

# Matrix Organization Theory and Environmental Impact Assessment

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In recent years matrix organization theory has offered an attractive and theoretically powerful alternative to traditional bureaucratic forms of organization. Yet the claims and propositions of matrix theory have not been tested against a broad body of experience, largely because of the widely varying and incomparable circumstances of identified attempts to use the matrix approach. A set of close approximations of the matrix model, namely government efforts to do environmental impact assessment, does exist and available data based on that experience offer the potential for a limited test of the propositions of matrix theory. The authors assess whether such approximations of matrix organization attain any of the benefits attributed to the matrix approach. Our data do not support those claims of matrix theory that we are able to examine. The authors consider a defense of matrix theory and suggest a reconsideration of matrix assumptions and definitions.

Matrix organization is discussed and recommended by many administration textbooks and serious scholarly works. It is widely thought, by academics and practitioners alike, to be the epitome of modern, sophisticated management thinking. It is, in sum, a fashionable theory about organizational structure and processes, even now thirty years after its origins.<sup>1</sup> Yet the empirical base of matrix organization

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**The Social Science Journal, Volume 27, Number 3, pages 235-252.**

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theory is thin, consisting mostly of a few well-done analytic case studies and numerous anecdotal reports. Difficulty in identifying a large enough population of sufficiently comparable cases has limited empirical research to date.

We argue, however, that a large number of comparable cases approximating matrix organization do exist as a consequence of efforts of U.S. federal agencies to implement the environmental impact assessment requirements of the National Environmental Policy Act (NEPA).<sup>2</sup> We examine here several of the propositions and claims made by matrix organization theory, using survey data collected originally to assess implementation of NEPA in four federal agencies.

## BACKGROUND

The matrix form of organization is reputed to be more effective than conventional bureaucratic structures in the face of: (1) conflicting goals; (2) pressure for high information processing ability; (3) conflict over resources; (4) a changing environment; or (5) a need to reconcile and integrate diverse perspectives in and out of an organization.<sup>3</sup> According to its advocates and theorists, matrix organization achieves this greater effectiveness in otherwise adverse circumstances by appearing to violate certain traditional tenets of management and administration. As such it has been offered by enthusiasts as a post-industrial alternative to conventional bureaucratic structures.

The ideal type matrix organization has five characteristics: (1) two or more intersecting lines of authority; (2) achievement of goals through task oriented work groups; (3) cross functional task groups; (4) temporary task groups; and (5) maintenance of functional departments.<sup>4</sup> In sum, a matrix organization has a dual authority structure, with task oriented work groups drawing members from various functional departments; hence the term "matrix."<sup>5</sup> Task groups are temporary, formed to address particular problems or to achieve particular objectives; they do not replace functional departments.

As such, matrix organization subsumes a number of similar techniques and approaches: task management, program management, project management, product management, and "ad hococracy." These terms reflect the history of the matrix concept. It was used and developed by the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA) in the 1950s and 1960s, where it was first noticed by management scholars and writers. Subsequently it was widely publicized, most extensively in business management publications. The matrix organization idea became a gold mine for professional consultants, spawning a vast "how to" literature. This literature was largely anecdotal in its evidence; nevertheless, it advanced many claims.<sup>6</sup>

More serious theorists of various stripes interpreted matrix organization as consistent with the organizational humanism family of organization theories. Matrix theorists never claimed that the theory was descriptive of large numbers of organizations, nor did they claim that matrix approaches would be preferable to other organizational arrangements except in such circumstances as mentioned above. The circumstances favoring matrix organization, however, were thought to

be on the increase as society continued to become more complex, more information based, and more dynamic. Emphasis was given to the special appropriateness of matrix organization theory to the “organization of the future” and thus to the organization of post-industrial society.<sup>7</sup> In this view, matrix arrangements were appropriate for an increasing number of organizations and were liberally prescribed as an effective organizational and management strategy.

Like the “how to” literature, but with more caveats and discussion of necessary contingencies, the theoretical literature made major claims for matrix organization. Also like the “how to” literature, the empirical foundation of the serious theoretical literature has remained narrow. Much of the theorizing has been of the “arm-chair” variety and has been largely speculative. Virtually all of the conspicuous successes cited have been with large, well-funded organizations with big scientific and technical missions, for example, DOD and NASA.<sup>8</sup> Both the theoretical and the prescriptive literatures are based on a few careful in-depth case studies and many anecdotal reports.

As such, conclusions based on this small number of analyses, analyses of a few well-funded, technically oriented experiences, are of dubious external validity. Indeed, because the few well-studied examples are complex, unique, and very special, there is doubt as well about the internal validity of many conclusions about the effectiveness of matrix organization. Theorists have thus remained free to theorize, largely unencumbered by the testing, modification, and reconsideration that extensive empirical grounding would impose.

Matrix organization has always had an ideological appeal to theorists and consultants, no doubt in large part because it offers an alternative to authoritarian, hierarchical organizational structures by linking decentralization, participation, and efficiency. Matrix theory is prescriptively compatible with other ideologically attractive humanistic organizational theories. Moreover, matrix organization seems to catch the wave of the future by being responsive to emerging imperatives of post-industrial society such as transience, complexity, conflict, professionalization, and technocracy, among others. Ideological resistance to any serious challenge of matrix organization theory finds justification in the real theoretical and practical difficulties of cross-sectional empirical research. This resistance is reinforced by the value of this generally accepted and unchallenged theory to consultants, both professionals and academic part-timers.

Broader based empirical research is not, however, impossible. We report on one such research effort here, based on a large number of less special cases for which matrix organization ought to be ideally suited, and for which a matrix pattern has in fact been adopted unknowingly for a number of years: namely, the efforts of major public agencies with respect to environmental impact assessment projects. So far as we can tell, the respective research literatures of matrix organization and impact analysis have never intersected.<sup>9</sup>

In a survey of four federal agencies, Bartlett found that personnel responsible for impact assessment projects were, variously, scattered among several staffs in agencies, integrated in basic planning groups, organized in environmental experts units within planning groups, or in stand-alone environmental units.<sup>10</sup> This diversity

of experience reveals a need for some organizing concept that rationalizes and clarifies the status of EIA work groups without surrendering the independence and flexibility needed for them to have an impact on agency planning processes. Slightly over half of the respondents surveyed reported that their experience in environmental impact analysis conforms to the ad hoc approach to policy analysis described by Viteritti.<sup>11</sup> This approach closely approximates matrix organization.

Environmental impact assessment is a response to the same characteristics of post-industrial society that gave rise to matrix organization.<sup>12</sup> Both matrix organization and environmental impact assessment are tools intended to help modern societies cope with transience and complexity in the relationship between humans and their environment. Both demand, and respond to a broader demand for, high information processing ability. Both aim to make possible a tailored and flexible pursuit of conflicting goals. Both emphasize the integration of knowledge and perspectives from various disciplines in a way that resists the dominance of a technocratic world view. Environmental impact analysis, as an organizational task, is plagued by the same problems of conflict, complexity, professionalization, and technocratic thinking that matrix organization is designed to overcome.<sup>13</sup> The project dimension of EIA is fundamental; each impact assessment comprises a temporary and unique set of tasks, with boundaries, goals, and deadlines. In short, EIA can be described as an activity that should be uniquely well suited to matrix organization.<sup>14</sup>

Despite this evident opportunity to deploy knowledge of matrix organization to enhance the conduct of environmental impact assessment, scholars who have studied EIA have not examined the relevance of matrix organization theory to its practice and management. Nor have matrix organization theorists looked previously to the large body of EIA experience to check their theories, claims, and propositions. In this research we seek to explore and assess the applicability of matrix organization theory in circumstances for which it ought to be thoroughly, perhaps even ideally, suited.

## ANALYSIS

We use here survey data collected for a different purpose—that of assessing the use of science in the practice of environmental impact assessment by four federal agencies (the Corps of Engineers, the Bureau of Land Management, the Soil Conservation Service, and the Forest Service).<sup>15</sup> One question asked how each field office of these four agencies had organized its environmental sciences expertise to implement NEPA. The responses were:

- a. Scattered among several staffs in the agency with primary responsibility for other tasks, but available for consultation (43.5%);
- b. Integrated in the basic planning groups or units (26.6%);
- c. Organized in separate “environmental experts units” *under* planning groups or units (12.6%);
- d. Organized in separate “environmental experts units” *independent of* plan-

- ning groups or units in the formal organization chart of the agency (10.1%);  
and  
e. Other (please specify) (7.2%).

The open-ended explanations provided by those checking “other” showed all of these offices to be using a combination of category a with categories b, c, or d. That is, some expertise was organized in separate units or integrated in planning, but most was located in other functional units and brought together on a project basis to do environmental impact assessment.

Thus, this question provides us with our independent variable. Some field offices clearly appeared to be using a task or matrix approach to organizing environmental sciences expertise (categories a and e): functional departments were maintained and impact assessment goals were pursued though temporary, interdisciplinary, task oriented work groups made up of individuals answerable to both their home departments and the project manager.<sup>16</sup> Other offices employed a more traditional solution of adding permanent separate units or adding personnel to planning units (categories b, c, and d). Approximately half our respondents could be classified as being part of matrix organizations at the field office level (50.7%), and half as being part of more traditional staff types of offices (49.3%).

A review of the matrix organization literature produces a number of recurring propositions, including (from a much longer list) claims that adoption and use of a matrix structure in an organization will lead to:<sup>17</sup>

1. enhanced utilization of persons and resources and more effective utilization of time;
2. improved communication with the support from relevant actors outside the organization;
3. more effective interaction within the organizational environment;
4. increased clarity of and emphasis on goals;
5. greater independence from outside interests;
6. improved ability to control or influence other organizations;
7. more effective achievement of tasks; and
8. improved morale, satisfaction, and personal commitment.

This is far from an exhaustive list; rather, we tried to identify all propositions in the literature to which our data might be linked conceptually.<sup>18</sup> Where possible, we used specific items as dependent variables in examining operationalized versions of these propositions. In some cases the fit with the underlying concepts were quite good. In other cases our operational variables are more removed and less well linked conceptually, and therefore not as valid as indicators—unfortunately an unavoidable handicap of secondary data analysis.

Regarding more effective use of resources and time, responses to several items provide a perceptual test of the comparative effectiveness of matrix versus staff offices as assessed by employees. Respondents were asked how much such factors as available manpower, availability of funds for environmental studies and re-

search, availability of necessary environmental expertise in-house, a capability for specifying and monitoring the work of outside consultants, and time constraints limited their agency's ability to do environmental impact analysis. The results, broken down by our operationalization of matrix and staff, are presented in Table 1. Contrary to the expectations or predictions of matrix organization theory, respondents in matrix offices were slightly more likely than those in staff offices to find these various resources limiting. The one exception to this pattern is the "capability for specifying and monitoring the work of outside consultants," which seemed to trouble staff offices a bit more often than matrix offices. Most notable about this data, however, is that the differences between matrix and staff employees are small. Measures of association ( $\tau b$ ) are all weak, and in no instance is the difference statistically significant.

Table 1. Indirect Indicators of the Effective Utilization of Resources

	Staff N = 204	Matrix N = 210
	(percentages)	
"To what extent do the following factors typically limit your agency's ability to respond to the environmental impact analysis requirements of NEPA?"		
—Available manpower		
Very limiting	17.6	20.2
Somewhat limiting	62.3	68.1
Not limiting	20.1	11.9
	$\tau b = .09$	
—Availability of funds for environmental studies and research		
Very limiting	32.4	38.5
Somewhat limiting	49.5	47.6
Not limiting	18.1	13.9
	$\tau b = .07$	
—Availability of necessary environmental expertise in-house		
Very limiting	3.9	5.2
Somewhat limiting	48.3	54.8
Not limiting	47.8	40.0
	$\tau b = .08$	
—Time constraints (deadlines)		
Very limiting	32.4	41.4
Somewhat limiting	55.9	47.6
Not limiting	11.8	11.0
	$\tau b = .08$	
—Capability for specifying and monitoring the work of outside consultants		
Very limiting	15.7	13.5
Somewhat limiting	51.5	60.1
Not limiting	32.8	26.4
	$\tau b = .04$	

\*Significant at the .05 level

\*\*Significant at the .01 level

\*\*\*Significant at the .001 level

Table 2. Indicators of Resource Availability

	Staff N = 204	Matrix N = 210
	(percentages)	
"Are all the professional disciplines needed for the NEPA-required analyses and planning readily available in-house in your agency?"		
—Yes	70.1	56.2
—No	29.9	43.8
	tau b = $-.14^{**}$	
"Were all the professional disciplines needed for the NEPA-required analyses and planning for this [identified] project available in-house in your agency?"		
—Yes	62.4	58.5
—No	37.6	41.5
	tau b = $-.04$	

\*Significant at the .05 level

\*\*Significant at the .01 level

\*\*\*Significant at the .001 level

Whether availability of resources is limiting, of course, tells nothing about how available resources are. The only data from this survey that address this issue are from a pair of questions asking whether all needed professional disciplines were available in-house in the agency. As can be seen in Table 2, matrix employees judged disciplinary resources to be less available than did staff employees. Thus, either matrix offices were allocated fewer, or had access to fewer, disciplinary resources, for whatever reason, or else matrix employees merely perceived a greater need for, or poorer utilization of, such resources—again for what reason is unclear. Neither interpretation supports the propositions that the matrix form of organization should produce enhanced utilization of resources, improved support from outsiders, or more effective interaction within the larger organization. In any event, even though the measures of association are still weak, the responses to this question are consistent with the slight tendency for matrix employees to see resources to be a greater limit on effectiveness.

As for matrix organization improving communication with and support from outside the organization, and improving interaction within the organizational environment, the data in Table 3 provide no backing for these propositions either. Generally few respondents reported as very limiting a lack of interest or commitment from agency higher-ups, lack of involvement of decision makers in the EIS process, guidance on how to do environmental impact assessment, or indifference of lack of cooperation on the part of personnel in the field. But, again, matrix respondents were slightly more likely to judge relationships with others to be either very or somewhat limiting of their effectiveness. Again, the differences between matrix and staff responses were not huge—measures of association are all weak—but they were consistently in the same direction. And two of the relationships here

Table 3. Indicators of Enhanced Organizational Relationships

	Staff N = 204	Matrix N = 210
	(percentages)	
"To what extent do the following factors typically limit your agency's ability to respond to the environmental impact analysis requirements of NEPA?"		
—Lack of interest or commitment from agency higher-ups		
Very limiting	6.4	7.1
Somewhat limiting	26.0	37.6
Not limiting	67.6	55.2
	tau b = .12*	
—Lack of involvement of decisionmakers in the EIS process		
Very limiting	6.9	10.0
Somewhat limiting	36.5	41.4
Not limiting	56.7	48.6
	tau b = .08	
—Guidance on how to do environmental impact assessment		
Very limiting	4.4	8.6
Somewhat limiting	33.0	32.9
Not limiting	62.6	58.6
	tau b = .05	
—Indifference or lack of cooperation on the part of personnel in the field		
Very limiting	5.9	5.3
Somewhat limiting	41.1	54.1
Not limiting	52.7	40.7
	tau b = .10*	

\*Significant at the .05 level

\*\*Significant at the .01 level

\*\*\*Significant at the .001 level

are statistically significant at the .05 level—hardly an affirmation of the claims of matrix theory.

Only with respect to a capability for specifying and monitoring the work of outside consultants (Table 1 above) is any support at all, however weak, to be found for the matrix theory claim of improved management of organizational relationships with others. To the extent that the matrix claim of increased clarity of and emphasis on goals is addressed by the item concerning guidance on how to do environmental impact assessment, the data suggest that goal clarity in matrix organizations typically is not enhanced.

Related to this claim of improved interaction is the expectation that matrix organizations will be able to define for themselves greater independence from outside interests and be better able to influence other organizations. The data in Table 4 suggest otherwise. Whether the issue was the right people being consulted or involved, the lessening of dependence on sponsors or economic interests, or enabling the agency to decline unwanted projects, the differences between matrix and staff responses were similar: matrix respondents tended slightly less often to



Table 4. Indicators of Autonomy and Effective Interaction with Organizational Environment

	Staff N = 204	Matrix N = 210
	(percentages)	
“Strengthening your agency’s science capabilities because of NEPA has enabled your agency to be less dependent on information supplied by sponsors or economic interests.”		
Agree or strongly agree	47.5	38.1
Uncertain	19.6	24.3
Disagree or strongly disagree	32.8	37.6
	tau b = $-.08$	
“The right people are typically consulted and involved in the environmental impact statement analyses of proposed actions by your agency.”		
Agree or strongly agree	82.3	78.1
Uncertain	8.8	8.6
Disagree or strongly disagree	8.9	13.3
	tau b = $-.06$	
“The scientific and technical information required by NEPA has occasionally been used by your agency to decline projects that it might otherwise have been forced to accept.”		
Agree or strongly agree	57.7	52.0
Uncertain	19.2	25.0
Disagree or strongly disagree	23.2	23.1
	tau b = $-.04$	

\*Significant at the .05 level

\*\*Significant at the .01 level

\*\*\*Significant at the .001 level

agree that their agency had become more independent of outside forces. Again the differences between matrix and staff responses were not large and not statistically significant.

Responses to general questions about effectiveness, which may also reflect dimensions of morale and personal commitment, are no more supportive of matrix theory claims. The survey responses presented in Table 5 indicate that matrix employees were a little less inclined than their staff counterparts to arrive at a favorable conclusion about the general effectiveness of their current activities.

In order to check for possible confounding or spurious associations among the above variables, we analyzed the above bivariate relationships using several control variables that made sense theoretically. In addition, we sought to identify possible relationships using a multivariate logistic regression model.<sup>19</sup> This effort turned up nothing of significance.

In summary we find no confirmation of matrix organization theory. None of the matrix propositions finds support; indeed, the evidence presented here occasionally suggests the contrary of what matrix theory claims. The magnitude of the differ-

Table 5. General Indicators of Effectiveness, Morale, and Personal Commitment

	Staff N = 204	Matrix N = 210
	(percentages)	
"The environmental impact statement is a very effective instrument for implementing the broad policy objectives of NEPA."		
Agree or strongly agree	59.1	50.7
Uncertain	11.8	14.4
Disagree or strongly disagree	29.0	33.9
	tau b = -.08	
"Based on what you have seen in relation to your own agency, do you think that NEPA and its environmental impact statement requirement results in better planning and decisionmaking than would otherwise be the case?"		
—Yes	84.5	77.9
—No	15.5	22.1
	tau b = -.08	

\*Significant at the .05 level

\*\*Significant at the .01 level

\*\*\*Significant at the .001 level

ences between matrix and staff employees is never great, but the pattern is generally consistent and all the more persuasive for that reason.

### IN DEFENSE OF MATRIX ORGANIZATION THEORY?

The organization theorist wishing to salvage matrix organization theory might be expected to offer four reactions to the evidence presented here so far.

First, the offices we classified as matrix were almost as effective as non-matrix offices and in most cases the differences were not significant, in spite of matrix offices having fewer resources. Indeed, the previous limited empirical literature indicates that, in spite of a few weakly substantiated claims to the contrary, matrix approaches do not in fact thrive in circumstances of resource stagnation or contraction. The relative disadvantage that matrix offices tended to suffer in the area of availability of necessary professional expertise is documented in Table 2 above. It may be that the use of matrix approaches is more commonly adopted as an organizational strategy by some agencies or offices because of the availability of fewer professional resources. Some circumstantial support for the argument can be found in the fact that the agency enjoying the greatest availability of disciplines, the Corps of Engineers (a historically "wealthy" agency),<sup>20</sup> is also the agency least likely to employ matrix organization arrangements in its field offices (only 14.7%). The Corps, of course, is not only wealthy but it is semi-military, which might make it more prone to hierarchy and fixed relationships. Still, controlling for both agency and professional resources did not change the pattern of relationships between matrix and staff responses.

A second objection might be that what we have defined as matrix organization falls too short of being true matrix organization—it amounts to a mere facade of a true project or team approach. The purely structural elements of the matrix type are present.<sup>21</sup> But perhaps some offices we classified as matrix were in fact using a minimal, disjointed, multi- (rather than inter-) disciplinary approach. Existence of only a few such offices would greatly dilute and disguise expected associations between matrix offices and other variables. Table 6 indicates that offices we classified as matrix were a little less likely than those we classified as staff to engage in four activities that should be routine in a true matrix organization: involvement of all disciplines early in the planning process, interdisciplinary review of documents, interdisciplinary meetings, and informal interdisciplinary communication. These data suggest that a significant number of offices may be matrix in structure but not in process.

To correct for this, we developed a more demanding operationalization of matrix organization using these variables. We reclassified as matrix only those field offices meeting the structural definition *and* for which respondents had reported that

Table 6. Indicators of the Cross Functional, Interdisciplinary, Participatory Nature of Task Oriented Work Groups

	Staff N = 204	Matrix N = 210
	(percentages)	
"Does your agency provide for <i>interdisciplinary</i> scientific review of EAs or draft EISs before they are officially issued?"		
—Yes	84.4	80.4
—No	15.6	19.6
	tau b = $-.06$	
"Did you ever meet with persons representing several disciplines in a meeting organized explicitly for the purpose of discussing environmental effects, planning, or analyses for this [specified] project?"		
—Yes	94.4	86.9
—No	5.6	13.1
	tau b = $-.13^*$	
"How often did <i>informal</i> communication and coordination occur among disciplines during planning and EIS preparation for this project?"		
—Frequently or almost daily	99.0	91.7
—Infrequently	1.0	8.3
	tau b = $-.18^{***}$	
"Were all the professional disciplines involved early in the planning process, during <i>preliminary</i> investigation and evaluation?"		
—Yes	86.8	86.4
—No	13.2	13.6
	tau b = $-.01$	

\*Significant at the .05 level

\*\*Significant at the .01 level

\*\*\*Significant at the .001 level

interdisciplinary review had been done of draft documents, that all relevant professional disciplines were involved early in the planning process, that interdisciplinary meetings were held, and that informal communication and coordination occurred among disciplines frequently or almost daily. The number of offices classified as matrix dropped dramatically with this more restrictive definition, from 210 to 114, but still no statistically significant relationships emerged between matrix offices and the other measures. We repeated our multivariate logistic regression analysis and, again, found little of significance.<sup>22</sup>

The third line of defense by the organization theorist might be that there are several prerequisites for the success of matrix organization, conditions not met by all, or any, of our field offices. Among the possible preconditions mentioned in various contributions to the literature are: (1) acceptance of conflict; (2) flexibility of personnel; (3) emphasis on group processes; (4) administrative independence; (5) commitment from higher ups; and (6) skilled project leadership. For example, Chadwin writes: "Many government . . . units do fall into ad hoc matrix patterns . . . without being aware they are adopting a matrix strategy . . . They are groping toward matrix without being aware of its requirements or effects."<sup>23</sup> Certainly this is true for EIA implementation (which is why we originally became interested in it as a type of government activity rich in potential for the application of matrix organization theory).

Although we have no data here regarding acceptance of conflict, the flexibility of personnel, or the quality of project leadership, some evidence about the emphasis on group processes is offered in Table 6, indicating that many offices did not emphasize group processes. It is not clear what is meant operationally by administrative independence, but evidence is available from several questions that these field offices have some, but very limited, independence. Table 4 indicates that offices we classified as matrix have not been able to secure greater independence than have staff offices. We also have some evidence about the level of commitment of organization higher ups (Table 3), which suggests that it probably is high but again shows little difference for matrix versus staff organizational formats.

There is little else we can say about these preconditions, except that, if taken seriously, they do rob matrix organization of much of its theoretical and practical appeal. In the case of environmental impact assessment in these four agencies, it may be that the persistence of a strong bureaucratic structure overwhelms whatever positive effect of the matrix approach that may be present. Perhaps matrix organization is a very special and fragile organizational arrangement that can succeed and thrive only in very exceptional circumstances.

Similarly, a possible final line of defense for matrix organization theory would be that our operationalized definitions of matrix are simply not valid. Perhaps *all* of our cases are examples of matrix organization—that is, when EIA projects are done by functional departments of planning or environmental analysis, in fact they are still done by temporary task groups with intersecting lines of authority. Or perhaps *none* of our cases are matrix organization—for example, intersecting lines of authority may be missing.<sup>24</sup>

Here again we can say little more with the data we have than that the theory is

indeed so loose that it is difficult to pin down. If in fact “partial approximations of the matrix type of organization are no solution. . . . They fail to achieve the full benefits of matrix organization; they exhibit a marked tendency to backslide toward more traditional bureaucratic forms,”<sup>25</sup> then what exactly constitutes full approximation? And just how widely applicable is the matrix organization model? Failure of matrix theorists to grapple seriously with these sorts of questions in the scholarly literature leaves an outwardly appealing but flexible and flimsy theoretical structure. And it leaves the critic with a heightened appreciation for what people such as Popper, Kuhn, and Lakatos have had to say about the refutation or rejection of theories generally.

### Reflections on Matrix Organization

Over a quarter of a century has elapsed since the concept of matrix organization first appeared in the literature. It continues to surface in at least three important areas.

Most general texts on the subject of management, in both private and public applications, make at least a passing reference to matrix organization. For example, in describing matrix organization, Haimann, Scott, and Conner claim that it “makes both coordination and assessment of any given project easier” and it “uses technology and workers as efficiently as possible within today’s changing currents.”<sup>26</sup>

A second arena in which matrix organization fares well is the more specialized literature on organization theory. This literature examines matrix organization in greater detail than do books on general management, but with nearly as much enthusiasm. References here usually incorporate some mention of the potential hazards of the matrix type. These are generally characterized as “matrix pathologies,” situations in which the normally robust concept encounters coincidental problems.<sup>27</sup> Often the literature suggests that the matrix form requires “a type of thinking that many managers are not used to or may even resist, since it requires that some traditional assumptions about position and authority be tossed aside.”<sup>28</sup> In particular, problems of coordination in the matrix structure are often commented upon. But we are assured that these problems are not fundamentally different from those experienced by conventional bureaucracies, just relatively more likely to occur, and that the advantages of the matrix structure still outweigh difficulties of coordination.<sup>29</sup> And to demonstrate the lasting vitality of the matrix structure we may be offered the “well established” example of the committee form of governance long used in universities.<sup>30</sup>

The continuing vitality of matrix organization is also evident in a third arena, the ever growing literature on project management. This specialized literature confidently assumes that matrix organization is the superior form of organization when applied to appropriate tasks.<sup>31</sup> Authors are unanimous in their conviction that the matrix structure is ideally suited for organizations that are project driven. But they are also careful to note that matrix organization has numerous requirements for

success. These are presented as methods for avoiding matrix pathologies, not as ways to ensure that the matrix type will out-perform bureaucracy.<sup>32</sup>

The empirical research presented here calls into question the core assumption of all of this literature. We were unable to find evidence that the matrix type out-performs bureaucracy in precisely the kind of task environment where the matrix approach is indicated. Our definition of the matrix type is grounded in the most basic literature on the subject. We are dealing with temporary, cross-functional task groups operating within a framework of permanent functional departments and intersecting lines of project authority. It might be objected that this definition is narrowly structural, leaving out important intangible elements of the matrix type. For example, Davis and Lawrence define matrix as “any organization that employs a multiple command system that includes not only a multiple command structure but also related support mechanisms and an associated culture and behavior patterns.”<sup>33</sup> This focus on an entire system of organization is obviously more complex and demanding than our sparse reliance upon structure and process alone. Yet our definition shares the same minimalist character as Weber’s classic formulation of the bureaucratic type of organization which, in an earlier era, was reputed to be the ultimate in technical efficiency. In this respect, the limitations of our data become the strengths of our research. Stripped of the priority institutional support that special projects often enjoy, and in the absence of a particularly supportive organization culture, matrix organization appears to produce results no better than more orthodox approaches.

We did not begin this research as skeptics of matrix organization theory.<sup>34</sup> Initially we were optimistic about the potential usefulness of its insights and its theoretical foundations as applicable to the management of environmental impact assessment. And we fully expected to find empirical support, however diminished by a lack of understanding by organizational participants, for at least some of the claims of matrix theory. Our hope was to clarify and contribute to matrix organization theory by improving its empirical grounding. It was our disappointment in the null results of our initial data analysis that pushed us to undertake further analyses in our search for explanation and, failing there, ultimately to a more critical questioning of the theory itself.<sup>35</sup>

Perhaps it is time to consider seriously that matrix organization might not be all it was, and still is, cracked up to be—perhaps the external validity of its propositions has not been demonstrated for reasons other than the shallowness of its empirical base. If the benefits of matrix organization are attainable only under very specific circumstances, circumstances that will rarely be found in the real world, of how much value is matrix organization theory? Perhaps even under routine conditions that ought to be ideal for a matrix approach—such as environmental impact assessment—traditional, permanent organizational arrangements still will work about as well (or better) on average. Of course, perhaps we should emphasize that the matrix approach does work about as well as traditional bureaucracy—but that is damning with faint praise whether one is a critic or an advocate.

One possible interpretation of this result is that good schedule and cost performance are not the best measures of project success after all. It may be more

important that the involved and affected parties are satisfied with the outcome.<sup>36</sup> This comes close to being an admission that project success is as much a political as a managerial concept. Such an interpretation would suggest that the supportive culture and institutional allocations that are often cited as prerequisites of matrix success also determine the end product. From this point of view, matrix organization is largely a strategy of public relations.

This also helps explain the nearly universal success that is attributed to the matrix type in the case-study based literature. If the requirements for the success of an organizational format are included in the very definition of that format, failing experiences are defined out of the universe of discourse. Had Weber been allowed such latitude, there would never have been a literature on bureaucratic dysfunctions.

These observations may also help explain the elusive quality of the matrix concept. It is, in common usage, less a social scientific concept than a piece of mythology. It is an intricate weaving of functional and project threads into a recognizable fabric of organizational life. To the theoretical royalty and their consultant courtiers, it is a fabric of brilliant color and subtle texture. But to empiricists of the common class, it is barely visible.

We do not suggest that this must *necessarily* be the case. Better empirical evaluation is a challenge, not an impossibility. And we do not want to claim too much for this particular piece of research—it is not a definitive test and should not be the last word on matrix organization theory. There are some unavoidable internal threats to the validity of what we have done here, which we recognize. We do not have perfect operationalizations of every key variable—a survey designed from the beginning for the purpose of testing matrix organization theory would have many more questions that better fit the concepts at issue (Nevertheless, given the vagueness and flexibility of the theory, designing such a survey would indeed be a daunting task).

We have raised questions more than provided final answers. Even analysis based on less-than-ideal operationalizations can formulate troubling questions, force theoretical clarifications, and inspire and inform additional inquiry. That is our hope. Thus we do think that we have offered evidence that suggests—what else?—the need for further research. At the least, a rethinking of some of the fundamental assumptions, definitions, and principles underlying matrix organization theory is in order.

## NOTES

1. See Walter F. Baber, *Organizing the Future: Matrix Models for the Post-Industrial Polity* (University, AL: University of Alabama Press, 1983) for a survey of published work on matrix organization through the early 1980s. The discussion of matrix organization contained herein is derived primarily from that source. See also Anthony G. White, *Matrix Management/Public Administration: A Selected Bibliography* (Monticello, IL: Vance Bibliographies, 1982).
2. Robert V. Bartlett and Walter F. Baber, "Matrix Organization Theory and Environ-

- mental Impact Analysis: A Fertile Union?" *Natural Resources Journal*, vol. 27 (Summer 1987), pp. 605–615.
3. For further discussion of the conditions favoring matrix structures see Mark Lincoln Chadwin, "Managing Program Headquarters Units: The Importance of Matrixing," *Public Administration Review*, vol. 43 (July-August 1983), pp. 305–314; and Baber, *Organizing the Future*, pp. 40–47.
  4. When viewed as an ideal type, the matrix model does *not* contain elements relating to various behaviors and attitudes commonly associated with project management. These are less elements of a definition than they are factors influencing the success of individual projects. Baber, pp. 30–47.
  5. Baber, pp. 58–59.
  6. Baber, p. 48.
  7. Baber, especially chapter 7.
  8. An exception to this general statement can be found in C. E. Teasly and R. K. Ready, "Human Service Matrix: Managerial Problems and Prospects," *Public Administration Review*, vol. 41 (March-April 1981), pp. 261–267. See also Mary Ellen Simon, "Matrix Management at the U.S. Consumer Product Safety Commission," *Public Administration Review*, vol. 43 (July-August 1983), pp. 357–361.
  9. Except in Bartlett and Baber, "Matrix Organization Theory and Environmental Impact Analysis."
  10. Robert V. Bartlett, "Science in the National Environmental Policy Act as Perceived by Agency Personnel: Organizational Arrangements, Personnel, and Bureaucratic Constraints," in L. K. Caldwell et al., *A Study of Ways to Improve the Scientific Content and Methodology of Environmental Impact Analysis* (Springfield, Virginia: National Technical Information Service, 83-222851, 1983), pp. 286–292.
  11. Joseph Viteritti, "Policy Analysis in the Bureaucracy: An Ad Hoc Approach," *Public Administration Review*, vol. 42 (September-October 1982), pp. 466–474.
  12. Bartlett and Baber, "Matrix Organization Theory and Environmental Impact Analysis."
  13. Bartlett and Baber, pp. 611–612.
  14. For more detailed discussion of whether EIS projects constitute settings conducive to the effective use of the matrix approach, see Bartlett and Baber.
  15. The questionnaire, methodology, and results for each question are reported in Bartlett, "Science in the National Environmental Policy Act," pp. 123–373 and Appendix IV. The survey, which focused on the science dimensions of environmental impact assessment, was conducted in summer 1981 with the cooperation of the four agencies. Questionnaires were sent to two persons in each field office of each agency—one person with an environmental analyst perspective and one with an agency planner or manager perspective. Potential respondents were instructed to complete the questionnaire only if their office had been significantly involved with a project requiring an environmental impact statement in the previous three years. A total of 532 forms were distributed. The response rates exceeded 92 percent for each agency. Deducting forms returned but uncompleted because of lack of impact assessment projects still left a response rate greater than 73 percent for each agency, for a total of 416 usable responses.
  16. These offices fit very closely four of the five defining characteristics of a matrix organization. For the fifth, we can reasonably expect that in most cases two or more intersecting lines of authority were maintained to govern EIS project teams and personnel, but this may not have been true in every office. In addition to the specific responses to this question, overwhelming support for this inference can be found in an



- understanding of the legal and political requirements for the way environmental impact assessment must be done by federal agencies. See Caldwell et al., *A Study of Ways to Improve the Scientific Content and Methodology of Environmental Impact Analysis*, Serge Taylor, *Making Bureaucracies Think: The Environmental Impact Statement Strategy of Administrative Reform* (Stanford, CA: Stanford University Press, 1984) and Robert V. Bartlett, "Rationality and the Logic of the National Environmental Policy Act," *The Environmental Professional*, vol. 8 (2), pp. 105–111.
17. This is not an exhaustive or comprehensive list of matrix propositions, which would number several dozens, if not several hundreds. We have omitted here the many speculative claims that are not anchored in theoretical or scholarly empirical research and which are often advanced by a single author only. We also have omitted propositions that clearly are in no way testable using the data presented here—for example, the claim that matrix organization should make innovation easier.
  18. Nor is there anything approaching a consensus in the literature regarding the direction, importance, or exact wording of these propositions, a problem we return to later in our analysis. Here we tried to identify the core of each claim, which in the literature is sometimes accompanied by significant caveats (caveats that if accepted often make the core propositions untestable).
  19. All of the variables in Tables 1 through 5 were employed in a series of multivariate logistic regression equations. In these equations the following predictor variables were used: type of organization (matrix or non-matrix), respondent's agency, respondent type (manager-planner as opposed to environmental analyst), and three measures (one per equation) of agency resources (respondents' perceptions of the sufficiency of agency manpower, funds, and in-house expertise). The remaining variables in Tables 1 through 5 were used as dependent variables. None of the 69 coefficients for type of organization were both correctly signed and statistically significant.
  20. Jeanne Nienaber Clarke and Daniel McCool, *Staking Out the Terrain: Power Differentials Among Natural Resource Management Agencies* (Albany: State University of New York, 1985).
  21. See note 16.
  22. For example, using this more complex operationalization of matrix organization in the model described in note 19 above, only three of the 69 coefficients for type of organization were correctly signed and statistically significant at the .05 level. None of those coefficients were statistically significant at the .01 level.
  23. Chadwin, "Managing Program Headquarters Units," pp. 307, 309. For examples of this unconscious approach and the partial approximations of matrix organization it produces, see Baber, *Organizing the Future*, chapters 5 and 6.
  24. See note 16.
  25. Baber, *Organizing the Future*, p. 108.
  26. Theo Haimann, William Scott, and Patrick Connor, *Management*, 5th ed. (Boston, MA: Houghton Mifflin, 1985), p. 279.
  27. Andrew Szilagyi and Marc Wallace, *Organizational Behavior and Performance*, 3rd ed. (Glenview, IL: Scott, Foresman, 1983), p. 499.
  28. Stephen Fink, R. Stephen Jenks, and Robin Willits, *Designing and Managing Organizations* (Homewood, IL: Richard D. Irwin, 1983), p.80.
  29. Warren Brown and Dennis Moberg, *Organization Theory and Management* (New York: John Wiley, 1980), p. 107.
  30. This chilling observation is offered by, among others, B. J. Hodge and William Anthony, *Organization Theory*, 2nd ed. (Boston, MA: Allyn and Bacon, 1984), p. 451.
  31. Among the more significant recent entries as David Cleland and William King, eds.,

- Project Management Handbook* (New York: Van Nostrand Reinhold, 1988); J. David Frame, *Managing Projects in Organizations* (San Francisco: Jossey-Bass, 1987); Louis Goodman, *Project Planning and Management* (New York: Van Nostrand Reinhold, 1988); Arthur Stinchcombe and Carol Heimer, *Organization Theory and Project Management* (Oxford: Norwegian University Press, 1985); and F. L. Harrison, *Advanced Project Management* (London: Gower Publishing, 1987).
32. The outstanding example here is Bruce Baker, David Murphey, and Dalmar Fisher, "Factors Affecting Project Success," in Cleland and King, *Project Management Handbook*, pp. 902-919.
  33. Stanley Davis and Paul Lawrence, *Matrix* (Reading, MA: Addison Wesley, 1977), p. 3.
  34. Bartlett and Baber, "Matrix Organization Theory and Environmental Impact Analysis."
  35. Although our findings and conclusions are not supportive of the claims of the scholarly (and not-so-scholarly) matrix organization literature, they do fit with a body of studies that have attempted to produce empirical evidence reflecting generally on participative, organizational humanist theories of organizational design. This group of theories, which, depending on one's perspective, either includes matrix theory or has much in common with it, makes many of the same claims as those examined here. Empirical investigation of those claims has so far produced a mixed picture. See a review of this literature in Nicholas P. Lovrich, "The Simon-Argyris Debate: Bounded Rationality Versus Self-Actualization Conceptions of Human Nature," *Public Administration Quarterly* 12 (Winter 1989): 452-483.
  36. Baker, Murphey, and Fisher, "Factors Affecting Project Success," p. 919.