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Zohar Laslo
SCE –Shamoon College of Engineering

The Adjustment of Locus of Influence and Organizational Forms Towards Better Project Portfolio's Performance

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Project managers support the idea that successful projects occur when the resources necessary for their work are obtained. Functional managers support the idea that resources should be made available based on the overall needs of the organization. In fact, organizations are much more complex entities as different project groups compete for scarce resources. One successful project may divert essential resources from other projects and thereby prevent the organization from achieving an overall successful performance. Thus, in contrast to the customary emphasis on the needs of individual projects when thinking about matrix forms, effective implementation calls for an 'optimized' equilibrium between the satisfaction of goals of the different organizational units. The paper introduces some insights about the implementation of matrix forms in high-tech project portfolios where uncertainty, ambiguity, and complexity are looming.

Keywords: project portfolio, matrix forms, locus of influence, flow of resources, purchase policy, setting priorities, low-tech environment, system dynamics model.

1. Introduction

The matrix structure has become the popular organizational framework for managing the development of new products and services (Perham, 1970) and the primary organizational means for maintaining an efficient flow of resources in project portfolios. This structure operates through a two-dimensional system of control: a projectline chain of command and a functional chain of command (Lawrence et al., 1982). Within the matrix, each chain of command keeps its traditional role and takes responsibility for goals as in the two earlier hierarchical forms of organization (Lawrence &Lorsch, 1967). Project managers retain responsibility for developing products, while functional managers concentrate on the organization's capability to make use of up-to-date technical knowledge. In order to complete a job, functional managers must address different objectives and priorities than project managers. The different objectives are based on functional managers' focus on long-term effectiveness, while project managers concentrate on more immediate accomplishments (Allen et al., 1988; Project Management Institute, 1997). The matrix organization attempts to combine the advantages of functional structures with product-oriented structures so as to create synergism by a shared responsibility between project and functional management. A balance between these often opposing forces in an organization was presumed to lead to an optimum balance between product completion and technical excellence (Katz & Allen, 1985). In matrix organizations, both lateral and hierarchical dimensions of matrices depend on one another and neither stands alone (Joyce, 1985). Organizations using matrix structures were expected to keep up with new technologies while obtaining savings in a more efficient assignment of human and physical resources.

Important issues that loom high in the management of R&D projects are those of uncertainty, ambiguity, and complexity (Pich et al., 2002). To survive, high-tech companies must cope with the effects these issues may produce. Burton &Obel, (1998) recommend the matrix configuration for high uncertainty environments,because matrix management allows for a greater ease in loaning an employee to another project without making the change permanent. In any event, it is easier to accomplish work objectives in an organizational structure such as matrix, where task loads are shifting rapidly between departments.

While the matrix enjoyed widespread popularity in the 1970s, discord about the effectiveness of the concept surfaced in the 1980s. Shortcomings in the matrix form of organization became evident as functional and project managers were found to compete detrimentally for organizational resources (Peters & Waterman, 1984). Project managers seek to obtain resources to meet any unanticipated circumstance by either expanding existing capacities or contracting for services from external suppliers. In contrast, functional managers oppose indiscriminate accumulation of assets by a project; they usually reject attempts to outsource work because of possible underemployment of firm personnel. A project portfolio adds another set of disagreements when project managers compete against each other for the allocation of scarce resources (Platje et al., 1994; Payne, 1995). These disagreements may be destructive according to evidence that high intensity conflicts revolve around items such as scheduling, priorities, and manpower (Thamhain&Wilemon, 1974).

Critics of the matrix, however, describe an inherent propensity for conflict among managers, which substantially limits its effectiveness. Although conflicts may actually encourage more effective information exchange that can improve decision making (Stasser& Titus,1985), this positive effect breaks down quickly when conflict becomes more intense (De Dreu&Weingart, 2003). Larson &Gobeli (1987) argued that even when conflict in the matrix was kept to a low level, shared decisionmaking caused slow reaction times and made it difficult to evaluate responsibility. Moreover, the strife reduces job satisfaction for functional managers (Turner et al., 1998) and results in contradictory policies that lead to a misallocation of resources and reductions in organizational effectiveness (Martin,1994; Cardullo, 1996). However, high intensity conflicts and an unbalanced power of influence are the most substantive failures of matrix implementation (Davis & Lawrence, 1977). High-tech companies, however, must survive in a dynamic environment and the matrix retains its popularity as the solution for rapidly changing marketplaces and technologies (Grinnell & Apple, 1975).

This paper surveys research carried out over a decade in which implementations of matrices seeking improved project portfolio performance have been investigated. This research has introduced new paradigms for matrix implementations due to the increased complexity of projects, especially those relative to uncertainty. A system dynamics model was developed and implemented for such complex high-tech environment, a milieu with high uncertainty in meeting project deadlines and with intensive competition over scarce resources.

2. The low-tech case

The first category in organizational classification is the low-tech case—an environment not involving scarce resources of unique specialization. Total shared resource capacity is not a constraint, because a shortage of internal resources can be reinforced through the import of external capacities that can be provided by subcontractors in a fairly rapid response time.In this environment the matrices can be classified into the following fundamental types (Laslo & Goldberg,2008):

1. Project matrices, so-called ‘profit and cost centres’.

2. Functional matrices, so-called ‘megaprojects’.

In project matrices power is given to project managers. The common configuration of these matrices is based on the following basic principles:

1. The project manager has full control over a project budget and is authorized to take independent make-buy decisions.

2. The functional unit manager allocates resource capacity without discrimination among projects (the same price, no project preferences, or project priorities).

The second principle is relevant for a high-tech case but not for a low-tech case,because in the latter environment each project manager is permitted to achieve full satisfaction of needed resources from external sources (outsourcing).

In functional matrices power is given to functional managers. The functional managers do not allocate resources to the projects, but rather, the resources are directly allocated to project activities, taking their criticality into consideration. The common configuration of these matrices is based on the following basic principles:

1. The functional manager allocates resources according to present or future internal capacity, and agrees to take external buy decisions only when this does not threaten the future employment of organizational resources.
2. The functional manager allocates internal resource capacity without discrimination (the same price, no preferences or priorities).

In the low-tech case, the principle of allocating internal resource capacity without discrimination is common to both project and functional matrices; the difference between these fundamental forms derives only from the 'make internally' or 'buy externally' policy (see Table 1).

Tab.1: Fundamental matrices associated with the lowtech case

Make or Buy Policy	MatrixForm
Full satisfaction of projects' needs	Project matrices
Partial satisfaction of projects' needs	Functional matrices

It is clear that project managers will prefer matrices where they have full control of the budget and where they are authorized to take independent make-buy decisions. Project matrices provide freedom to obtain all resources seen as needed to implement programs.

For the functional manager, the project matrices can be seen as a disaster. These matrices prevent reasonable planning for future employment of the organization's capacities. Functional managers seek functional matrices so they can control when and how projects are given additional resources, often on the basis of outsourcing.

The different preferences of the matrices in a low-tech environment are shown in Table 2.

Tab. 2: The lowtech case: Preferences of matrices

Matrices From the Aspect of ...	ProjectMatrices	FunctionalMatrices
The project manager (P)	Best matrices	Worst matrices
The functional manager (F)	Worst matrices	Best matrices

The traditional description of confrontations occurring within a matrix organization is shown in Figure 1.

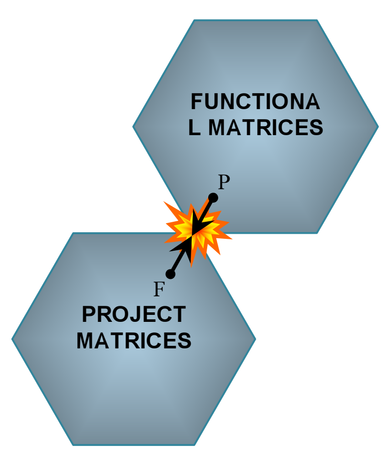

Fig. 1: The lowtech case: Single front of confrontation

The implementation of project matrices by an organization is never acceptable to functional managers (F) who pursue functional matrices. This aspiration by functional managers will be opposed by a coalition of project managers (P) involved with both favoured and unfavoured projects. In contrast, functional managers will do everything to prevent moves to project matrices.

This confrontation is intrinsic to the nature of the managerial positions. Davis & Lawrence (1978) suggest that because power struggles occur when managers share authority, organizations should seek ways to prevent conflict from reaching destructive heights.

3. The high-tech case

Laslo & Goldberg (2008) consider the high-tech case as one where organizational technological specialization causes difficulties in achieving additional resource capacities in a rapid response time, although reinforcement by external capacities is legitimate. The allocated capacities of scarce resources are constraints that determine progress in the implementation of a project.In this environment the matrices can be classified into three fundamental types:

- Project matrices.
- Balanced matrices (prioritized resource allocations).
- Functional matrices.

Project matrices are the same in both the high-tech and low-tech environments. Moreover, the basic principles of these matrices remain the same. In contrast to the low-tech situation, however, in the high-tech situation, resource allocation without discrimination becomes a real decision alternative. When the organization maintains a monopoly over scarce resources, it would have difficulty supplementing those resources through external purchase. In both low-tech and high-tech environments, functional matrices are based on the same principles.The balanced matrices are unique to the high-tech environment. Where scarce resources are involved, an organization's readiness and ability to purchase those resources externally cannot satisfy the resource needs of the projects—external resource unavailability trumps both readiness and ability to pay.Limited capacities must be shared somehow between favoured and unfavoured projects.

In the balanced matrices, greater power goes to favoured project managers and to functional managers who deal with unfavoured project managers. The configuration of these matrices is based on two principles:

1. The functional manager allocates organizational resource capacity according to directed priorities - usually to the favoured projects, while unfavoured projects have to manage with the remaining resources.
2. The make-buy policy is usually differential and determined by a project's priority.

With the virtual impossibility of a differential make-buy policy because of an inability to obtain further scarce resources, instead of two fundamental matrices involving differential project treatment, we define only one fundamental form. So, the high-tech case can be described through three fundamental matrices based on two dimensions: the make-buy policy and the priority policy (see Table 3).

Tab. 3 Fundamental matrices associated with the hightech case

Priority Policy Make or Buy Policy	Equal Resource Allocations	Prioritized Resource Allocations
Full satisfaction of projects' needs	Project matrices	Balanced matrices
Partial satisfaction of projects' needs	Functional matrices	

A two dimensional definition of fundamental resource policies in the high-tech environment brings about a consideration of more complicated decision preferences (see Table 4).

Tab. 4 The hightech case: Preferences of matrices

Matrices From the Aspect of ...	ProjectMatrices	BalancedMatrices	FunctionalMatrices
The favoured project manager (H)	Fair matrices	Best matrices	Worst matrices
The unfavoured project manager (L)	Best matrices	Worst matrices	Fair matrices
The functional manager (F)	Worst matrices	Fair matrices	Best matrices

In this case, competition between projects on resource allocations, especially concerning scarce resources, breaks the traditional coalition between project managers, and brings about unexpected agreement between functional managers and project managers.

In a high-tech situation, scarce resource capacities are constraints. These constraints reduce the attractiveness of project matrices among managers of favoured projects. Project matrices offer unlimited resource capacities for normal resources, but competition occurs for scarce resources with unfavoured projects. Balanced matrices create an option for favoured projects to obtain scarce resources. Therefore balanced matrices should be the preferred choice for favoured project managers. Functional matrices, on the other hand, mean favoured projects face a rationing of resources, and give favoured project managers a good reason to reject such matrices.

Project matrices are the favourite matrices for managers of unfavoured projects. These matrices guarantee them a share of all resources, in contrast to balanced matrices that leave unfavoured projects with a low probability of receiving scarce resources and could lead to their failure. Despite the fact that functional matrices also aim at rationing resources, unfavoured projects prefer them over balanced matrices, because they have a better chance of receiving resources.

The functional managers' objective, because it is directed at the optimized use of available resources, makes the functional matrices the most attractive. For the same reason, functional managers reject the project matrices, matrices that prevent resource allocation planning. Balanced matrices, however, can be a compromise for functional managers. Project managers, however, disagree on the worth of balanced matrices, because favoured projects are not limited by the need to allocate resources to internal development, while unfavoured projects, most of which are internal ventures, face difficulties as resources are pulled from them to be given to the favoured, mostly sponsored, projects.

According to Laslo & Goldberg (2008), the high-tech environment derives three confrontations within the matrix organization as shown in Figure 2.

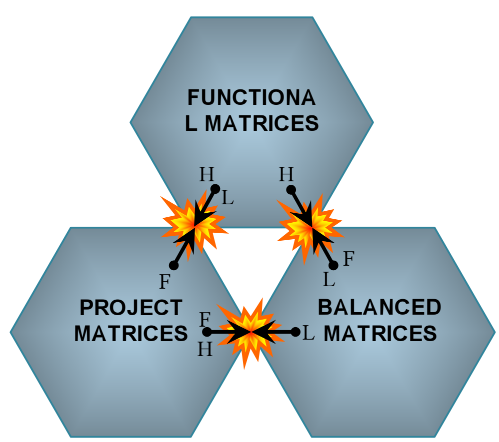

Fig. 2: The hightech case: Three fronts of confrontation

All project managers resist functional matrices. When favoured project managers (H) seek project matrices, they are able to build a coalition with the unfavoured project managers (L) against the functional managers. But if favoured project managers try to improve their position even further by adopting balanced matrices, functional managers and unfavoured project managers may cooperate to oppose this move.

Functional managers, on the other hand, will do everything they can to prevent project matrices. When they attempt to achieve full control over buy decisions through functional matrices, however, the traditional coalition between the favoured and the unfavoured project managers oppose them. But if functional managers are ready to compromise, they can achieve an agreement with the favoured project managers on the adoption of balanced matrices, a step that will be opposed by unfavoured project managers.

Balanced matrices are the preferred policies for favoured projects, but a disaster for unfavoured projects. Managers of unfavoured projects can partner with functional managers if they agree to improve their position by moving toward the functional matrices, a step that will be opposed by favoured project managers. The efforts of unfavoured project managers to go farther, and to obtain project matrices, will be confronted by an unexpected coalition of favoured project managers and functional managers.

4. The system dynamics model of a project portfolio's flow of resources

A model describing a dynamic flow of resources in a project portfolio can be used to evaluate the impact of alternative matrices on the performances of the project portfolio, of its functional units, and of each of its individual projects.Under uncertainty, these expected performances are difficult to investigate empirically because all the variables are an integral part of a complex nonlinear organizational system where it would be impossible to obtain an adequate variety of situations. When it is infeasible or impossible to compute an exact result with a , the Monte Carlo method tends to be used (Metropolis &Ulam (1949). Contrary to deterministic modeling using best guess single-point estimates, the Monte Carlo method considers samples of random variables as model inputs to produce a large number of probabilistic outcome occurrences (Vose, 2000). Monte Carlo simulations can quantify the effects of uncertainty in project schedules and budgets, providing the project manager with statistical indicators of project performance, such as target project completion date and cost. The Monte Carlo method has also been widely used for decades to simulate various mathematical and scientific situations, and it is frequently referred to in project management curricula and standards, such as A Guide to the Project Management Body of Knowledge (Project Management Institute, 2004). Broad Monte Carlo simulations allow a limitless number of comparisons, where a real organization would resist intervention because of its possible consequences. Hence, many more variables are controlled than would be possible in a study of real organizations.

Forrester's 'system dynamics' theory provides a means to understand the payoff outcomes of each player's actions in such a complex and uncertain system (Forrester, 1980). What makes using system dynamics different from other approaches to studying systems is the use of feedback loops. In its simplest sense, system dynamics focuses on information that is transmitted and returned throughout the progress of a process, and the system behaviours over time that result from those flows. The feedback loops create the nonlinearity found so frequently in complex dynamic problems. Running 'what if?' simulations to test certain matrix forms on such a model enables us to study reinforcing processes—feedback flows that generate exponential growth or collapse—and balancing processes—feedback flows that help a system maintain stability.

The probability of a project meeting a scheduled due date within a fixed budget cannot be estimated for R&D projects because of uncertainty about the resources and time needed to complete any one activity,as well as the extent to which freed resources can be used to expedite the work of other activities. In such a situation, giving full satisfaction to all assumed project requirements at the first stage of a project may actually bring about delays due to an inability to meet unexpected and unmet resource requirements at later stages because of constrained budget conditions. In contrast, projects with only partial satisfaction of requirements may, under crisis conditions, obtain additional resources in order to prevent delays. The system dynamics model as shown in Figure 3 enables the prediction of the matrix form outcomes.

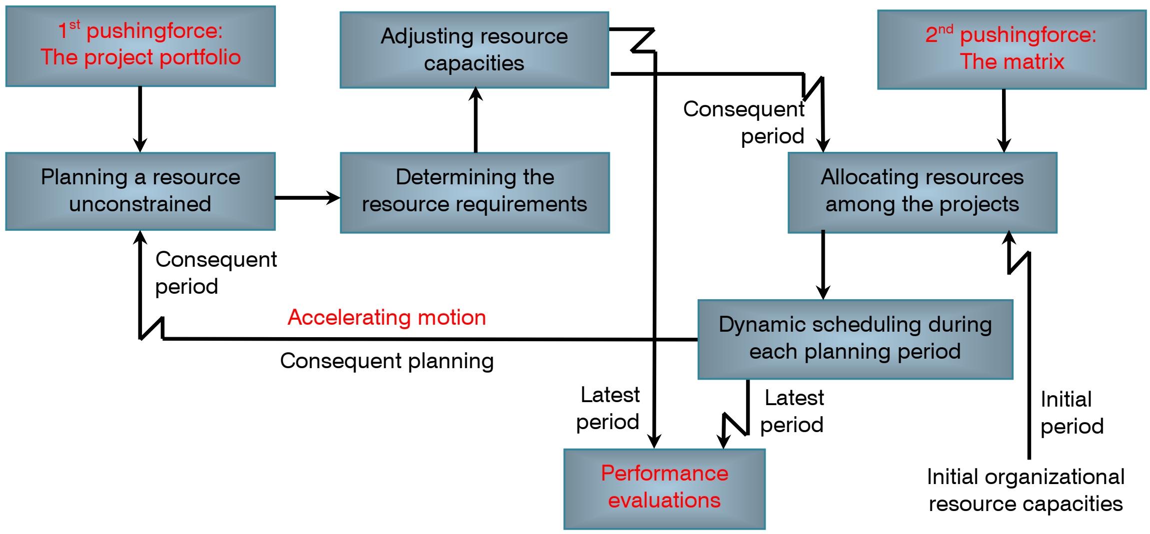

Fig. 3: System dynamics model of project portfolio's flow of resources

The first pushing force in this model is the project portfolio. Moore (1977) argued that the flow of resources is the basic force that identifies the dynamic nature of a system. Efficient flow of resources requires continuous matching between eligible project activities with available capacities of resources, and vice versa. Laslo & Goldberg (2001; 2008) introduced three independent characteristics; each of them determines the chance to attain such events of successful matching. The probability of project programs meeting timetables and not exceeding allocated budgets was found to be influenced by these characteristics:
1. Required asset specificity- the need by projects for scarce resources.
2. Multidisciplinary activity - the extent to which activities needed personnel from different functional areas.
3. Time duration variance - the degree of uncertainty regarding the time necessary to complete activities.

Each of these three characteristics can be used as an indicator of the project portfolio's' technological status. Increasing level of each characteristic indicates higher technological degree, but also more complicated scheduling process and instability of the flow of resources within the project portfolio. By applying binary attributes (low or high) to each characteristic, eight possible combinations define eight different project portfolio patterns from which projects can be sampled. These sampled projects enable us to investigate the performances of the different matrix forms within eight project portfolios with various typologies.

The second pushing force in this model is the matrix form. Assuming a'' model, system dynamics feedback loops for alternative matrix forms provide the following possible results:
- The feedback loops might not contribute new information that could influence decisions regarding favourite matrix form.
- The feedback loops might reveal that a preferred matrix form is not as advantageous as previously thought and therefore leads to neutrality.
- The impact of the feedback loops might even demonstrate that a previous position was wrong and reverse a participant's position about which matrix form to favour.

An objective function composed of one or more of a large number of objectives can be chosen for performance evaluations of the project portfolio, each of its projects, and each of its functional units. For the analysis of the impact of matrix forms on these performances, the following objectives were selected by Laslo & Goldberg (2001):
1.Reducing delay penalties.
2.Reducing direct labour costs.
3.Reducing idle labour costs.
4.Reducing manpower expansion expenses.
5.Reducing losses from unnecessary outsourcing.

5. Insights provided by the implementation of the system dynamics model

5.1. Adjusting the locus of influence to organizational objectives

The readiness to change organizational structures is particularly important in an environment characterized by rapid changes in the nature of the competition, while at the same time offering new technological advantages. Upper management may choose to centralize decision making and provide greater resources to particular projects, give control over budget decisions to functional managers, or provide more freedom to individual projects to make use of similar resource allocations (Kim & Burton, 2002). In order to optimize matrix performance, the distribution of power among project and functional managers must be changed continuously in line with the project portfolio's characteristics and objectives.

The study which is described in detail in the article 'Matrix structures and performance: The search for optimal adjustment to organizational objectives' (Laslo & Goldberg, 2001) aimed to find when organizational and market conditions necessitate increases or reductions in the influence of project managers, in order to reach improved performance of the project portfolio and/or its units.The locus of influence within the organization is reflected by the different matrix forms.Conversion of the functional matrix into a balanced matrix or, of the balanced matrix into a project matrix increases the influence of project managers; while conversion of the project matrix into a balanced matrix, or, the balanced matrix into a functional matrix increases the influence of the functional managers what decreases the influence of the project managers.

The implementation of the system dynamics model provided simulated results from which we can draw the following conclusions as shown in Figure 4:

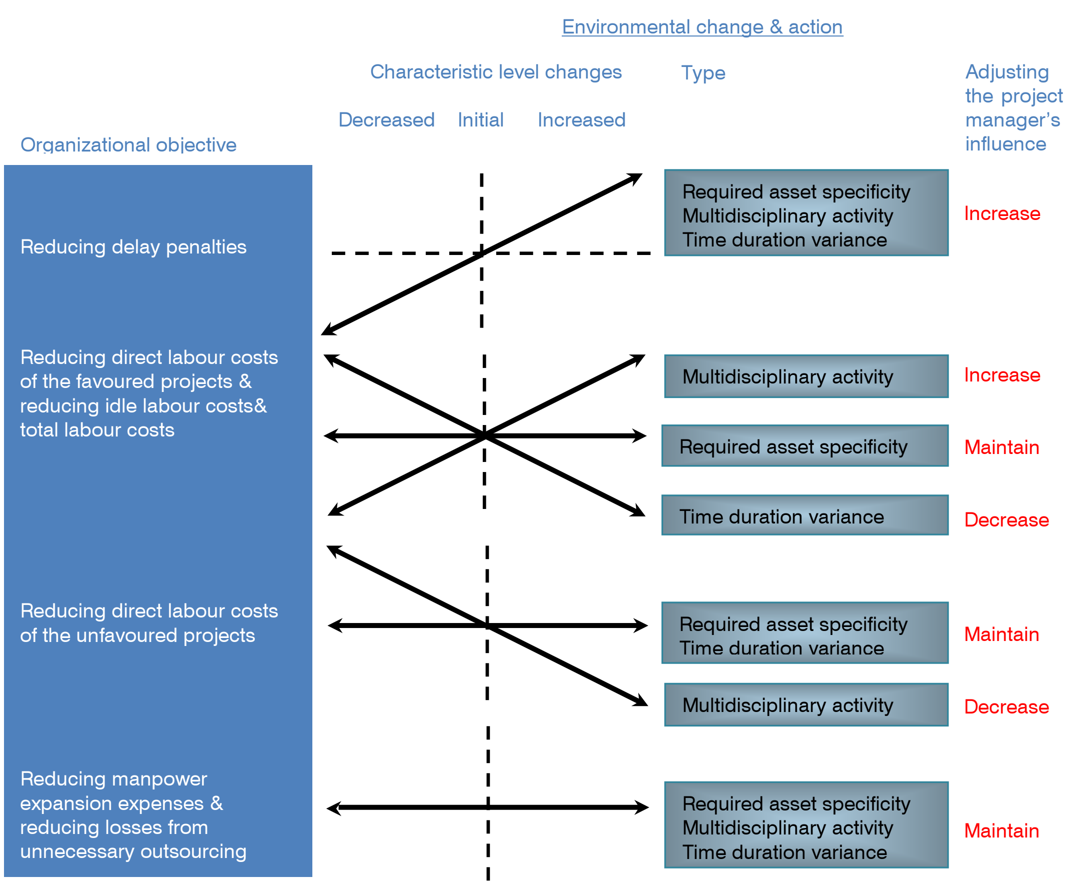

Fig.4: Differential recommendations for adjusting the locus of influence as response to changes of the project portfolio's typology

- For the objective of reducing delay penalties:

– As the level of each of the three characteristics increase from the initial level, it is necessary to increase the influence of project managers. Similarly, decreases from initial levels of each of these characteristics encourage a decrease in the influence of project managers.

- For the objectives of reducing direct labour costs of the favoured projects, idle labour costs and total labour costs (the sum all direct costs and idle labour costs) as well:

– Any change in the level of required asset specificity does not require any change in the locus of influence;
– As the level of multidisciplinary activity increases from the initial level, it is necessary to increase the influence of project managers. Similarly, decrease from initial level of this characteristic encourages a decrease in the influence of project managers;
– As the level of time duration variance increases from the initial level, it is necessary to decrease the influence of project managers. Similarly, decrease from initial level of this characteristic encourages an increase in the influence of project managers.

- For the objective of direct costs of the unfavoured projects labour:

– Any change in the level of required asset specificity or time duration variance does not require any change in the locus of influence;
– As the level of multidisciplinary activity increases from the initial level, it is necessary to decrease the influence of project managers. Similarly, decrease from initial level of this characteristic encourages an increase in the influence of project managers.

- For the objectives of reducing of manpower expansion expenses and losses from unnecessary outsourcing changes:

– Any change in the level of each of the three characteristics does not require any change in the locus of influence.

5.2. Looking for a consensual project portfolio's matrix form

Conflicts believed to be unavoidable are assumed to reduce the effective performance of matrix structures because project managers and functional managers struggle for greater control over the allocation of organizational resources. As a consequence, organizations do not unite around one matrix form and fail to adopt one of the matrix forms as a preferred organizational structure.A difficulty of predicting the full consequences of each matrix form in a dynamic environment has become a serious complicating factor in attempted pre-accepted formation. Disagreement among managers over matrix forms, however, may turn out to be unrealistic as the attainment of a favoured matrix form may actually reduce their performance.The study which is described in detail in the article 'Resource allocation under uncertainty in a multi-project matrix environment: Is organizational conflict inevitable?' (Laslo & Goldberg, 2008) aimed to find the possibility of unnecessary and unrealistic conflicts in the context of the favoured matrix form. The authors calculated the expected net benefit to be obtained by each organizational participant for each matrix form as the participants relate to various project portfolio's characteristics and objectives.

Assuming that the functional managers' objectives always seek reducing the idle labor costs, the manpower expansion expenses and the losses from unnecessary outsourcing, the implementation of the system dynamics model provided simulated results from which it was possible to draw the following conclusions:

- Consensus on functional matrices can be attained only when both favoured and unfavoured project managers' objective is reducing direct labor costs. Consensual matrix form is attainable in each project portfolio pattern where the level of the multidisciplinary activity is high. In an additional pattern where the level of this characteristic is low, the level of required asset specificity is high and the level of time duration variance is low such consensual matrix form is attainable as well.
- Reduction of the number of conflicts in the context of matrix form, but not consensual matrix form, can mostly be achieved in other scenarios, i.e. additional combinations of project managers' objectives and project portfolio patterns.

When the participants are aware that some of the conflicts are in fact unrealistic, in some scenarios consensual matrix form is attainable while in other scenarios only reduction of the number of conflicts among the organizational participants as demonstrated in Figure 5.

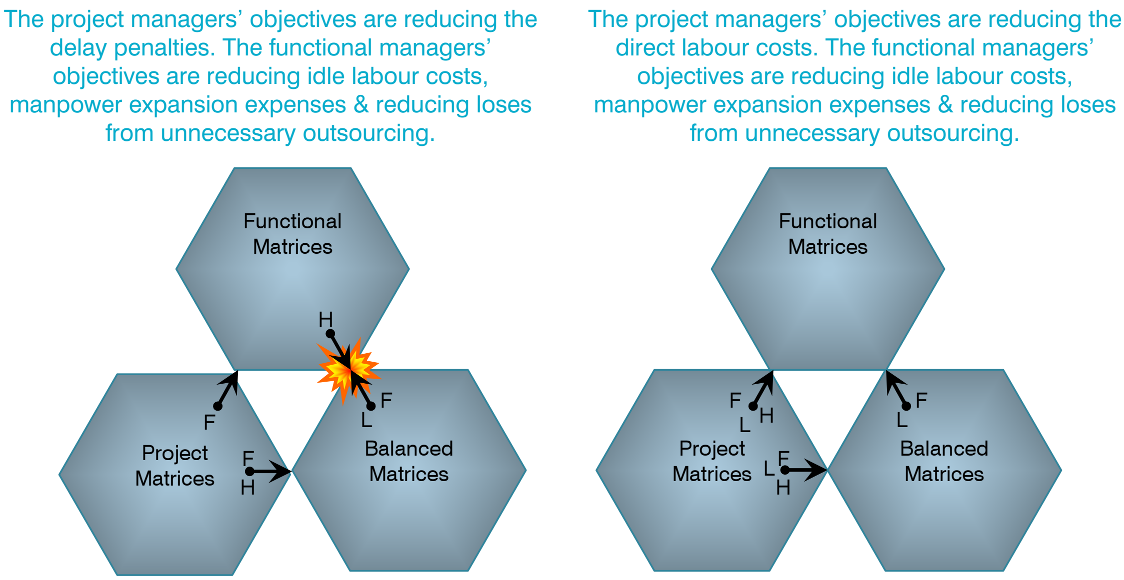

Fig. 5: Realistic conflicts for a project portfolio where the level of the three characteristics is high

5.3. Looking for an additional implementation of the balanced matrices

Hendrix et al. (1998) found that a multi-project situation causes problems in the allocation of scarce resources,such as personnel, to a diversified project portfolio. They suggest flexible resource planning to take into account the availability of scarce resources. Laslo (2010), as in detail description in his article 'Project portfolio management: An integrated method for resource planning and scheduling to minimize planning/scheduling–dependent expenses', investigated the implementation of this suggestion in information technology project portfolios, where such resources are available, but very expensive. The idea of the integrated matrices is implementation of a project matrix on normal resources and a functional matrix on scarce resources. For this purpose a sophisticated resource planning and scheduling search algorithm was developed.The simulated results of the integrated matrix form implementation,in comparison with those of the project matrices implementation,showed the following:

- For the objective of reducing delay penalties the integrated matrices seem to be significantly superior.
- For the objective of reducing idle labour costs the integrated matrices seem to be significantly superior.
- For the objective of reducing manpower expansion expenses the integrated matrices seem to be significantly superior in the context of scarce resources but inferior in the context of normal resources.
- For the objective of reducing losses from unnecessary outsourcing the integrated matrices seem to be significantly inferior.

Summary

Irrespective of the findings in the context of the matrix forms and their implementations in project portfolios, a simulation can never be the reality—it can only reflect it. These studies assumed 'h' participants and a management policy directed at the improvement of the project portfolio's performance. 'Noises' such as friendship or antagonism among participants may change the results. Nevertheless, these studies provide evidence for the problematic nature of assumptions about behaviours and conflicts in matrix structures, and call for further research.

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About the Author

Zohar Laslo
SCE –Shamoon College of Engineering
zohar@sce.ac.il

Zohar Laslo is Dean and Professor of Industrial Engineering at SCE - Shamoon College of Engineering. He received his B.Sc. and M.Sc. from the Technion - Israel Institute of Technology, Ph.D. (Summa cum Laude) from the Ben Gurion University of the Negev and continued as a post-doctoral research fellow at the Tel Aviv University. His academic career includes teaching and research at Bezalel - Academy of Art, Ben Gurion University of the Negev, Tel Aviv University and SCE - Shamoon College of Engineering. Prof. He has published over 60 publications in the operational research and industrial management literature.