Matrix Management: Contradictions and Insights

Erik W. Larson, David H. Gobeli

Matrix management has been championed by many as the best way to manage the development of new products and services.¹ Born out of the aerospace race, matrix management is a “mixed” organizational form in which normal hierarchy is “overlayed” by some form of lateral authority, influence, or communication. In a matrix, there are usually two chains of command, one along functional lines and the other along project lines. Perhaps published, during the early 1970’s, a list of matrix users which included such prestigious companies as American Cyanamid, Avco, Carborundum, Caterpillar Tractor, General Telephone and Electronics, Hughes Aircraft, ITT, 3M, Monsanto Chemical, TRW, and Texas Instruments.²

While matrix enjoyed widespread popularity in the seventies, discord has begun to surface in the eighties. For example, Texas Instruments reportedly dumped its matrix system, citing it as one of the principle reasons for economic decline.³ Medtronic, one of the leading producers of cardiac pacemakers, scrapped its formal matrix system after two years of frustration.⁴ Similarly, Xerox recently abandoned matrix, claiming that it had created a stranglehold on product development.⁵ Probably the most damning criticism can be found in the popular In Search of Excellent, in which Peters and Waterman assert that the tendency toward hopelessly complicated and ultimately unworkable structures “reaches its ultimate expression in the formal matrix organization structure [which] regularly degenerates into anarchy and rapidly becomes bureaucratic and non-creative.”⁶

Is matrix management an unworkable system that eventually stifles the development of new products and services? Or is matrix management an effective mechanism for managing development projects in organizations? Hard evidence on the efficacy of matrix is virtually nonexistent. For the most part the literature consists of anecdotal success or failure stories. We believe that the issue has been obscured further by failing to recognize that there are different types of matrix. We further contend that the mixed reviews of matrix pertain more to different types of matrix rather than to matrix management in general.

While matrix has been applied to a number of different contexts (i.e., financial services, hospitals, construction), our focus is on its application to product
development. To pursue this issue, we sampled over 500 managers, experienced in the development of new products and services, and collected data regarding both the usage and effectiveness of different matrix structures in their company. Before reporting the results, three different forms of matrix structures will be described and their relative advantages and disadvantages discussed.

**Three Matrix Structures**

Galbraith has distinguished different forms of matrix on a continuum which ranges from the functional organization to the pure project organization. The functional organization is the traditional hierarchical structure in which the organization is usually broken down into different functional areas, such as engineering, research, accounting, and administration. When applied to a product development effort, the project is divided into segments and assigned to relevant functional groups with the heads of the functional groups responsible for their segments of the projects. Coordination is provided by functional and upper levels of management.

At the other end of the spectrum is the project organization, in which all the resources necessary to complete a project are separated from the regular functional structure and set up as a self-contained team headed by a project manager. The project manager has direct authority over all the personnel on the project.

Matrix organizations lie between these two extremes by integrating the functional structure with a horizontal project structure. Instead of dividing a project into separate parts or creating an autonomous team, project participants report simultaneously to both project and functional managers. The open violation of the principle of unity of commands is the trademark of a matrix management.

Companies apply this matrix arrangement in a variety of different ways. Some organizations set up temporary matrix systems to deal with specific projects while matrix may be a permanent fixture in other organizations. In addition, specialists may work full-time on one project or contribute to a variety of projects. One useful way to examine different forms of matrix
management is in terms of the relative influence of project and functional managers; three different forms of matrix can be identified.

A Functional Matrix occurs when the project manager’s role is limited to coordinating the efforts of the functional groups involved. Functional managers are responsible for the design and completion of technical requirements within their discipline. The project manager basically acts as a staff assistant with indirect authority to expedite and monitor the project. Conversely, Project Matrix refers to a situation in which the project manager has direct authority to make decisions about personnel and work flow activities. Functional managers’ involvement is limited to providing services and advisory support. Finally, a Balanced Matrix is one in which the project manager is responsible for defining what needs to be accomplished while the functional managers are concerned with how it will be accomplished. More specifically, the project manager establishes the overall plan for completing the projects, integrates the contribution of the different disciplines, sets schedules, and monitors progress. The functional managers are responsible for assigning personnel and executing their segment of the project according to the standards and schedules set by the project manager. The merger of “how and what” requires both parties to share responsibility and authority over work flow operations. Table 1 summarizes these descriptions as well as the functional and project organization for reference.\(^8\)

Matrix is essentially a compromise between the traditional functional organization and a pure project organization. It is more flexible than a functional organization but not as flexible as a project team. At the same time, it is more efficient than a project team, but incurs administrative cost which is unnecessary in a functional organization. Table 2A summarizes the major advantages and disadvantages reported in the literature.

Many of the problems associated with matrix are in contradiction with its strengths. Critics have described matrix as being costly, cumbersome, and overburdening to manage, while proponents praise its efficiency and flexibility. Everyone agrees that matrix is a delicate system to manage, but few have discussed the relative efficacy of different types of matrix. With this in mind, the three types of matrix structures will be compared according to the
advantages and disadvantages associated with matrix. Table 2B summarizes the tentative conclusions of this discussion.

**Advantages:**

- *Efficient Use of Resources* – All three forms of matrix allow specialists as well as equipment to be shared across multiple projects.
- *Project Integration* – Granting the project manager more control over work activities should increase project integration, but at the same time quality may suffer since input from functional areas is less concentrated.
- *Flexibility* – The multidisciplinary involvement inherent in all three kinds of matrix should enhance flexibility and adaptive reactions. This should be especially true for the Balanced Matrix in which consensus through give-and-take are necessary to win joint approval. The Functional Matrix and Project Matrix are likely to be less flexibly since authority is more clearly defined, making decisions less negotiable.

**Table 1. Project Management Structures**

<table>
<thead>
<tr>
<th>Functional Organization:</th>
<th>The project is divided into segments and assigned to relevant functional areas and/or groups within the functional areas. The project is coordinated by functional and upper levels of management.</th>
</tr>
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<tbody>
<tr>
<td>Functional Matrix:</td>
<td>A person is formally designated to oversee the project across different functional areas. This person has limited authority over functional people involved and serves primarily to plan and coordinate the project. The functional managers retain primary responsibility for their specific segments of the project.</td>
</tr>
<tr>
<td>Balanced Matrix:</td>
<td>A person is assigned to oversee the project and interacts on an equal basis with functional managers. This person and the functional managers jointly direct work flow segments and approve technical and operational decisions.</td>
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</table>
Project Matrix: A manager is assigned to oversee the project and is responsible for the completion of the project. Functional managers’ involvement is limited to assigning personnel as needed and providing advisory expertise.

Project Team: A manager is put in charge of a project team composed of a core group of personnel from several functional areas and/or groups, assigned on a full-time basis. The functional managers have no formal involvement.

- Information Flow – Vertical information flow should be enhanced under all forms of matrix; since one of the roles of the project manager is to be a central communication link with top management. Lateral communication, however, should be strongest in a Balanced Matrix. This is probably due more to necessity than design. Shared decision making places a premium on close communication through which agreements are eventually shaped. Conversely, lateral communication may suffer a bit under a project using Functional Matrix since the project manager and functional managers are not as dependent upon each other as in a Balanced Matrix.

- Discipline Retention – A key advantage that matrix has over the pure project team approach is that it allows participants to sustain their link with their functional area while working on multidisciplinary projects. This not only provides a home port for specialists to return to once work on the project is completed but also helps participants to remain technically sharp in their discipline. Still, the ability of participants to maintain ties with their specialty area is likely to decline as their involvement becomes more and more under the jurisdiction of the project manager.

Table 2A. Advantages and Disadvantages of a Matrix Organization

Advantages
+ Efficient use of resources – Individual specialists as well as equipment can be shared across projects.
+ Project integration – There is a clear and workable mechanism for coordinating work across functional lines.
+ Improved information flow – Communication is enhanced both laterally and vertically.
+ Flexibility – Frequent contact between members from different departments expedites decision making and adaptive responses.
+ Discipline retention – Functional experts and specialists are kept together even through projects come and go.
+ Improved motivation and commitment – Involvement of members in decision making enhances commitment and motivation.

Disadvantages
- Power struggles – Conflict occurs since boundaries of authority and responsibility deliberately overlap
- Heightened conflict – Competition over scarce resources occurs especially when personnel is being shared across projects.
- Slow reaction time – Heavy emphasis on consultation and shared decision making retards timely decision making.
- Difficulty in monitoring and controlling – Multidiscipline involvement heightens information demands and makes it difficult to evaluate responsibility.
- Excessive overhead – Double management by creating project managers.
- Experienced stress – Dual reporting relations contributes to ambiguity and role conflict.

- Motivation and Commitment – Inherent in all types of matrix is a high degree of involvement in decision making, which should enhance personal commitment and motivation. Team spirit, however, is likely to be higher under a Project Matrix since participant involvement is more project focused. Still, many specialists find interacting with different types of people and performing a wide range of activities frustrating. It is difficult to conclude which structure will elicit the highest levels of commitment and motivation.
Table 2B. Comparative Advantages and Disadvantages of Three Types of Matrix Structures

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Functional Matrix</th>
<th>Balanced Matrix</th>
<th>Project Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Resource efficiency</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>+ Project integration</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
</tr>
<tr>
<td>+ Discipline retention</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>+ Flexibility</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>+ Improved information flow</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>+ Improved motivation and commitment</td>
<td>Uncertain</td>
<td>Uncertain</td>
<td>Uncertain</td>
</tr>
</tbody>
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<table>
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<tr>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>- Power struggles</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>- Heightened conflict</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>- Reaction time</td>
<td>Moderate</td>
<td>Slow</td>
<td>Fast</td>
</tr>
<tr>
<td>- Difficulty in monitoring and controlling</td>
<td>Moderate</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
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Disadvantages:
- *Power Struggles* – Matrix is predicated on tension between functional managers and project managers who are in competition for control over the same set of resources. Such conflict is viewed as a necessary mechanism for achieving an appropriate balance between complex technical issues and unique project requirements. While the intent is noble, the effect is sometimes analogous to opening Pandora’s box. Legitimate conflict spills over to a more personal level, resulting from conflicting objectives and accountabilities, disputes about credit and blame, and attempts to redress infringements on professional domains. The Balanced Matrix is more susceptible to these kinds of problems since power and authority are more negotiable under this system. Power
struggles should be reduced under functional and project matrixes since the relative authority of each party is more clearly defined.

- **Heightened Conflict** – Any situation in which equipment and people are being shared across projects lends itself to conflict and competition for scarce resources. A Functional Matrix, however, should alleviate some of these problems since specialists can directly appeal to their functional superior to resolve conflicting demands on their time and energy.

- **Reaction Time** – While shared decision making enhances the flexibility of the Balanced Matrix, the drawback is the time necessary to reach agreement. The Project Matrix should produce faster results since the project manager is not necessarily bound to a consensus style of decision making, which is formalized in the Balanced Matrix. For the same reason, the Functional Matrix should be quicker than the Balanced Matrix, but not as fast as the Project Matrix since decision making has to be coordinated across functional lines.

- **Monitoring and Control** – Matrix is susceptible to passing the buck, abdication of responsibility, and cost accounting nightmares. This is particularly true for Balanced Matrix in which responsibility is explicitly shared across functional and project lines. While in principle each functional area is responsible for its particular segment of the project under a Functional Matrix, contributions naturally overlap, making it difficult to determine accountability. The Project Matrix centralizes control over the project, permitting more efficient cost-control and evaluation systems.

- **Excessive Overhead** – All three forms of matrix increase administrative overhead by instituting the role of project manager. Administrative costs, in the form of salaries, are likely to be higher for the Balanced and Project forms of matrix due to the greater roles of the project manager.

- **Experienced Stress** – The very nature of development projects tend to make it a very stressful experience for participants. Matrix management appears to exacerbate this problem. Multiple reporting relationships and divided commitment across projects heighten role conflict and ambiguity. Stress is likely to be a more serious problem where ambiguity is the greatest: the Balanced Matrix. Both the Functional Matrix and the Project Matrix are likely to reduce ambiguity and associated stress, since lines of authority and responsibility are more clearly defined.
Overall, these comparisons indicate that the advantages and disadvantages associated with matrix are not necessarily true for all three forms of matrix and that each type of matrix has its own unique set of strengths and weaknesses. The comparisons also suggest that the Project Matrix is superior in many ways to the other two forms of matrix. The Project Matrix is likely to enhance project integration, increase reaction time, diminish power struggles, and improve the control and monitoring of project activities and costs. On the down side, technically quality may suffer since functional areas have less control over their contribution.

The Functional Matrix is likely to improve technical quality as well as provide a better system for managing conflict across projects. The Achilles’ heel is that functional control is maintained at the likely expense of poor project integration. The Balanced Matrix represents a compromise between the two extreme approaches and as such shares to a lesser degree several of the advantages of the two other approaches. At the same time, it is the most delicate system to manage and is more likely to succumb to many of the problems associated with matrix.

The questions that need to be addressed are: What has been the experience of actual companies with these different matrix structures? Which form of matrix is the most widely used? More to the point, does practice support theory? Do practitioners support our conclusion that the Project Matrix is the most effective form of matrix for developing new products and services?

The Study
This study is part of a research program sponsored by the Project Management Institute (PMI). PMI is the professional association for practitioners of project management and has over 5,000 members worldwide. Data were collected by means of a mailed questionnaire which was sent to randomly selected PMI members in both Canada and the United States. Repeated mailings yielded a 64 percent response rate. This study is based on the 510 respondents who reported that they were primarily involved in development projects directed at creating new products, services, and/or processes.

Over thirty percent of the sample were either project managers or directors of project management programs within their firm. Sixteen percent were members
of top management (i.e., president, vice-president, or division manager), while 26 percent were managers in functional areas such as marketing, operations, and accounting. Eighty percent share the common experience of having been a project manager at some time during their career.

The sample represents a wide variety of industries. For example, 14 percent were involved in developing pharmaceutical products, 10 percent were in aerospace, and 10 percent were involved in developing computer and data processing products. Among the other industries represented in lesser numbers are telecommunications, medical instruments, glass products, petrochemical products, software development, and housewares goods.

As we report our findings, we are keenly aware that individual perceptions do not provide the best basis for drawing inferences about effectiveness. Still, the breadth of the study provides a useful referent point for assessing the current status of matrix in North America.

Matrix: Usage

In order to ascertain experience with matrix, respondents were asked two questions: Has your organization ever used matrix management to develop new products or services? If so, what is the likelihood matrix will be used again? If they responded that it would not be used again, then they were asked to state the reasons why. Figure 1 represents the results for these two questions.

Over three-quarters of respondents reported that their company has used matrix. Of those who responded yes, 89 percent felt that matrix would probably or definitely continue to be used. Only 1 percent reported that matrix would definitely not be used again. Among the reasons
given for dropping matrix were breakdowns in coordination between functional and project managers, a shift towards using project teams to complete projects, and the size of their organization was too small to take advantage of a matrix system. Still, the overwhelming opinion was that matrix is the dominant mode for managing development projects in the organizations sampled and will continue to be so.

These results address matrix in general. The usage of the three types of matrix was measured by having respondents indicate the number of current projects (“many”, “few”, or “none”) in their organization that utilized each structure (see Figure 2). Respondents based their responses on a capsule description of each structure (as presented in Table 1).

![Figure 2. Usage of Different Matrix Structures](image)

All three forms of matrix were widely used. Project Matrix was the most popular, with over 78 percent of the respondents reporting that this form of matrix was being used to manage development projects in their company. Seventy-four percent reported that their firm used the Functional Matrix while 68 percent reported using the Balanced Matrix.

Since size affects economies of scale, availability of resources, and integration requirements, usage rates for the different structures were compared to the size of the firm. The only significant variation occurred in companies with less than
100 employees. Over 84 percent of respondents working in small firms reported using a Project Matrix while the usage levels were lower for both the Balanced Matrix (62 percent) and Functional Matrix (56 percent). No differences were revealed in the usage patterns of large and medium-sized firms.

Matrix: Effectiveness – Respondents were asked to rate the effectiveness of each of the matrix structures they had experienced. Controlling cost, meeting schedule, and achieving technical performance parameters were among the factors considered in evaluating the different structures. The average rating for each form of matrix is reported in Figure 3. The results indicate a strong preference for the Project Matrix, which was rated above effective. The Balanced Matrix was considered effective, while the Functional Matrix was rated below effective.

The ratings for the total sample are somewhat clouded by the fact that not all the respondents had direct experience with each of the three matrix structures. A more valid reference point can be obtained from the 123 respondents who had direct experience with all three structures. Their ratings are also reported.
in Figure 3, and here the pattern is further reinforced. The Project Matrix received the highest rating while the Functional Matrix was rated as ineffective. The Balanced Matrix received only a marginal rating.

Potential variations in the above results were examined for the size of the firm. One of the reasons mentioned for dropping matrix was that the organization was too small to sustain a matrix structure. However, when effectiveness ratings were examined according to size of the firm, size had little impact on the ratings. For example, both respondents in firms of less than one hundred employees and respondents in firms of greater than 1,000 employees rated Project Matrix as the most effective.

The results indicate a strong preference for a Project Matrix in which the project manager has primary responsibility and control over development activities. These results may have been tempered by self-interest since a significant portion of the sample was project managers. To examine this potential bias, the ratings of project managers were compared with those of top management and managers in other functional areas. These results revealed only minor differences in the ratings of the three groups. Top management, project managers, and even functional managers were in agreement that the Project Matrix is the most effective form of matrix. The Functional Matrix was considered the least effective, even by functional managers.

**Discussion and Conclusions**

While matrix might be viewed as being cumbersome, chaotic, and anarchical by critics, it is still widely used by North American businesses. Over three-fourths of the respondents reported that their organization has tried matrix and will continue to use it. These results contradict the notion that the popularity of matrix is waning, suggesting instead that matrix is the dominant mode for completing development projects. The support is strong, but not without reservations. The following comment from one respondent is typical of the feelings toward matrix management: “Matrix management works, but it sure seems difficult at times. All matrix managers must keep up their health and take stress tabs.”

More specifically, all three forms of matrix were popular, with the Project Matrix having a slightly higher usage rate than either the Balanced Matrix or the
Functional Matrix. Size of the firm affected usage patterns only with regard to small firms which were found to have a much stronger preference for the Project Matrix. The effectiveness data confirmed our prediction concerning the relative efficacy of the different matrix structures. The Project Matrix was consistently rated superior to the other two forms of matrix. The Balanced Matrix received a marginal rating, while the Functional Matrix was considered ineffective. These effectiveness ratings were not affected by the size of the firm.

The results of this study reveal an interesting contradiction. If the Project Matrix form is considered the most effective, why are the other two forms used nearly as often?

One explanation for this contradiction can be found in the work of Davis and Lawrence. They argue that matrix systems tend to evolve over time, beginning first with a Functional Matrix, followed by a shift towards a Balanced Matrix, and ultimately maturing into a Project Matrix. The comparable usage patterns among the matrix structures suggests that the organizations sampled may be at different stages of matrix development.

A related factor is resistance to change. Matrix management, especially the Project Matrix form, represents a radical departure from the conventional functional approach to organizing. Such change is likely to evoke strong resistance. This is especially true among functional managers, who perceive their authority being usurped by the project manager. Since authority typically resides along functional lines before the introduction of matrix, it would seem only natural that vested interests play a role in choosing a weaker form of matrix. Several project managers commented that their company’s reliance on a Functional Matrix was politically motivated and that their functional counterparts strongly opposed expanding the role of project managers over projects.

This condition also underscores once again the need to recognize that not all matrix structures are the same. Our position is that much of the recent criticism leveled at matrix is more relevant to the balanced and functional forms of matrix. Conversely, much of the support for matrix probably comes from those using the Project Matrix form. While more rigorous studies are
needed to substantiate this claim, the responses from practitioners in this study support this argument. The final lesson to be learned is a relatively simple one: managers who are concerned with the development of new products and services should consider moving to a Project Matrix if they haven’t already done so, especially if they see the disadvantages of a Functional Matrix and a Balanced Matrix occurring in their firm.

References


9 Stanley Davis and Paul Lawrence, op. cit.