

## USING FACILITY LOCATION THEORY TO EVALUATE TEAM BUILDING EFFECTIVENESS

By: John Boedo and Joyendu Bhadury

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### **Abstract:**

Team building is considered a fundamental element of organizational success these days. Firms are using experiential learning activities to foster the generative learning that is intrinsic to successful teams. However, there is scant literature on measurement tools for the effectiveness of these activities. In an attempt to address this gap, this paper seeks to apply techniques from Facility Location theory to prescribe a methodology for measuring the effectiveness of team building exercises. The methodology developed is applied in a pilot study to a data set developed by Moorefield (1994). Our preliminary results seem to indicate that team building exercises do not perform well in terms of influencing / educating their audience, thus raising an issue of concern regarding the prudence of investing in them.

### **Article:**

#### INTRODUCTION - LEARNING TEAMS AND MANAGEMENT DEVELOPMENT

Team building is considered a fundamental element of organizational success in the 1990's. There is increasing evidence that directly connects teamwork to increased profitability and enhancement of a firm's reputation in its industry. In consequence, Fortune has estimated that by the end of the decade three times as many Fortune 500 firms will be using team based management than as presently the case (Fulmer (1992)). These new team methods of consensus decision making and total quality management have immediate implications for the way future and existing managers are to be trained.

A curious paradox characterizes much of the discourse on team training. On the one hand, organizations explicitly recognize the crucial role that developmental learning must play in helping them maintain competitive vitality. On the other, there has been little specificity regarding exactly what type of learning is needed within team-based management - Fulmer (1992). Therefore, if organizations sponsoring management development initiatives want to see training concepts applied in such a way as to enhance their business performance, it is essential that the learning environment be relevant and effective in enhancing the development of those dispositional capacities which team players need to use most.

It is useful here to consider three kinds of learning, as postulated by Botkin (1979). The first kind, maintenance learning, is simply learning better and more efficiently what we already know

how to do. The main drawback to maintenance learning is that it often leads to unanticipated consequences, which then provides an opportunity for a second kind - shock learning. This type of thinking is always responsive, and is best thought of as a kind of crisis management approach to problem solving. The third type of learning, anticipatory, is both future oriented and participative. Instead of considering only what has worked in the past, it tries to formulate creative solutions to problems which have not yet emerged. Moreover, anticipatory learning is based on the idea that no individual or authority has all the information, knowledge, or solutions; rather, it assumes that capable people working together can create better alternatives than any single individual. Viewed from this framework, it is clear that the participatory aspect of anticipatory learning is the basic element which runs through and strengthens the power of teams. It is equally clear that traditional management development methods, including the use of lectures, case studies, and short self-contained exercises, are not designed to provide the particular learning and education necessary for effective team building (Fulmer and Graham (1993), Rakich (1991)). While concepts discussed in traditional development programs are believed to have value at the completion of the activity, they do not accommodate the new vision of the role that team learning now plays in competitive corporate strategy (Stumpf (1992)).

In response to this situation, experiential learning activities such as adventure-based training, outdoor training, and interactive workshops have been designed to foster the generative learning intrinsic to successful teams Jayne (1992). The idea behind these programs is to provide an experience that generates non-routine insights into group problem solving and which is suited to the holistic and future-oriented thinking of strategic planning. The instructional design includes three process of cognitive, emotional, and behavioral learning: the team and/or business strategy is used as cognitive material, while experiential activities provide the emotional and behavioral learning experiences as metaphors for a normal team working environment. In this way, experiential learning programs claim to integrate both content (actual subject matter of group task) and process (the means by which the group achieves the output) components of teamwork - see Mullen (1992).

A most intriguing aspect of the structured experiential learning movement is the intensity of the debate regarding its usefulness as a competitive educational strategy. Critics of experiential learning programs contend that this kind of management training is, at best, a waste of time, and at worst, detrimental to managerial effectiveness Wagner et. al. (1991). In fact, Wagner et. al. (1992) quote Jack Faivery from a Wall Street Journal article, where it is argued that "building outdoor party- games and simulations, when the real work to be done is all around, should be grounds for managerial malpractice indictments".

Such strong rhetoric notwithstanding, there is justifiable concern about experiential workshops when there exist little or no established practices for measuring how effective such programs are. This deficiency is readily apparent in much of the published material to date on experiential team training. Appelbaum (1992), Bailey (1991), Berger (1991), Barner (1989), Fulmer (1992), Holden (1990) and Luscher (1990) all cite cases of a particular training program and suggest prescriptive lists, but none suggest how these measures could be systematically evaluated. Other writers, including Akende (1992), Bradford (1989/90), Kazemak (1991), and Kirkpatrick and Smith (1991) go part of the way towards stipulating some kind of normative measurement standards. While most of these studies suggest some form of qualitative measures to ensure

success or minimize failure, only a few suggest objective (scientific) approaches to establishing the effectiveness of team development training. Most notably, Schweiger (1989) presents a method for measuring strategic decision making of teams. That paper uses a case study and questionnaire and employs traditional methods of statistical significance tests against experimental and control groups. Unfortunately, such tests can only make comparative judgements. What is desirable is a methodology that allows a manager to make judgements regarding the efficacy of a program based on an absolute scale. However, development of such a scale/methodology necessitates an axiomatic study - which is our focus here in this paper.

Parallel to the above literature, there has been a growing interest by management researchers in studying managerial cognitive styles within a team strategic thinking framework - see Wagner et. al. (1991). However, the cognitive processes by which individuals gather and evaluate information remain at best tenuously connected to the objectives of team building interventions. A review by Cotton (1988) concluded that the overall effectiveness of participative decision making is uncertain because its valuation varies markedly with both the form of "participative decision making" and the criterion for effectiveness. Thus, although the term "participative decision making" often is used as if it refers to a single concept, it has been defined conceptually and operationally in many different ways. A general methodology for assessing improvements in team strategic decision-making processes has yet to be developed.

Therefore, to summarize, structured management development is more than a fad. The generally favorable responses it garners from executives and managers continue to strengthen its status as an effective human resource development strategy. Therefore, if team building is a critical investment in the human resources of an organization, then any investment decision must necessarily be accompanied by an assessment of the effectiveness of the outcomes with respect to time and money spent.

In an effort to address this gap, our paper suggests a new methodology for measuring the effectiveness of team building exercises. We will now define the theoretical/axiomatic foundation of our model. As mentioned before, the model borrows from the well established area of Facility Location Theory (see Daskin (1995), Drezner (1995)), basing itself on the premise that the objectives of such an exercise is to influence its participants to bring them to the a state of "sameness" that enables them to function effectively as a team. This is envisioned as being similar to the process that is used to locate public facilities to serve a group of customers in a socially optimal fashion - a topic that has been extensively studied by location theorists. Borrowing on one such model, namely, the Minisum Single Facility Location Problem, we define the ideal team as being the analog of a public facility that has been located to minimize the average travel distance to all the customers that it serves. It seems reasonable to argue then that a perfect, and therefore, utopian, team building exercise should be able to educate its participants so that they are swayed to this common point of perception and/or knowledge, with the minimum amount of effort on behalf of the team members. Basing ourselves on this premise, we then develop a method for evaluating the effectiveness of a given team building exercise by measuring its actual influence on the participants against the minimum influence of a perfect exercise. Our method, when applied to a data set collected from a study by Moorefield (1994), gives results that are in harmony with the findings of that study.

The remaining paper is divided as follows. The next section details the new methodology expounded in this paper, along with a discussion of the requisite background from Location Theory. This is followed by the section where we discuss the pilot study performed on the data set in Moorefield (1994), the results obtained therefrom and their significance. Finally, the fourth section summarizes the conclusions of the paper, Outlines the limitations of the present study that open avenues for future research on this subject.

## A NEW OBJECTIVE MEASUREMENT METHODOLOGY

As mentioned above, the purpose of this paper is to articulate an objective method for evaluating team-based development based on the utilization of individual cognitive capabilities in team approaches to strategic decision-making. The cognitive mix of a strategic decision- making group has been neglected in strategic research (Smith (1995)). The thesis to be argued here is that any valid approach to measuring team development must explicitly recognize that it is individualism which provides a team with its strategic power. This thesis in turn is predicated on three crucial tenets: (i) that problem solving, cognition, and decision- making are situated within contextual frameworks of personal and social epistemologies, beliefs, and understanding; (ii) that teams possess strong potential capabilities for growth in terms of what individual members already know; and (iii) that strategic decision-making is a participant activity requiring that teams operate on and modify the things they are trying to understand.

The specific methodology will borrow from the area of Location Theory, in particular the Minisum Single Facility Location Problem (see Daskin (1995), Drezner (1995)); hence, we begin with a brief outline of this problem. Assume that a group of customers are located on the plane at different sites and that a single facility needs to be located in order to serve them. All the customers are supposed to be interested in using the facility; hence, each would like the facility to be as close as possible. Closeness between two points is supposed to be measured by the Euclidean metric , i.e. the straight line distance between these two points. Given this, the Minisum Single Facility Location Problem seeks to find that location point in the plane which minimizes the average distance to all these customers - this optimal point is referred to as the 1- median or simply, the median (see Daskin (1995)).

Notationally, the Minisum Single Facility Location Problem can be expressed as follows. Assuming that the location of the customers are given by points  $P^i = (a^i, b^i) = 1, \dots, m$  in the plane, where  $m$  refers to the total number of customers. Let  $X = (x, y)$  be any point on the plane. Then the median is given by a point  $X^*$  which satisfies:

$$X^* = \arg \min_X \left\{ \sum_{i=1}^m \left[ (x - a^i)^2 + (y - b^i)^2 \right]^{1/2} \right\}$$

If however, the customers are represented as points in an n-dimensional Euclidean space  $\mathfrak{R}^n$ ,

where customer point  $P^i$  is described by the vector  $(p_1^i, p_2^i, \dots, p_n^i)$ , then the median is given by a point  $X^* = (x_1^*, x_2^*, \dots, x_n^*)$  that satisfies:

$$X^* = \arg \min_{X \in \mathfrak{R}^n} \left\{ \sum_{i=1}^m \left[ \sum_{j=1}^n (x_j - p_j^i)^2 \right]^{1/2} \right\}$$

where  $X = (x_1, x_2, \dots, x_n)$  represents an arbitrary point in  $\mathfrak{R}^n$

It is well known that unless the problem is degenerate (where all the customer points are collinear), the median  $X^*$  is unique for any given configuration of customer points. However, as the problem is non-linear, no known closed-form solution exists, but several iterative algorithms have been developed by different researchers that converge to the median. The most renowned of these algorithms is the classical Weiszfeld's Algorithm, due to Weiszfeld (1936). Due to its seminal nature, Weiszfeld's Algorithm has been extensively studied by location theorists and several of its theoretical and empirical properties are well documented in the location theory literature. Two such properties that are of relevance in this study are that (i) this algorithm performs very well in practice and (ii) it extends to higher dimensional space in a straightforward manner.

In applying the single facility location problem, we begin by representing each team member's dispositional cognitive attributes by a unique point in a multidimensional space where each dimension represents a different cognitive attribute of the team. These points are found by measuring each team member's dispositional cognitive attributes by an appropriate instrument. A straightforward application of Weiszfeld's Algorithm then yields the median of these points in this multidimensional space. As argued before, our basic tenet is to argue that with the perfect team building exercise should be able to bring all the team members a common level of development. Since the median minimizes the average distance to all the representative points, it is therefore logical to assume that it represents that developmental level in this cognitive space where all the team members can be brought to with the minimum total effort/cost. Said differently, the average distance of the median to these points is thus representative of the minimum amount of influence that would be exerted by a perfect team building exercise on the given team. Hence, it can be used as a normative reference to evaluate the effectiveness of any other team building exercise on the same team, or even to provide a useful baseline for a series of similar measurements as a team develops over time.

The next step in this methodology would then be to measure actual team development as a result of the exercise by finding the representative points of the team members in this multidimensional cognitive space both before and after the given team building exercise. Computing the net displacement for each member's representative point and then averaging over the entire team thus gives a measure of the actual influence of the given team building exercise on the team members. Juxtaposed with the minimum influence that could be exerted on these team members by the perfect exercise, we then have a evaluation of effective the given team building exercise has been when compared to the perfect one.

First, we discuss the significance of the mapping used to represent the team members. To that end, it is immediately clear that when mapped to a multidimensional attribute space in the manner discussed before, the collective database is essentially a geometric display of cognitive elements pertaining to dispositional attributes within a team. It functions as a conceptual framework for describing each person's cognitive attributes, but the only elements portrayed in the model are those available to the individual's awareness. The model is intended to represent only a single set of cognition, rather than the totality of cognitive ideas entertained by a person, implying that separate structures are required for each cognitive domain of interest; hence each one of them is represented by a unique dimension of this space. This avoids the assumption that

there is consistency across an individual's conceptions about all types of objects. (Note that in this study "objects" refer to each individual's capabilities within this particular experiential learning situation.).

Further, the usage of the Euclidean distance norm in the measurements implies that this perceptual space is conceived as having a Euclidean geometry, and thus consisting of vectors with metricized dimensions. A Euclidean geometry greatly facilitates the development of measures. Even though in real life many cognitive attributes probably lend themselves better to a non-Euclidean representation, they are not easily elaborated in this form. The algebraic specifications provided by a Euclidean space are preferred because they are precise and easy to work with. Indeed, it is unlikely that measures developed from a non-metric geometry would be more valid, for limits of precision are set by the procedures for assessing cognition rather than by the algebra involved. The procedures include rather imprecise questions which admit substantial response error; in fact, the actual state of cognition for most people is probably quite imprecise. Therefore, a Euclidean geometry is just as likely to provide a valid representation as any other.

Pertaining to the applicability of a minimum algorithm, two aspects are of special concern here. First, it is useful to consider the sum total of individuals' efforts precisely because we are interested in how the group as a whole reacts to a given training situation. The merit in formulating our measurement instrument as a minimum location problem is that it captures individual contributions to team effectiveness that are implicit in the group learning process. In other words, our final measure need not partial out each member's efforts precisely because the focus is on how the team as a whole has developed. This approach is fully consonant with research concerning the roles and interaction of individuals within team- building interventions (Bettner et al. (1991)).

Second, and arguably bolder conjecture pertaining to a minimum measurement concerns its generalizability. Recall that a major obstacle to measuring participatory decision making was its context dependent variation as a function of form. The primary purpose of this study is to construct a measurement tool that can be applied across a diverse range of management development interventions. Since a minimum measure requires, by definition, only the initial cognitive capabilities of each team member, it can, in principle, be used with any kind or duration of participatory decision making experience. This context free utility will become fully manifest when compared to analytic techniques that test for statistical significance.

## PILOT STUDY

### *Data Sets*

The framework that will be used to measure one particular domain of team building is drawn from Moorefield's (1994) quasi-experimental study of team training. This study used a version of the Experiential Training Session Survey (ETSS) instrument developed by Stone and Wagner (1992) to obtain behavioral measures of team building among participants, in a four hour outdoor centered workshop and a four hour indoor centered session. The ETSS is a collection of five separate scales which group team functioning into the following five dimensions:

1. Awareness: measured by a six-item 7 point Likert scale adapted from the Michigan Organizational Assessment Questionnaire (Seashore et. al. (1982)) investigates the

individual's personal relationship to other members and the group's perception of the problem and its solution. Reliability estimates for this scale have an average alpha of 0.81 (Paustian (1992)).

2. Effectiveness - defined by a 7-item, 7-point Likert set adapted from the Survey of Organizations questionnaire (Taylor and Bowers (1972)) investigates how well the group achieves its ask in the given time frame. The scale includes how well individuals cooperate, the effectiveness of communications, and perceived goal clarity of the unit. This instrument has been shown to produce an average reliability alpha of 0.91 (Moorefield (1994)).
3. Work Locus is measured by a 16-item, 7-point Likert response set developed by Spector (1988). This scale examines the nature and extent to which problems are solved individually or by consensus, and was shown to have an alpha coefficient of 0.85 in a large scale outdoor training study (Baldwin (1991)).
4. Self Esteem is a 4-item, 7-point Likert measurement of an individual's positive or negative view of one's self at work, and has been shown to have an alpha coefficient of 0.82 (Baldwin (1991)).
5. Communication measures the ability of team members to share and communicate effectively ideas and opinions, and to give and receive feedback. It uses a 12-item 7-point Likert scale developed by Stone and Wagner (1992) and possesses high internal consistency (alpha greater than 0.90).

The sample for Moorefield's study consisted of 41 employees from Electronic Data Systems divided into three teams: one outdoor team (n=16) and two indoor teams (n=9 and 16). The experimental methodology for all three teams was the same. Team function was initially measured by the ETSS so as to provide a baseline against which a similar measurement was made at the completion of the workshop. The three process of cognitive learning, emotional, and behavioral learning, as expounded in Mullen (1992), were incorporated directly into the design of workshop activities: several problem solving tasks were used as cognitive material, while indoor and outdoor activities provided the emotional and behavioral experience as metaphors for normal teamwork environment.

Tables 1, 2, and 3 summarize the results of the ETSS questionnaire subsequent to an initial orientation period but prior to the actual experiential learning sessions.

**Table 1:**  
**Pre-Workshop Descriptive Data for Outdoor Team (n=16)**  
**(Moorefield, 1994)**

| <u>Student</u> | <u>Effectiveness</u> | <u>Awareness</u> | <u>Control</u> | <u>Comm</u> | <u>Esteem</u> |
|----------------|----------------------|------------------|----------------|-------------|---------------|
| 1              | 6.43                 | 4.50             | 2.50           | 6.25        | 3.25          |
| 2              | 4.57                 | 5.50             | 2.38           | 6.17        | 3.75          |
| 3              | 4.14                 | 5.83             | 3.00           | 6.00        | 2.75          |
| 4              | 3.86                 | 4.67             | 3.13           | 5.25        | 2.00          |
| 5              | 3.29                 | 4.50             | 3.31           | 4.92        | 4.25          |
| 6              | 3.43                 | 5.17             | 3.38           | 5.42        | 1.50          |
| 7              | 3.00                 | 5.67             | 3.31           | 4.67        | 4.25          |
| 8              | 5.00                 | 5.83             | 2.06           | 4.33        | 1.50          |
| 9              | 6.85                 | 6.67             | 3.69           | 6.67        | 4.00          |
| 10             | 2.57                 | 5.17             | 2.81           | 5.00        | 2.25          |
| 11             | 4.71                 | 3.50             | 2.00           | 3.17        | 1.25          |
| 12             | 5.29                 | 3.83             | 2.88           | 3.67        | 3.00          |
| 13             | 5.57                 | 4.17             | 2.88           | 3.83        | 2.25          |
| 14             | 5.71                 | 6.50             | 2.75           | 3.93        | 2.00          |
| 15             | 6.00                 | 6.33             | 2.75           | 4.08        | 2.50          |
| 16             | 6.29                 | 4.83             | 2.63           | 6.50        | 3.00          |

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**Table 2**  
**Pre-Workshop Descriptive Data for Indoor Team I (Moorefield, 1994)**

| <u>Student</u> | <u>Effectiveness</u> | <u>Awareness</u> | <u>Control</u> | <u>Comm</u> | <u>Esteem</u> |
|----------------|----------------------|------------------|----------------|-------------|---------------|
| 1              | 5.81                 | 5.57             | 3.50           | 6.25        | 3.69          |
| 2              | 4.29                 | 4.00             | 2.25           | 4.75        | 2.88          |
| 3              | 5.14                 | 5.28             | 2.50           | 5.42        | 2.43          |
| 4              | 5.71                 | 5.83             | 3.25           | 5.75        | 3.56          |
| 5              | 5.43                 | 5.43             | 2.75           | 5.50        | 3.56          |
| 6              | 2.71                 | 3.43             | 1.12           | 3.25        | 2.06          |
| 7              | 2.86                 | 3.57             | 1.75           | 3.83        | 2.25          |
| 8              | 3.14                 | 3.43             | 2.25           | 4.00        | 2.18          |
| 9              | 5.43                 | 5.57             | 2.75           | 4.58        | 3.31          |

**Table 3**  
**Pre-Workshop Descriptive Data for Indoor Team II**  
**(Moorefield, 1994)**

| <u>Student</u> | <u>Effectiveness</u> | <u>Awareness</u> | <u>Control</u> | <u>Comm</u> | <u>Esteem</u> |
|----------------|----------------------|------------------|----------------|-------------|---------------|
| 1              | 4.25                 | 3.63             | 2.06           | 4.19        | 1.69          |
| 2              | 5.69                 | 5.19             | 3.63           | 6.17        | 2.88          |
| 3              | 5.81                 | 5.50             | 2.75           | 5.06        | 2.56          |
| 4              | 5.88                 | 5.56             | 2.63           | 5.00        | 2.68          |
| 5              | 6.06                 | 5.63             | 2.56           | 5.63        | 3.38          |
| 6              | 5.31                 | 5.81             | 3.13           | 6.00        | 2.06          |
| 7              | 5.38                 | 6.31             | 3.19           | 4.94        | 2.94          |
| 8              | 5.00                 | 6.19             | 2.91           | 5.44        | 1.63          |
| 9              | 4.63                 | 4.50             | 3.44           | 4.88        | 2.81          |
| 10             | 6.50                 | 5.17             | 2.44           | 6.00        | 2.50          |
| 11             | 6.81                 | 6.63             | 3.81           | 5.18        | 2.13          |
| 12             | 5.50                 | 6.25             | 3.50           | 4.38        | 3.31          |
| 13             | 6.25                 | 4.81             | 3.31           | 5.13        | 2.44          |
| 14             | 4.50                 | 5.06             | 3.38           | 5.25        | 2.38          |
| 15             | 6.56                 | 5.13             | 2.50           | 4.34        | 2.19          |
| 16             | 5.13                 | 4.94             | 3.25           | 5.50        | 2.31          |

## RESULTS

As evident, the particular data from Moorefield's study translated to a five dimensional space (one dimension each for effectiveness, awareness, control, communication and esteem respectively). Thus, team member was defined by a five element point vector in this space. The procedure used for finding a useful team measure was then the two step construction discussed before. Step one began with a straightforward application of the Weiszfeld algorithm on the data set. A simple MATLAB routine was written to implement Weiszfeld's algorithm and find the median for each of the data sets in Moorefield's study and fifty iterations of Weiszfeld's algorithm were run to determine the median of each set . Table 4 lists the respective medians of each the data sets.

**Table 4**  
**Optimal Minisum Locations (Medians)**

**X\*: the median = (effectiveness, awareness, control, comm, esteem)**

Outdoor Team 1:  $X^* = (4.70, 5.17, 2.84, 5.01, 2.64)$

Indoor Team 1:  $X^* = (4.87, 4.96, 2.58, 5.03, 2.98)$

Indoor Team 2:  $X^* = (5.65, 5.44, 2.98, 5.21, 2.54)$

Step two used these optimal points to determine the average distance traveled for each team. The total Euclidean distance between the optimal minisum location point and each team member's initial location was calculated and then divided by the sum of the weights (i.e., costs per unit distance). Since all weights were assumed to be unity, their summation reduced to the number of members in each team. The results are summarized in Table 5.

**Table 5**  
**Average Distance Computed from Median Location**

|               |      |
|---------------|------|
| Outdoor Team  | 2.10 |
| Indoor Team 1 | 1.89 |
| Indoor Team 2 | 1.26 |

**Table 6**  
**Descriptive Statistics (Mean)**

|                 |               | <u>Effect.</u> | <u>Aware</u> | <u>Control</u> | <u>Comm</u> | <u>Esteem</u> |
|-----------------|---------------|----------------|--------------|----------------|-------------|---------------|
| Outdoor Team    | Pre-Workshop  | 4.79           | 5.17         | 2.84           | 4.99        | 2.72          |
|                 | Post Workshop | 5.05           | 5.17         | 3.14           | 5.01        | 3.32          |
| Indoor (Team 1) | Pre-Workshop  | 4.50           | 4.67         | 2.88           | 4.81        | 2.46          |
|                 | Post Workshop | 4.98           | 4.99         | 2.87           | 4.79        | 2.41          |
| Indoor (Team 2) | Pre-Workshop  | 5.57           | 5.39         | 3.03           | 5.19        | 2.49          |
|                 | Post Workshop | 5.86           | 5.78         | 2.86           | 5.51        | 2.10          |

**Table 7**  
**Comparison of Minisum Average Distance vs. Actual Average**

|                  | <u>Minisum</u> | <u>Actual</u> | <u>Actual/Minisum (%)</u> |
|------------------|----------------|---------------|---------------------------|
| Outdoor Team     | 2.10           | 1.38          | 65%                       |
| Indoor (Team I)  | 1.89           | 0.56          | 30%                       |
| Indoor (Team II) | 1.26           | 0.69          | 54%                       |

The actual average distance for each team in Table 7 was calculated in a similar manner by (1) finding the Euclidean distance between pre and post workshop locations for each individual team member; (2) summing; and (3) dividing by the number of members of each respective team. This completed the constructive process for our measure. Tables 6 and 7 contain the descriptive pre and post workshop statistics and the comparative results of average distance traveled.

The final results of the study are summarized in the last column of Table 7 which gives the respective ratios of the average displacement of the three given teams with respect to what a utopian exercise would have achieved. As argued before, this ratio thus gives us an evaluation of the actual effectiveness of the given team building exercise. Perhaps the most striking result of Table 7 is that none of the three teams have managed to attain their average minisum mark. Since this criterion represents a kind of worst case scenario, we can deduce that all three team training

workshops were unsuccessful in bringing the team as a whole to some non arbitrary minimal point. This conclusion seems to be in consonance with the general findings of Moorefield (1994).

The implication of this finding is unambiguous: as more and more organizations have begun to send participants to team building workshops, there has been a parallel demand that these experiential activities produce measurable positive outcomes that relate to defined objectives. In this study, we used a minimal baseline standard to measure the effectiveness of an actual team building exercise and found its performance to be lacking. This tentative evidence from our analysis suggests that setting the standard of team development as the minimal average gain may prove a more formidable objective than even the staunchest optimist would have thought.

It should be emphasized that this conclusion still holds even if we are tempted to shift the blame (of failure) from training procedures to personal motivation. There is nothing intrinsic to the minisum location problem that allows us to neatly isolate behavior from context. In contrast to this unwarranted reductionism, the minisum approach is holistic: it measures the behavioral development of a team-in-context as its members move simultaneously towards some single point. Thus, the only acceptable conclusion we can draw is that the overall development of team behavior within a particular training session did not meet minimal expectations.

#### CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

This paper has presented an innovative method for evaluating the effects of team training experiences. This method, which is based on the minisum facility location model, essentially compares the actual performance of a team building exercise on a given team against that of a utopian one that is capable of uniting these team members into a perfect team with minimum effort on behalf of the team members. The general procedure of the methodology was shown to be very straightforward: first, a valid and reliable instrument was used to assess pre and post experience development across a cohesive set of team related behaviors; second, this data was mapped to a perceptual attribute space; third, the optimal minisum location was determined via Weiszfeld's algorithm, from which the average minisum distance was easily found. We tested our method on an actual data set and concluded from this preliminary study that the workshop activities in the data set were ineffective.

As a methodology, the novel feature of the average minisum distance measure is its simplicity: it is a straight-line distance that can be directly compared to another straight line distance of actual progress. For this reason, it should have broad appeal to non-quantitative managers and human resource specialists alike.

The results here should be amenable to extension into a general methodology. However, while the technique presented in this paper does show good promise, the general robustness of the measure needs to be corroborated and future research on this topic should investigate this perspective. Systematic analysis of the measure using varying data collection instruments and team development programs are required to establish reliability and generalizability. This further research will make it possible to quantify with precision the relationship between the minisum and actual average distances, thereby allowing us to assess degrees of progress in addition to our "all or nothing" judgment.

Another promising area of research would be to experiment using different metrics. For example, the squared Euclidean distance function may prove to be a useful way to transfer learning effort as a weight into the actual metric, since this metric is more sensitive to outliers than the normal Euclidean metric and learning/motivation may have the same characteristic.

## REFERENCES

- Akende, A., (1992) "Team Skills Development: An Experience based Framework for Management Training", *Journal of European Industrial Training*, Vol.16 No.1, pp.10-16.
- Appelbaum, S.H., (1992) "Organizational Deflection, or Who Owns the Real Problem? Debunking the Nurse Physician Conflict by Team Building", *Leadership and Organization Development Journal*, Vol. 13 No. 1, pp. 2126.
- Baldwin A. (1991) "Effects of Outdoor Challenge Training on Group and Individual Perceptions," Paper presented at the *Society for Industrial and Organizational Psychology*.
- Bailey, B.A., (1991) "Developing Self Awareness through Simulation Gaming", *Journal of Management Development*, Vol. 9 No. 2, pp. 38-42.
- Bettenhausen, K.L., (1991) "Five Years of Group Research: What We have Learned and What Needs to be Addressed", *Journal of Management*, Vol. 17, No. 2, pp. 345-381.
- Berger, M., (1991) "Breaking Down Barriers Part II: Inter-Departmental Team Building", *Industrial and Commercial Training*, Vol. 23 No. 2, pp. 7-11.
- Botkin, B. (1979) *No Limits to Learning*. Club of Rome.
- Bradford, J.P., (1989/90) "Getting Together: A Composite Case Study in Team Building", *Optimum*, Vol. 20 No. 2, pp. 38-51.
- Cotton C. (1988) "Diverse Forms and Different Outcomes", *Academy of Management Review*, Vol. 13 No. 1, pp. 8-22.
- Daskin M.S. (1995). "Network and Discrete Location: Models, Algorithms and Applications," John Wiley and Sons, New York.
- Drezner, Z. (1995) ed. "Facility Location: A Survey of Applications and Methods". Springer-Verlag New York, Inc.
- Fulmer, R.M., (1992) "Nine Management Development Challenges for the 1990's", *Journal of Management Development*, Vol. 11 No. 7, pp. 4-9.
- Fulmer, R.M., (1992) "Using Cases in Management Developing Programmes", *Journal of Management Development*, Vol. 11 No. 3, pp. 33-37.
- Fulmer, R.M. and Graham, K.R., (1993) "A New Era of Management Development ", *Journal of Management Development*, Vol. 12 No. 3, pp. 30-38.

- Gamer, R.W., (July 1989) "The Right Tool for the Job", *Training and Development Journal*, pp. 46-51.
- Holden, L.P., (February 1990) "Training for Team Building", *Training and Development Journal*, pp. 37-42.
- Jayne, V., (February 1992) "Are Better Managers Built Outdoors?", *Management*, pp. 4549.
- Kazemak, E.A., (1991) "Ten Criteria for Effective team Building", *Healthcare Financial Management*, Vol. 45 No. 9, p. 15.
- Kirkpatrick, T. and Smith, B., (1991) "Team Development for Real", *Industrial and Commercial Training*, Vol. 23, No. 4, pp. 3-8.
- Luscher, B., (1990) "Improving Working Relationships: Group Effectiveness Training", *Journal of European Industrial Training*, Vol. 14 No. 5, pp. 4-20.
- Moorefield, D.L., (1994) "A Comparative Study of Experiential Learning Utilizing Indoor centered Training and Outdoor centered Training," Unpublished Dissertation, Texas Woman's University, Texas, USA.
- Mullen, T.P., (1992) "Integrating Self-Directed Teams into the Management Development Curriculum", *Journal of Management Development*, Vol. 11, No.5, pp.43- 54.
- Paustian, S.L., (1992) *Training Evaluation: The Transfer of Training of Outdoor Development Programs*. Cited in Moorefield (1994).
- Rakich J., (1991) "Simulation in the Hospital Setting: Implications for Managerial Decision making and Management Development", *Journal of Management Development*, Vol. 10 No. 4, pp. 31-37.
- Schweiger, D. (1989), "Experimental Effects of Dialectical Inquiry, Devil's Advocacy, and Consensus Approaches to Strategic Decision Making", *Academy of Management Journal*, Vol. 32 No. 4, pp. 745-772.
- Seashore, S.E., Lawler, E.E., Mirvis P. and Camman, C., (1982) "Observing and Measuring Organizational Change: A Guide to Field Practice," John Wiley and Sons, New York.
- Senge, P.M., (Autumn 1990) "The Leader's New Work", *Sloan Management Review*, pp. 7-23.
- Smith, Y. S., (1995) "Images and Cognitive Styles in Strategic Decision Making Groups" Unpublished Dissertation, Texas Tech University, Lubbock, Texas, USA.
- Spector, P.E., (1988) *Locus of Control in Work Scale*. Cited in Moorefield (1994)
- Stone, J. and Wagner, R.J., (1992) *Development of an Interpersonal Relations Scale for Outdoor based Experiential Training Programs*. Cited in Moorefield (1994).

Stumpf, S.A., (1992) "Special Section on Experimental techniques in Management Development", *Journal of Management Development*, Vol. 11 No. 5, pp. 41-42.

Taylor, J.F., and Bowers, D.G.,(1972) "Survey of Organizations: A Machine Scored Standardized Questionnaire Instrument," Institute for Social Research, University of Michigan, Ann Arbor, Michigan USA.

Wagner, R., Baldwin, T., and Roland, C., (March 1991) "Outdoor Training: Revolution or Fad?", *Training and Development Journal*, pp. 50-65.

Weiszfeld, E., (1936) "Sur le Pointe pour Lequel la Somme des Distances de n Points Donnes est Minimum," *Tohoku Mathematics Journal*, Vol. 43, pp. 355-386.