

Canadian Manufacturing Network

# Workplace Literacy and Essential Skills Research

Advanced Precision  
Process Improvement through  
Problem Solving



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## Executive Summary

### Advanced Precision: Process Improvement Through Problem Solving

Advanced Precision Machining and Fabrication Ltd. is a Dartmouth, Nova Scotia-based manufacturer of high quality, military grade machined components. The company serves a range of Canadian and US clients in military, aerospace, ocean science, and oil and gas quality machined components on the forefront of machining technology. An ISO registered company, Advanced Precision employs computer assisted design equipment as well as highly flexible speed machining equipment allowing production employees to reduce costs and order lead-times by bypassing multiple setups, handling costs and defective parts.

This case study evaluates a training program, Process Improvement through Problem Solving, developed by Advanced Precision in 2013 in response to identified shortcomings in its workforce's capabilities. In particular, the company's leadership recognized the critical importance of enhancing workforce skill levels in order to remain competitive globally and to meet the increasing demands of new technologies—complexity, quality, flexibility, and efficiency.

The ten-week, 40-hour course focussed on thinking and problem solving skills. Participants explored and practiced the use of four widely-used problem solving tools—Brainstorming, Fishbone Diagram, the 5 'Whys', and Flow Charts. The goal was to address areas identified for improvement—communication between departments and people; atmosphere and motivation; training and ongoing development of people; and scheduling and troubleshooting strategies.

Although the training evaluation suggested that the training did not measurably result in direct, near-term, business improvement as anticipated, it did uncover other surprising and substantial benefits from essential skills training.

Both training participants and their managers reported only low or moderate gains in such key performance measures as improvements in quality and reduced scrap. Interviews revealed that the training failed to deliver impact because the new knowledge and skills were not satisfactorily transferred to the job. This situation—likely the result of poor program design by the outside vendor—is, regrettably, one of the most common reasons why training frequently fails to deliver expected improvements in job performance and productivity.

Even although the essential skills training failed to immediately impact business outcomes, it did, nevertheless, have dramatic consequences. The training yielded insights and created an enhanced, organization-wide level of awareness of the critical importance of adopting new approaches and strategies to improve workplace process and productivity.

Enhanced awareness resulting from the problem-solving experience encouraged management to implement a formal program to systematically and continuously manage and improve production quality and performance (called process management). In retrospect, the initial essential skills training, although unsuccessfully implemented, became the springboard for the implementation of new and more effective training and, more importantly, for the adoption of a company-wide culture of quality and continuous improvement.

Although the new program, Process Management, was not formally evaluated as part of this study, management calculates that the training has resulted in the savings of one FTE (full time equivalent employee) per day plus an additional \$1,200 savings daily resulting from other improved efficiencies.

The striking success of the new Process Management tools and methodology has encouraged management to establish process management as a permanent, core element of its manufacturing culture.

Interestingly, the new training sought to overcome the transfer barriers experienced in the previous essential skills program by systematically linking and integrating the training into the needs of the workplace. As a result, all training takes place within the context existing workplace problems and is immediately applied to solving ongoing efficiency, quality, and productivity challenges.

According to Advanced Precision' Human Resources Manager, Susan Elliot, "By instilling fundamental problem-solving capabilities in our workers, the (earlier essential skills) training introduced us to the improvement concepts and possibilities. Although that first effort in problem solving training did not have a great bottom line payoff, it was ultimately invaluable. It's been the springboard that launched our current successes in improving quality and productivity."

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## Case Study

### Advance Precision: Process Improvement through Problem Solving

By Canadian Manufacturing Network with research & report contributed by Lynette Gillis Ph.D. & Allan Bailey, Centre for Learning Impact "

#### Study Background

**Overview of Advanced Precision** Advanced Precision Machining and Fabrication Ltd. designs, manufactures and assembles high quality, precision components and complex fabrications. Operating from its Dartmouth, Nova Scotia, facilities the company serves a range of Canadian and US clients in military, aerospace, ocean science, and oil and gas.

In a little over two decades, Advanced Precision has evolved as a highly flexible supplier of quality machined components on the forefront of machining technology. The company employs sophisticated computer assisted design equipment as well as the latest in 5-axis multi-tasking and speed machining equipment. Such assets permit rapid and complex design and allows production employees to reduce costs and order lead times by bypassing multiple setups, handling costs and defective parts.

Advanced Precision is a registered ISO 9001:2008 and is qualified to produce and distribute defence products throughout Canada and the United States. A significant percentage of the firm's core business is with U.S. defence contractors who have selected Advanced Precision as a strategic partner for offset programs related to Canadian Crown projects.

**Training Rationale** The training program, Process Improvement through Problem Solving, training program was developed in response to respond to gaps identified through an organizational needs assessment. The assessment revealed Advanced Precision's continued success in the increasingly competitive world of precision machining would require enhancing critical capabilities of the workforce. In particular, it was recognized that key essential skills areas—communications and problem solving—required enrichment if the organization is to meet the increasing demands increasing complexity, quality, flexibility, and efficiency.

**The Training** The training included problem solving and a verbal communication component designed to help work teams develop better understanding between departments and between various professional levels of the organization. This ten-week, 40 hour course focussed on thinking and problem solving skills—how to identify and address process challenges and opportunities for improvement.

Participants explored and practiced the use of four widely-used problem solving tools throughout the program. These tools were used as a method to explore previously identified workplace issues, problems or processes in need of improvement.

The four main tools used were: Brainstorming, Fishbone Diagram, the 5 'Whys', and Flow Charts. These tools were used to work on four areas identified for needed improvement: a) communication between departments and people, b) atmosphere and motivation, c) training and ongoing development of people, and d) scheduling and troubleshooting strategies.

**The Training Outcomes** Evaluation results suggest that problem solving training did not measurably lead to direct, near-term improvement in business outcomes as anticipated. The results, however, may have shed a spotlight on a dimly understood strategic benefit of essential skills training.

According to Advanced Precision, in spite of its lack of immediate success, the problem solving training led the organization to a heightened awareness of training's potential. This new awareness subsequently led to the adoption of additional and more focused Process Management training that is currently yielding substantive performance improvements and is directly improving bottom line results.

### **Failure of Problem Solving Training**

The earlier problem solving training program failed as a result of one of training's most notorious barriers to success—the failure of participants to *transfer* their new learning to their jobs. (See the Learning Value Chain below.)

Initially, it was anticipated the problem solving training would result in improvements in eight key metrics. For example it was hoped that the training would improve efficiency and quality as well as lead to reduced scrap and cycle times. Study results suggest that there was little meaningful improvement in these measures as a result of the training.

After the ten weeks course, however, both training participants and their managers reported only low or moderate gains in all key performance measure. Notably, in the post-training survey all managers reported only "low" or "moderate" improvement in quality and reduced scrap. Three-quarters of managers reported only "low" or "moderate" gains in efficiency, reducing cycle time, and enhancing productivity.

In the post-training survey training participants identified several key factors responsible for the failure to transfer learning to the job: 'lack of interest and support of management' (66% of participants); 'existing policies, procedures, and work processes' (67%); and 'unable to dedicate the time needed to practice new skills' (50%).

These types of barriers represent a classic training failure mode—failure to transfer. Such situations often result from poor training design/implementation which typically affords few built-in opportunities for participants to apply new strategies to real world problems back in the workplace. In this instance, the training was conducted by an outside vendor who provided classroom instruction but no provisions for follow-up activities or strategies to help employees integrate new skills in their jobs.

### **Essential Skills: The Springboard Effect**

Even although the problem solving training failed to impact business outcomes, it did bring about other unintended benefits to the organization. According to Advanced Precision' Human Resources Manager, Susan Elliott, the program gave managers and production staff a new appreciation for, and insights into, the possibilities and the potential of adopting new tools and strategies to improve workplace process and productivity.

As a result of the learning from the problem-solving training, Advanced Precision management made the decision to develop and implement a formal program to systematically and continuously manage and improve production quality and performance. A new training program, Process Management, was developed that

employs many of the strategies taught in the original problem solving training, only this time the training from the outset has been systematically linked and integrated into the needs of the workplace. A key difference in this most recent program is that all training takes place within the context of solving ongoing efficiency, quality, and productivity challenges experienced by Advanced Precision.

Although the newer program was not subject to the research evaluation methodologies of this study, it is worth noting that the Advanced Precision has already completed implementing new process management strategies in one of their precision milling operations and has begun applying them in other parts of their operations.

The organization has tracked the business outcomes resulting from improved efficiencies in the milling process. The company asserts that the new process-management techniques have resulted in the savings of one FTE (full time equivalent employee) per day plus an additional \$1,200 savings daily resulting from other improved efficiencies. The early success of the new Process Management training program has encouraged management to establish process management as a core element of its manufacturing culture.

Interestingly, Advanced Precision attributes the success of the new process management program and its full adoption company-wide to the earlier, less successful problem solving training. That first program was a catapult to success. Reports Advanced Precision's Elliott, "By instilling fundamental problem-solving capabilities in our workers, the problem-solving training introduced us to the improvement concepts and possibilities. Although the effort in problem solving training did not have a great bottom line payoff, it was ultimately invaluable. It's been the springboard that launched our current successes in improving quality and productivity."

## Methodology: High Impact Evaluation

**The Case Study Methodology** **The Learning Value Chain™**  
The Advanced Precision investigation adopts the Learning Value Chain evaluation approach—the core evaluation framework and instrument-set develop for the Gillis and Bailey High Impact Evaluation model. The Learning Value Chain™ framework offers an uncomplicated, field-tested framework for evaluating the learning effectiveness and the business value of training and human resource investments (Figure1).

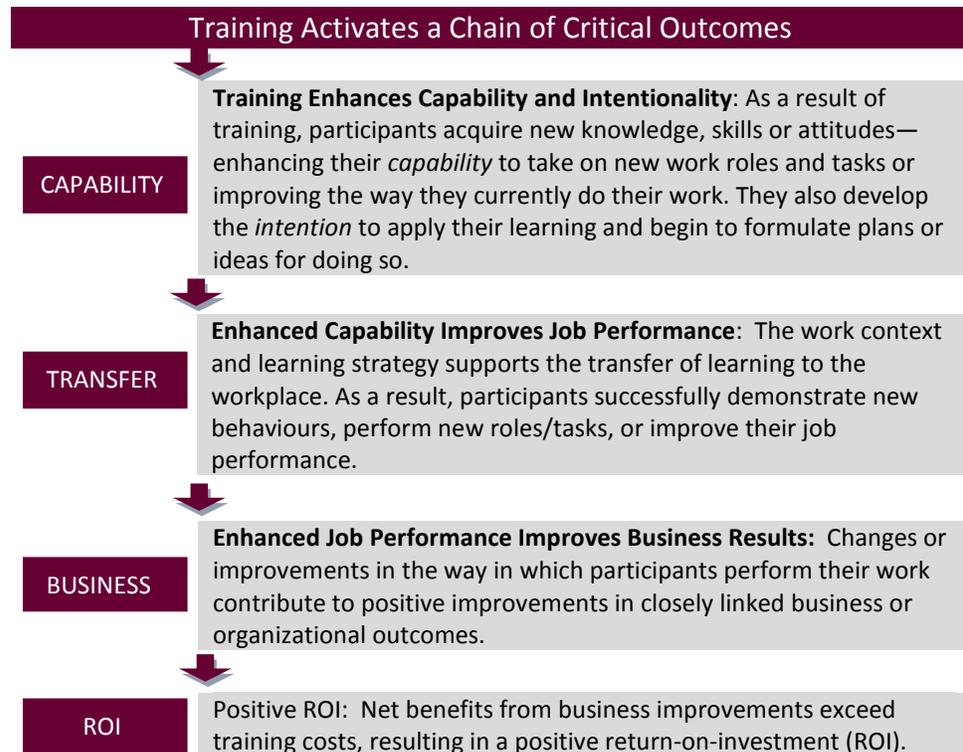
In the Learning Value Chain™, the training program triggers a chain of critical outcomes. Monitoring this chain of outcomes adds an innovative and critically important predictive value to the evaluation process. As desired outcomes are achieved at each link along the chain, greater value is added and the likelihood increases that training will result in positive business outcomes and return on investment. Conversely, if training fails to meet outcomes at any link, value is diminished and the prospect of positive business results and return on investment is at risk.

Using the Learning Value Chain™ framework, the training program is evaluated at

each of four links (Capability, Transfer, Business Results and ROI). At each link, data is gathered to assess the extent to which the training has achieved key outcomes, added value and enabled the next critical event in the chain to occur.

The Learning Value Chain™ model also incorporates a diagnostic strategy to investigate training practices and strategies that may strengthen or weaken outcomes at each link and subsequently influence business impact and return on investment.

**Figure 1**  
**The Learning Value Chain™**



## Capability Results

**Evaluation Questions:** Did training participants develop new capability: acquire new knowledge and skills, adopt new attitudes, improve existing skills, or discover new and more productive ways of doing work? Did participants also develop the intention to apply their learning or improve their job performance?

### Training enhances learning and had a high or moderate impact on other Capability indicators such as Confidence, Motivation and Perceived Value

To assess Capability—the first link in the Learning Value Chain™—course participants were asked to complete the Capability Questionnaire at the conclusion of the Process Improvement through Problem Solving training.

The findings suggest that the training program enhanced participants' capability. Self assessments by participants suggest overall gains in learning. Assessment of improvement by participants' managers also suggested gains in skills and knowledge. The majority of learners also expressed a moderate level of confidence in their ability to use the techniques learned in training. Most expressed 'high' or 'moderate' levels of motivation to use the training. All participants perceived value in the training.

### Key questionnaire results are described below and summarized for all program participants in the Capability Index (Figure 2).

- **Skills & Knowledge:** Before training, the majority (two-thirds) of training participants rated their knowledge and skill level as “low” and the remainder rated their knowledge as “moderate” or “high.” After training, two-thirds rate their knowledge and skills “moderate” and a quarter rate their level as “high.”
- **Manager Rating Knowledge and skills:** 80% of participant's managers rated their employee's knowledge and skill levels as “low” prior to training. After training managers opinions were equally divided—almost half rating the skill and knowledge levels of participants as “low” and a similar number reporting levels had improved to “high.”
- **Confidence in Applying Learning:** The largest proportion of participants (62%) report a “moderate” level of confidence in their ability to effectively apply their problem solving knowledge and skills to their jobs. Of remainder, 34% report a “high” level of confidence.
- **Motivation to Apply Learning:** Half of participants report that they are “highly” motivated to apply their learning; one-third are “moderately” motivated.
- **Perceived Value:** Half of participants (50%) perceive the program's value as “high” (i.e., credible, practical, relevant, and essential). The remainder rated to value as “moderate.”

**Risk Alert for Transfer** The majority of participants report a moderate impact on their skills and knowledge as result of training and are only moderately confident in their ability to apply the learning. The yellow flag alert suggests that moderate ratings may hinder learning transfer. Employing strategies to strengthen these results will enhance the likelihood of the program impacting job performance, organizational results and ROI.

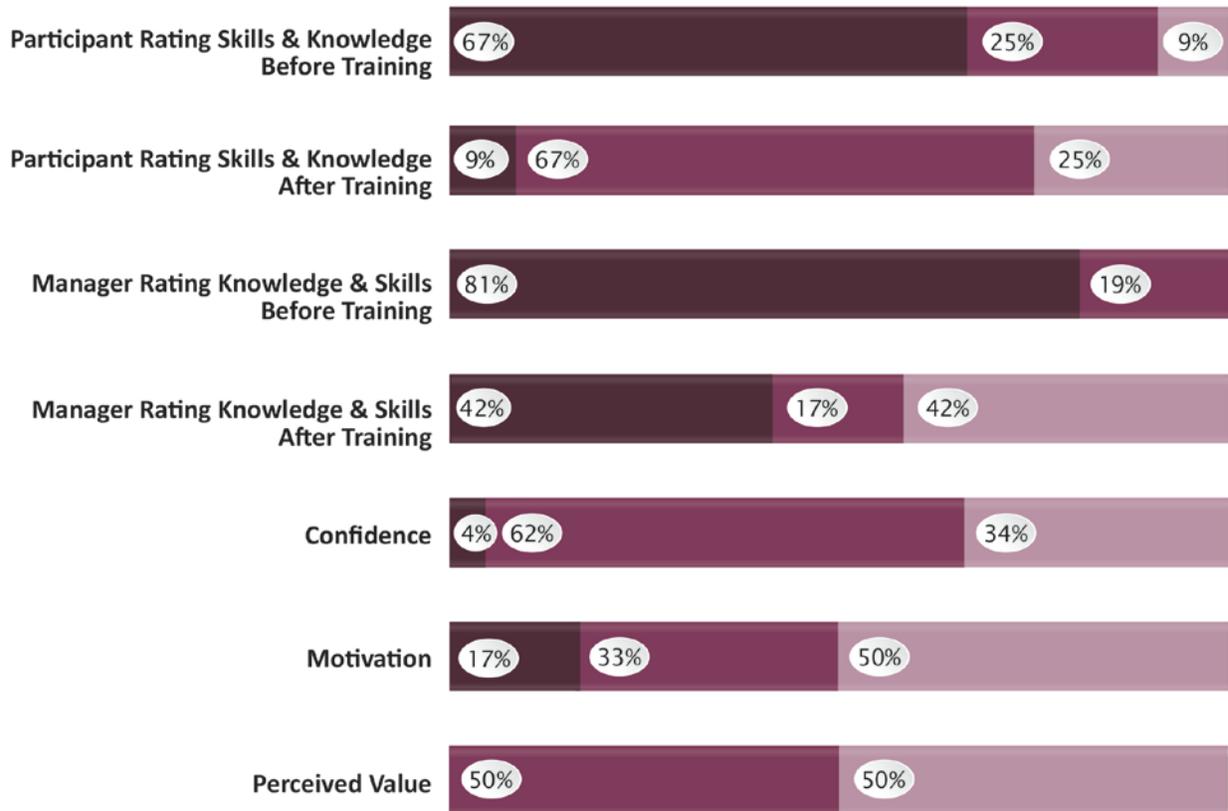
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**Effective Practices** The following practices for facilitating learning were identified by participants as having a "moderate"<sup>1</sup> positive contribution to the learning:

- The problem solving discussions
  - Applying the problem solving techniques to problems or issues that the participants identified
  - The brainstorming activities
  - The flow charting activities
  - Clearly communicating the learning and performance objectives
  - Making recommendations for improvements
  - Providing useful feedback during activities
  - Providing opportunity for collaboration, discussion, and learning from others
  - Engaging and sustaining the learners' interest
  - Providing realistic and work-related practice activities
  - Eliciting learners' prior knowledge or experience in relevant areas
  - Presenting key concepts clearly and logically
  - Providing useful response to questions, guidance or clarification
  - Providing opportunity for learning assessment and reflection
- (<sup>1</sup> A mean rating of 3 to 3.9 on a five-point scale ranging from 'not effective' to 'very effective')

**Figure 2**

■ **Low Rating:** 1 and 2 on a 5-point scale | ■ **Moderate Rating:** 3 on a 5-point scale | ■ **High rating:** 4 and 5 on a 5-point scale



**RISK ALERTS:** Plans for action: at the end of training, 83% have few or only some ideas or plans for using their training on the job. Typically this low level of planning poses a risk for transfer. In this training, however, it's expected that participants will formulate their plans when they develop their workplace learning project.

## Transfer Results

**Evaluation Questions:** Did the work environment and learning strategy support the transfer of learning to the job? Did training participants apply their learning to their jobs, and did the application of learning impact their work or job performance?

**Although participants and managers report relatively modest application of new skills to the job, both groups report substantive performance.**

To assess Transfer—the second link in the Learning Value Chain™—training participants were asked to complete Transfer Questionnaire (TQ) approximately (two months) following the conclusion of the training program.

The findings suggest that almost three-quarters of those who were trained did not apply the new learning on the job. Managers' perceptions, however, were somewhat more positive with more than half reporting a "moderate" or "high" level of application to the job. Participants and their managers generally perceived on the job performance improvements resulting from the training were modest. More than half of participants and two-third of their managers perceived only "low" or "moderate" or levels of performance improvement after training.

**The Transfer Index that follows summarizes these key results:**

- **Learning Application:** Almost one three-quarters (70%) of participants report a "low" degree of learning application to their jobs.
- **Managers Perceptions of trainee's application:** A majority of managers (42%) perceived a "low" level of application of the problem solving training by employees to their jobs. Of the remaining managers, one-third report "moderate" application while one quarter report a "high" level of application.
- **Performance Improvement:** 42% of participants perceived a "high" level performance improvement as a result of the training. The remaining participants were split—almost one third reporting "moderate" performance improvement (31%) and one quarter reporting a "low" level of improvement (26%).
- **Managers' perceptions of Performance Improvement:** Almost two-thirds of managers perceived a "moderate" level of performance improvement resulting from enhanced problem-solving skills. One-third of managers perceived a "high" level of performance improvement.

## Transfer Alerts

The majority of participants (70%) reported that they did not apply the four problem solving techniques learned in training. (Managers' assessment of learning application was higher.)

More than half of training participants (57%) described the impact of training in other areas of job performance as "low" to "moderate." (Managers perceived training as having a "moderate" performance improvement.) The findings suggest a strong need to encourage more rigorous application of learning to the job in order to achieve a positive impact on business outcomes and ROI.

**Barriers to Transfer** The following training and implementation issues were most frequently identified by participants as barriers impeding the transfer of newly acquired knowledge and skills to the job:

- Learners lack the interest and support of management (67%)
- Workplace Policies, procedures, rules, work processes (67%)
- Too difficult to break old habits (50%)
- Unable to dedicate the time required to practice new skills or adopt new ways of doing things (50%)
- Lack support from colleagues or peers (50%)
- Lack feedback on my performance (50%)

■ **Low Rating:** 1 and 2 on a 5-point scale | ■ **Moderate Rating:** 3 on a 5-point scale | ■ **High rating:** 4 and 5 on a 5-point scale

