bridging the two seemingly intransigent positions of culture-as-metaphor and culture-as-systematic description. It is significant that Engeström's work so frequently incorporates the two camps of cultural description: he draws examples (as noted above) from both fiction and everyday life; he speaks as much to the human qualities of creativity in formulating culture as he does to the sociohistorical circumstances surrounding cultural inheritance; and he is as concerned with the possible as with the "actual." Put bluntly, Engeström wants to have the best of both worlds in describing culture: he wants an accurate map of human organization "as it is," and a vision of organization "as it can be." Engeström is one of only a handful of *scholars* who have assumed this perspective, but he argues that the synthesis of the actual and the possible is part of every organizational actor's life and that its effects are ongoing and constant. Activity is not, in this view, indicative of a merely innovative theoretical perspective; it is literally the life-stuff of organizations.

What further benefits have we gained from this study? The first area of benefit comes from the exposition of Engeström's ideas to the academic community. We have managed to assimilate in a reasonably succinct manner the sometimes overwhelming amount of information encountered in Engeström's *Learning by Expanding* (1987b). The reader who tries to tackle this work must be warned in advance that we have managed to touch only the barest highlights of activity theory. In fact, we have tended to concentrate only on those aspects of the theory that relate to the explanation of the activity triangle, an elaboration of its chief components, and its use as a tool of retrospective organizational analysis.

We have therefore had to skip over several highly interesting ideas that might be more relevant to an *interventionist* use of activity theory, such as the *zone of proximal development.* Engeström's work, like that of any scholar who is attempting to account for organizations in their full complexity, resists a first, second, or even third reading. Nevertheless, the effort is well worthwhile: one has a sense, upon grasping the subtlety of Engeström's thought, that here at last is a substantial and complete account of the role of individuals within organizations, as well as of the effect of organizational structure on individual actors.

Another area of benefit from our study relates directly to the Challenger incident, for at least three reasons. First, the activity model we have constructed locates the tension between the individual organizational actor's perceptions, and their awareness of what is going on in the activity system as a whole. Had Mulloy and the people at Thiokol been made aware, over extended periods of time, of the internal contradictions embodied in the activity triangle on the night of January 27, 1986, it is less likely that they would have clung so stubbornly to their individual viewpoints that a launch on the following morning would have occurred. Those who would dismiss this prediction as overly optimistic might keep in mind that an activity theoretical analysis of an organization in process involves far more than simply providing a consultant-like set of prescriptions for the organizational actors "to follow." In activity theory, the results of diagnostic procedures is just the beginning of the process of correction; from the knowledge of relatively limited dysfunctional aspects of organizational life, the activity theorist begins to explore ever widening circles of the effect of the work activity in the actor's environment. In Engeström's study of the Finnish health center (1987a), for example, one can note in one interview the discovery by one of the doctors that he has been constrained by a double bind of which he was unaware, and the subsequent, often discomforting, adjustments he had to make when confronted with this realization. In contrast to the monologic prescriptions favored by traditional organizational analysis, the process of analyzing one's organization through activity theory, together with the gradual adjustment of individuals and of the activity system as a whole, tends to objectify conflicts, making them less personal, and more a characteristic of contradictions inherent in the activity system itself.

Second, our analysis brings into serious question the assumption of the Rogers Commission (PCSSCA 1986) that contradictions are obstacles to effective organizational functioning, aspects of the system that must be "fixed." As Engeström shows, contradictions are not only inevitable in any dynamic system, but are signs that the system is growing, expanding, and evolving. In Engeström's terms, contradiction is the sign of organizational *function*, not *dys*function. Tragic though the loss of lives in the Challenger disaster may have been, there is a certain sense in which the event ensures the future safety of those in the space program by compelling actors in the system to attend more closely to the nature of their work activities.

Third and finally, activity theory may offer a way to collate a matrix of explanations provided by the Rogers Commission (PCSSCA 1986) and the House Committee (USHRCST 1987). In reading the analyses of both these investigative bodies one has a sense that certain *pieces* of the puzzle are explained in complete, even excruciating, detail (e.g., the history of the O-ring design and manufacturing flaws, the problems with chain-of-command, the improper flagging of major concerns), while a picture of what is going on in the *system as a whole* remains elusive. Application of activity theory to such a complex problem virtually forces the analyst to account for *inter*relationships among a plethora of contributing factors.

As a fitting close to our analysis, we can return to Bateson's parable of the Zen master. In that story, the student's options within the old activity system seem exhausted: whether he says the stick is real, says it is unreal, or simply says nothing, he will suffer punishment. As in many Zen parables, however, the way out of the dilemma lies not in words, but in direct action. The only way to avoid getting hit with the stick is to *seize it from the Master's hand.* By becoming conceptually aware that a new activity is possible, the student discovers the springboard which enables him to move the activity system to a new stage of development.

The Zen paradox provides an excellent metaphor through which to conceptualize the Challenger catastrophe. In the events leading up to the Challenger launch, the people at NASA, and their contractors, seemed to have exhausted their options within the framework of the old, "cost-conscious," activity system. They might have been made aware, gradually and incrementally over an extended period of intervention through application of activity theory, of the inescapable contradictions inherent in their work activity system. They therefore might have been alerted to the existence of alternatives to the "cost-conscious" activity system, and empowered to generate springboards that would have allowed them to move beyond the conflicting points of view to an awareness of the possibilities for creating new contexts for the system as a whole.

REFERENCES CITED

Allison, Graham
1971 Essence of Decision. Boston: Little, Brown.
Anonymous
1986 A Serious Deficiency. Time (March 10):38–42.
Bakhurst, David
1988 Activity, Consciousness and Communication. The Quarterly Newsletter of the Laboratory of Comparative Human Cognition 10:31–39.
Bateson, Gregory
1972 Steps to an Ecology of Mind. New York: Ballantine Books.
Benedict, Ruth
1934 Patterns of Culture. New York: Houghton Mifflin.
Bruner, Jerome
1985a Actual Minds, Possible Worlds. Cambridge, MA: Harvard University Press.
1985b Vygotsky: A Historical and Conceptual Perspective. *In* Culture, Communication, and Cognition. J. V. Wertsch, ed. Pp. 21–34. Cambridge, MA: Cambridge University Press.
Chiu, T.
1988 Whistle-blower. Life 11:17–22.
Clifford, James
1986 Introduction: Partial Truths. *In* Writing Culture: The Poetics and Politics of Ethnography. J. Clifford and G. E. Marcus, eds. Pp. 1–26. Berkeley: University of California Press.
Clifford, James and George Marcus
1986 Writing Culture: The Poetics and Politics of Ethnography. Berkeley: University of California Press.
Cole, Michael
1985 The Zone of Proximal Development: Where Culture and Cognition Create Each Other. *In* Culture, Communication, and Cognition. J. V. Wertsch, ed. Pp. 146–161. Cambridge, MA: Cambridge University Press.
D'Andrade, Roy
1984 Cultural Meaning Systems. *In* Culture Theory: Essays on Mind, Self, and Emotion. R. A. Shweder and R. A. LeVine, eds. Pp. 88–119. Cambridge, MA: Cambridge University Press.
Dwyer, Kevin
1979 The Dialogic of Ethnology. Dialectical Anthropology 4:205–224.
Engeström, Yrjö
1987a Developmental Studies of Work as a Testbench of Activity Theory. Paper presented at the Context, Cognition and Activity Conference, Stenungsund, Sweden.
1987b Learning by Expanding: An Activity-Theoretical Approach to Developmental Research. Helsinki, Finland: Orienta-Konsultit Oy.
1988 How to do Research on Activity? The Quarterly Newsletter of the Laboratory of Comparative Human Cognition 10:30–31.
Feynman, Richard
1988 "What Do You Care What Other People Think?": Further Adventures of a Curious Character (As told to Ralph Leighton). New York: W. W. Norton.
Geertz, Clifford
1973 The Interpretation of Cultures. New York: Basic Books.
Habermas, Jurgen
1971 Knowledge and Human Interests. J. J. Shapiro, trans. Boston: Beacon Press.
Holt, G. Richard and Joseph N. Scudder
1988 Reasons and Reason: Competing Views of Rationality in the Challenger Shuttle Catastrophe. Paper presented at the Annual Convention of Speech Communication Association, Boston.
Ilyenkov, E. V.
1977 The Concept of the Ideal: Philosophy in the USSR and Problems of Dialectical Materialism. Moscow: Progress Publishers.
Kroeber, Alfred
1987 The Nature of Culture. *In* Perspectives in Cultural Anthropology. H. Applebaum, ed. Pp. 80–84. Albany: State University of New York Press.
Kruglanski, Arie
1986 Freeze-think and the Challenger. Psychology Today 20: 48–49.
Leontyev, Aleksei
1978 Activity, Consciousness, and Personality. Englewood Cliffs, NJ: Prentice Hall.
Leontyev, Aleksei
1981 Problems of the Development of the Mind. Moscow: Progress Publishers.
Luria, Aleksandr
1976 Cognitive Development: Its Cultural and Social Foundations. Cambridge, MA: Harvard University Press.

Marx, Karl
1973 Grundrisse: Foundations of the Critique of Political Economy. Harmondsworth, England: Penguin Books.
Mead, Margaret
1937 Cooperation and Competition among Primitive Peoples. New York: McGraw-Hill.
Meyer, Alan
1984 Mingling Decision Making Metaphors. Academy of Management Review 9:6–17.
Murdock, George
1963 Outline of World Cultures. New Haven, CT: HRAF Press.
Perrow, Charles
1984 Normal Accidents. New York: Basic Books.
Presidential Commission on the Space Shuttle Challenger Accident (PCSSCA)
1986 Report to the President. 5 vols. Washington, DC: US Government Printing Office.
Sangren, P. Steven
1988 Rhetoric and the Authority of Ethnography: "Postmodernism" and the Social Reproduction of Texts. Current Anthropology 29:405–435.
Schön, Donald
1979 Generative Metaphor: A Perspective on Problem-Solving in Social Policy. *In* Metaphor and Thought. A. Ortony, ed. Pp. 254–283. Cambridge, MA: Cambridge University Press.
Scribner, Sylvia
1985 Knowledge at Work. Anthropology and Education Quarterly 16:199–207.
Shaw, Robert E. and Thomas R. Alley
1985 How to Draw Learning Curves: Their Use and Justification. *In* Issues in the Ecological Study of Learning. T. D. Johnston and A. T. Pietrewicz, eds. Pp. 275–304. Hillsdale, NJ: Lawrence Erlbaum Associates.
Simon, Herbert A.
1976 Administrative Behavior, 3rd ed. New York: The Free Press.
Strauss, Carol
1990 Who Gets Ahead? Cognitive Responses to Heteroglossia in American Political Culture. American Ethnologist 17:312–328.
Tylor, Edward B.
1874 Primitive Culture: Researches into the Development of Mythology, Religion, Language, Art, and Custom. Boston: Estes & Lauriat.
US House of Representatives, Committee on Science and Technology (USHRCST)
1987 Investigation of the Challenger Accident. 2 vols. Washington, DC: US Government Printing Office.
Volosinov, Valentin
1973 Marxism and the Philosophy of Language. L. Matejka and I. R. Titunik, trans. Cambridge, MA: Harvard University Press.
Vygotsky, Lev
1978 Mind in Society: The Development of Higher Psychological Processes. Cambridge, MA: Harvard University Press.
Wertsch, James V., ed.
1985 Culture, Communication and Cognition: Vygotskian Perspectives. Cambridge, MA: Cambridge University Press.