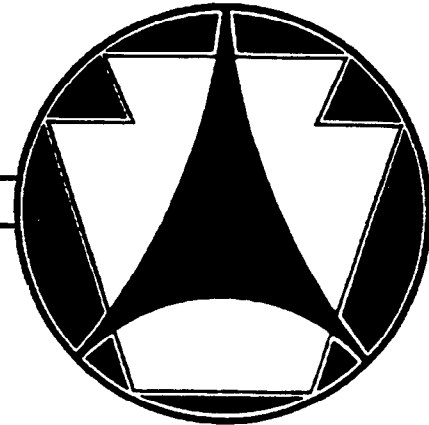# COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

PENNDOT RESEARCH

DEVELOPING A LEARNING ORGANIZATION

University-Based Research, Education and Technology
Transfer Program
AGREEMENT NO. 359704, WORK ORDER 46

FINAL REPORT

DECEMBER 2000

By P. B. Nagendra, T. W. Falcone, and A. Amin Mohamed

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16. Abstract
The report pertains to the long-term project undertaken by District 10-0 of Pennsylvania DOT to understand and promote the concepts of a learning organization using the principles espoused by MIT professor Peter Senge. The training, as well as the instruction and facilitation of the yearlong project, were done by three professors from the Department of Management at Indiana University of Pennsylvania. The project was intended to improve the knowledge, skills, and attitudes necessary for organizational development and to integrate the principles of systems thinking in the organization. The results of the project and the training program, as evidenced by several testing and observation tools, show significant improvement in all the three aspects for the participants—knowledge, skills, and attitudes. The report outlines the details of the project including the training program, the pedagogy, the composition of the groups of trainees, the tests, assignments, and results of the program. The report also outlines recommendations for the future.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

From October of 1999 through September 2000, approximately 70 of the top managers in PennDOT's District 10-0 participated in a pilot training and organizational development program that was designed to help the District become a "learning organization." District 10-0 had been contemplating such a program for several years and special funding was quite timely in enabling them to pursue fundamental organizational development based on sound managerial and organizational values and principles. A team of three management professors from Indiana University of Pennsylvania was contracted to provide monthly classes on the full range of learning organizations concepts, applications, and interventions.

The program was very intensive, requiring managers to attend a daylong seminar each month for a year, participate actively in class, complete out-of-class assignments, read two lengthy books, and then implement the concepts into their work lives. District 10-0 dedicated many resources to the program and expected high levels of commitment from all the participants.

The coverage of learning organization concepts was comprehensive and exhaustive. It was based primarily on MIT Professor Peter Senge's concepts espoused in his popular book, *The Fifth Discipline*, and the corresponding Field Book (exercise book). Each of Peter Senge's five disciplines was discussed and studied in depth during two months of classes. Exercises from Senge's Field Book, as well as from other sources that illustrated the concepts, were extensively used to drive home Senge's ideas.

The results from a pre-test that measured knowledge, attitudes, and the ability to apply learning organization ideas were compared with a post-test to ascertain the success of the program. The results of the comparison between the two tests were quite positive, with participants showing strong growth in learning and the application of concepts. The results for attitudes were not statistically significant, but clinical analysis of testimonials from the participants showed very positive perceived progress and extreme satisfaction with the experience.

The program appears to have been very successful in helping District10-0 move closer to becoming a learning organization. The hands-on approach over an extended period of time seems to promote long-term learning and a culture of change and commitment. The facilitators recommend this pilot program be considered for other venues in the PennDOT system as well as other similar public organizations. Furthermore, it is recommended that follow-up training at District 10-0 further reinforce learning organization concepts and extend the ideals of continuous improvement. Another important step is for District 10-0 to disseminate the theories and practices of a learning organization to the employees who did not go through the training program. This can be done in different ways--by in-house training, short-term external training, or by actively utilizing the principles in work meetings and other activities in the organization. While training other employees in the organization, it is recommended that a cross-section of employees from *all* the levels of the organization be involved.

1. INTRODUCTION

This research report will present some of the results of the year-long seminar on Peter Senge's learning organization held at District 10-0 from October 1999 to September 2000. The report will also explore some of the theoretical and pedagogical findings from the experience, as well as the performance and the overall success of the undertaking.

The project initially was supposed to be a series of 12 classroom training sessions conducted jointly by three instructors. It was discovered quickly, however, that a genuine "learning organization" training program had to be more integrated. The class itself had to be intimately involved to ensure the necessary commitment to change fundamentally. A shared sense of reality and a vision for the future needed to be created. This was done by developing a variety of hands-on exercises for the class and inviting volunteers from the class to actually help design the class. Also, after-action-reviews (AARs) were conducted after every class to help everyone engage in improving and evaluating the experience.

Considerable time is spent in this report discussing how far this class of the top 70+ managers in District 10-0 progressed toward becoming a learning organization. The typical resistance to change was experienced in the early stages, but the comparisons between the pre-test and post-tests demonstrate growth of the management core toward Senge's model. Our personal observations are also used to support the contention that District 10-0 made quite a leap forward.

2. BACKGROUND

Pennsylvania Department of Transportation District 10 recognizes that it is important to sustain and promote quality and productivity at all levels and functions of the organization. It has undertaken a number of initiatives to be a world-class organization. The organization has recently embraced the Baldrige criteria, undertaken "Strengths, Weaknesses, Opportunities, and Challenges" (SWOC) analysis, defined strategic focus

areas, developed a customer focus, and undertaken a variety of best practices to more strategically align the organization. An in-depth study of the "learning organization" concepts fits nicely with these other activities/components and lies at the heart of organizational development. Organizations simply must "learn how to learn" if they are to remain at the cutting-edge of quality in today's hyper-competitive organizational environment.

The idea of exposing more than 70 top managers in District 10-0 to this kind of material was serendipitous in several ways. First of all, District 10-0 was able to get a special grant to pay for the class. In addition, Mr. Bob Friday, an independent consultant, had been trying to convince District 10-0 officials for several years that they needed a training program such as this one. Subsequently and coincidentally, Bob Friday was hired as a manager by the Indiana University of Pennsylvania School of Continuing Education, through which the three instructors provided the training program.

3. THE TRAINING PROGRAM

The more than 70 participants in the training program were selected by the District Engineer and other senior managers in District 10-0. The participants included all managers from the top seven tiers of the district. The need for the training program was identified as described earlier. The training coordinators from Indiana University of Pennsylvania included three faculty members from the Department of Management—Prashanth B. Nagendra, Thomas W. Falcone, and A. Amin Mohamed. The training program was designed in summer 1999 by the three coordinators, working closely with a team of managers from District 10-0.

4. PROGRAM STRUCTURE

The learning-organization training program was based largely on Peter Senge's work in the subject area using his book, *The Fifth Discipline*, as well as the field book that

supports it. *The Fifth Discipline* provides a solid framework for developing a learning organization. It is based on five basic disciplines as described briefly below:

1. *Personal mastery* (continuously clarifying and deepening one's real personal vision);

2. *Mental models* (surfacing, understanding, and clarifying deeply ingrained assumptions and generalizations of our world—business and personal);

3. *Shared vision* (discovering a shared picture of the future of the organization/team that will foster genuine commitment and enrollment rather than just compliance);

4. *Team learning* (developing the ability to develop a dialogue in which team members are in a mode that embraces the collective good and refrain from individual self-interest); and

5. *Systems thinking* (the discipline that underlies the other four. It brings the concept of interconnectedness into organizational context).

The year-long program was comprised of 12 sessions, conducted once a month. The first session was held in October 1999 and the last session was in September 2000. The managers in the program were divided into two cohort groups of almost equal size. There were 70 managers at the beginning of the program, and due to retirements, turnover, and hiring, 75 managers in all were enrolled in the program. A total of 65 managers were enrolled in the program from beginning to end. Attendance was taken during each session and was maintained by both the training coordinators, as well as the training manager from PennDOT. The first and last sessions were conducted with all 70$^+$ participants, while sessions 2 through 11 were repeated for the two cohort groups. Switching between cohort groups was allowed only for valid reasons and was arranged by mutual agreement between two individuals in the two different cohort groups. Conscious effort was made to maintain uniformity of content, examples, exercises, and pace in the two cohort groups. All sessions started at 9:00 a.m. and ended at 3:30 p.m. with a half-hour lunch break between noon and 12:30 p.m.

The first session was the introductory session, while the last session was a synthesis of the material covered. The first and last sessions were also attended by the Pennsylvania Deputy Secretary of Transportation, Mr. Pete Tartaline. He helped inaugurate the

program by describing the need for such a program and returned at the end to provide guidance to the participants on how they could utilize the program to foster a learning environment in the entire organization. In the remaining 10 sessions, the coordinators addressed the five disciplines described above in two sessions per discipline. An analogy of the human body was used to introduce the framework of the five disciplines.
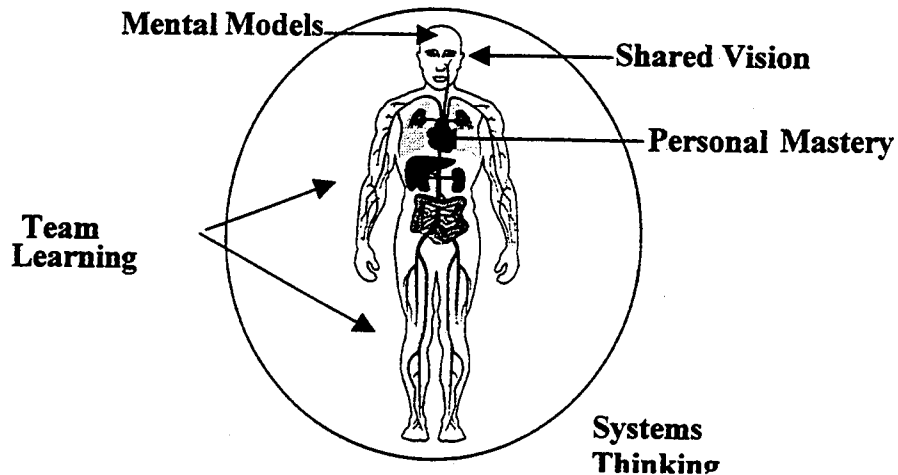
The *heart* represents the discipline of *personal mastery*. It is only from the heart that individuals can clarify what is truly important to them and only from the heart emanate enthusiasm and loyalty—two attitudes that individuals bring to their jobs *voluntarily*. Employers cannot force these attitudes on their employees on a consistent basis. The architects of learning organizations are individuals that are dedicated to high levels of personal mastery. The *brain/mind* represents the discipline of *mental models*. The skills of reflection and inquiry that form the foundation of challenging and improving mental models are a function of the brain/mind. The *eyes* represent the discipline of *shared vision*. We all have two eyes, but luckily the light that emanates from them both is one resulting in an individual's single physical vision. Similarly, a learning organization's members together co-create a single shared vision. The *hands and legs*, the primary motor organs of the body, represent the discipline of *team learning*. An organization comprised of individuals with high levels of personal mastery, improved mental models, and shared vision can reach its destination (vision) with the help of the motor organs of a learning organization—team learning. The *entire body* is representative of the discipline

of *systems thinking*. The interconnectedness of the different organs and systems of the body exemplifies the need for systems thinking in organizations, which are similar to organisms in several respects.

5. PEDAGOGY

The program was originally designed to be a training program, whereby the three instructors would "teach" the principles and practices of learning organizations utilizing experiential exercises and the framework provided in *The Fifth Discipline*. It was obvious in the beginning of the yearlong program that the instructors had to play the roles of consultants and facilitators to a certain extent, in addition to being teachers during the sessions. Within the first three months of the program, two volunteer-teams were set up from the 70+ participants. One team volunteered to help the instructors with designing content and format for each of the sessions, while the second team was responsible for designing experiential exercises that would be relevant to the District 10-0 working environment. The instructors worked very closely with these two teams. These teams not only helped the instructors in staying on target with their pedagogy, but also helped empower the participants and alleviate the initial resentment toward the program itself by some of the participants. The instructors maintained close contact with the teams through e-mail, fax, and telephone. Also, the instructors met with the teams for one hour from 8:00 – 9:00 a.m., right before the first session of each month, to plan the itinerary and exercises for the following month.

Each of the sessions comprised of the following agenda—a review of previous material, covering new concepts through interactive lecturing by the instructors, discussion, experiential exercises, presentations by participants, discussions facilitated by instructors and finally, an after-action-review (AAR). The ratio of time devoted to interactive lecturing/experiential exercises and discussions was approximately 40/60. This was based on the experience of the instructors and the feedback received by the participants. This format was very effective, as evidenced by the AARs and the informal feedback obtained by the participants.

For each of the sessions, participants received a PowerPoint handout (with space to make notes). The handout contained a comprehensive outline of the interactive lectures, a detailed explanation of the experiential exercises to be conducted during the session, an analysis of the assignment from the previous session, and a synopsis of the previous session's material. Each session started off with the coordinators introducing the agenda for the session and a brief review. The last fifteen minutes of each session was dedicated to an AAR. The AAR provided valid and immediate feedback from the participants and the instructors on specific forms of pedagogy that need to be sustained as well as improved. The instructors used the constructive feedback in their quest for continuous improvement.

As mentioned earlier, the training program was designed around Senge's *The Fifth Discipline*. However, the coordinators introduced the participants to several related management philosophies and practices. For example, Stephen Covey's ideas about being proactive and managing time, Peter Drucker's work on leadership, Deming's discussion of quality and change management, etc. were introduced to the participants during the interactive lecturing. A library of more than 40 articles related to learning organizations was created for the benefit of the participants. The District also had audio and video tapes on the topic for participants to listen and watch during their spare time. Several experiential exercises that helped participants clarify personal vision, surface and test mental models, develop shared vision, and so on were conducted in class. Wherever appropriate, exercises were directly drawn from the District 10-0 work environment that had strategic and immediate importance for the organization. An excellent example of that was the successful incorporation of the ongoing business plan process in the District with the shared vision and team learning components of the training program.

Many new managerial tools were introduced during the training program and, in addition, the managers gained experience in using them during the program. Examples include storyboarding, scenario analysis, force-field analysis, and AAR. Several short videos

illustrating the learning practices in several successful learning organizations helped the participants in understanding and practicing these techniques.

At least one team exercise was conducted during each session. The teams were formed based on the objective of the exercise. Some of the team exercises involved functional teams (design, construction, maintenance, administration), some involved geographic divisions (county offices), and some teams were formed randomly. Each of the team exercises included specific objectives, process, and presentation of findings and/or recommendations. The coordinators made sure that they worked with each of the teams closely in order to assure efficiency and effectiveness. The large participant cohort group size of 35^+ in this intensive program necessitated active participation of all three instructors in the training program, especially during the team exercises.

6. THE LEARNING TRIANGLE

Throughout the training program, there was an emphasis on all the three sides of the "learning triangle": knowledge, skills, and attitude. The coordinators imparted knowledge of systems thinking, quality management, organizational development, change management, and related management topics in their interactive lectures. Skills such as team learning, dialogue, co-creation of vision, communication, and suspending and improving mental models were gained through several experiential exercises conducted during the sessions. The class discussions, experiential exercises, and assignments were also designed to improve the attitude of participants towards communication, teamwork, interpersonal relationships, etc. The difference between the pre-test and post-test (which will be discussed in detail in the **RESULTS** section), as well as other results, showed that there was significant improvement in all three facets of learning.

7. RESULTS

Training effectiveness is evaluated relative to the objectives that the training was designed to achieve. The objective of this training was to improve the participants' knowledge of Peter Senge's learning organization concepts.

There are several methods for evaluating the effectiveness of training. One method is to measure the changes in knowledge and attitudes as a result of the training. To do this, a test-retest methodology is adopted. In this approach, the participants are assessed on knowledge and values before and after the training using one test. Statistical analysis of the test results can then be used to determine if any improvement has occurred as a result of the training.

The test that was constructed to evaluate the training was composed of three parts. The first part of the test was composed of 27 multiple-choice questions to measure knowledge of the five disciplines of the learning organization. The questions were based on the content of Peter Senge's book, "*The Fifth Discipline.*"

The second part of the test was composed of 21 statements that participants were required to rate their approval of, using a five-point Likert-type scale that ranged from strongly disagree to strongly agree. These statements were designed to reflect values related to organizational learning, such as participative leadership, learning, and continuous change. The maximum number of points that the participants could achieve on this section was 105 points.

The third and final part of the test was composed of two essay questions. The first question asked the participants to identify the characteristics of a great organization or team that they were a part of. This question was designed to measure the participants' ability to apply the learning organization concepts. In other words, the purpose was to know if these concepts had become part of the participants' vocabulary. The second question asked the participants to describe their role in fulfilling District 10's vision,

mission, and values. The purpose of this question was to measure how the training has affected the participants' view of their role in the organization. These two questions also addressed Senge's five disciplines of a learning organization

The pretest was administered during the first session and the posttest was administered during the last session; 66 participants took both tests.

8. ANALYSIS

As mentioned above, the first part of the test measures improvements in knowledge as the result of the training. The mean score on this part of the test before the training was 13.7 out of a maximum of 27. On average, participants answered incorrectly about half of all the questions. After the training the mean score on the post-test increased to 18.7. This improvement in test performance is statistically significant at the 99.9% level. Also, the median score in the pre-test was 14, while the median score in the post-test was 19. The range in the post-test (lowest 12 to highest 25) also improved significantly from the range in the pre-test (8 to 24). These results indicate that the participants' knowledge of Peter Senge's learning organization theory improved substantially as a result of the training.

Results of the second part of the test, which measures change in attitudes, indicated a small increase in mean score from 75 points before the training to 76 after the training. However, this increase is not statistically significant. The lack of significant attitudinal change may be attributed to the high positive attitudes that the participants possessed before the training. In other words, the participants came to the training program believing in the importance of participative leadership, learning, and change. When these attitudes are already present at a high level, it becomes difficult for training to further improve them.

To examine further the impact that this training had on the attitudes of the participants, a content analysis was performed on the final class assignment (participants were asked to list three things they will do differently as a result of the learning organization training).

9

This content analysis involved counting the number of times specific statements that indicate attitude change were made.

A number of participants actually documented in the final assignment that their attitudes had changed, are changing, or are intended to change. Others mentioned that they had seen changes in the attitudes of others around them as follows:

The numbers next to each statement represents the number of individuals who expressed that particular view:

- "Acknowledge mistakes immediately" 18
- "Being loyal to the truth" 19
- "The triangle represents personal mastery. The base of the triangle is attitude." 23
- "Recognize that I am the main cause of my problems" 25
- "Strive to eliminate the we/they attitude" 26
- ". . . challenging the way I think" 28
- "I must be aware of my assumptions and stereotypes" 29
- "Be more cognizant of what I say and actually do" 30
- "Be more patient, listen to the whole problem before making rash decisions" 31
- "I will train my employees the essentials of the learning organization and guide them in applying it." 40

Other participants emphasized their desire to communicate better as follows:
- "Get beyond discussion and debate to dialogue" 3
- "By everyone discussing and sharing their ideas, we have more input and far less problems" 10
- "I will cease taking some words literally" 11
- "Communication has improved" 24
- "More selling than telling" 32

Participants also emphasized the need for personal change and growth as follows:

- "Consider my own as well as other's mental models" 4
- ". . . leading significant change and being a visionary" 6
- " Learn to work together to affect positive organizational change" 7
- " I think much more about mental models than I previously did" 15
- " Be committed to personal growth and learning" 27

Additionally, participants expressed their need to built openness, trust and teamwork as follows:

- " Promote honesty and openness" 8
- ". . . create a team environment" 9
- "I will reaffirm my belief that integrity above all else is of utmost importance" 12
- "We will create shared vision" 13
- "Co-create shared vision" 14
- "Diversity is imperative" 15
- " Mentor newer employees" 16
- "Be more conscious of the importance of getting people involved to obtain their input and buy-in" 20
- "Promote learning by coaching" 39

Although the results were not statistically significant in the attitude part of the post-test, the above statements from the final assignment provide sufficient evidence that the attitudes are extremely positive, mainly as a result of this training program.

As for the third part of the test, which was designed to measure the trainees' ability to use the concepts and ideas presented to them during the training, the results indicate significant improvements. Content analysis was used to analyze the trainees' responses. This method involved counting the number of times a specific concept was used by the trainees. The table below provides a summary of the word count results.

Concept	Pre-training	Post-training
Five Disciplines		
• *Personal Mastery*	0	10
• *Mental Models*	0	6
• *Shared vision*	68	115
• *Teams*	66	146
• *Systems thinking*	12	22
PennDOT Vision & Mission		
• *Quality*	13	15
• *Customers*	59	70
• *Services*	49	64
• *Partners*	8	9

As the above table shows, the trainees used the five disciplines and PennDOT vision and mission concepts much more frequently after the training than before it. This may demonstrate the ability of the trainees to apply these concepts to their work setting. It may also indicate that the trainees now focus more on such concepts as quality and customers more than before the training. Additionally, it was noticed that the trainees' post-training responses were much longer and detailed than their pre-training responses (an average of 775 words/participant in the post-test compared to 510 words/participant in the pretest). This may indicate that the trainees have developed, perhaps because of the training, a more detailed view of their role in achieving District 10's vision, mission, and values.

9. RECOMMENDATIONS

1. This pilot program may be considered for other venues in the PennDOT system, as well as other similar public organizations.

2. Follow-up training at District 10-0 will further reinforce learning organization concepts and extend the ideals of continuous improvement.

3. District 10 should consider disseminating the theories and practices of a learning organization to the employees who did not go through the training program. This can be done in different ways—by in-house training or short-term external

training, or by actively utilizing the principles in work meetings and other activities in the organization. While training other employees in the organization, it is recommended that a cross-section of employees from *all* the levels of the organization be involved.

4. The trainers should play the role of consultant and facilitator in order to assure success in the training program related to organizational development.

5. Participants should play an active role in designing the content and pedagogy of the training program and should be allowed to volunteer for the program.

6. In order to assure long-term benefit from this training program, the facilitators recommend that the knowledge and skills acquired during the program must be integrated into the day-to-day activities of the organization.