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4. Universal Performance Behaviors: What Ought to Be in the Technologist's Toolkit

by John W. Sinn

This is the second in a series of three IDEAS articles on development and application of a conceptual model. The first article, identified in the author's note, described the model and the underlying rationale that guided its development. The current article, the second in the series, articulates and identifies behaviors that ought to be part of the array of competencies, or behaviors, of all technologists, regardless of their specific professional assignment.

If the profession accepts the notion that there is, indeed, a common set of behaviors, then it follows that the core skills and knowledge that are appropriate to preparing technologists and the instructional and learning arrangements that will ensure that these happen ought to be considered by the profession. The third article, which will be published in this journal's Winter/Spring 1998 issue, will provide content recommendations and learning instruction strategies for education and training programs based on the considerations of the common behaviors. **JS**

Although this article can stand alone, it should be read in conjunction with a companion piece, "Building a Model for Technology Studies," which appeared in the Journal's Volume 22, Number 2, Summer/Fall 1996 issue. The model discussed in that article has undergone revision based upon reader, client, and user feedback. Changes based on these inputs are reflected here. The model was originally conceived to guide the work of the Center for Quality, Measurement, and Automation (CQMA) in the College of Technology at Bowling Green State University (BGSU). CQMA experiences with a number of technology transfer projects for business and industrial clients have contributed much to the refinement of the model. Also, participation in the development of an Applied Quality Science bachelor's degree program further tested, refined, and demonstrated the efficacy of the model as did more recent experiences with a research project conducted for the American Society for Quality Control (ASQC) to define core knowledge for technologists. Details and reports of these experiences may be obtained from the author.

This article is about first considerations that lead to suggestions for instruction and learning in traditional and nontraditional circumstances. It enumerates and describes behaviors that are universal or common to all technologist functions. Based upon these behaviors, the technologist's toolkit of core content and skills is derived.

Universal Technologist Behaviors

Several behaviors can be identified as common or universal to technologist performance regardless of an individual's specific industrial responsibilities or technology focus.

Technologists are team builders, problem solvers, and technical managers and leaders. Three technological behaviors of (a) data, analysis; (b) documentation, assessment; and (c) synchronous leadership, action are components of broader problem-solving behaviors. These focused technological behaviors are shown in Figure 1. The overlap of the circles implies interaction and synergy of the behaviors for team building, problem solving, and improvement.

The phases of assessment, analysis, and action displayed in Figure 2 provide part of the base for problem solving. These take place within a broader infrastructural context created by the three primary behaviors in Figure 1 and are related to feedback for successful problem solving. While shown as a linear activity, the functions are not always discreet, straightforward, and simplistic. Yet the relationships suggest a useful strategy for bringing forward technical solutions and improvements.

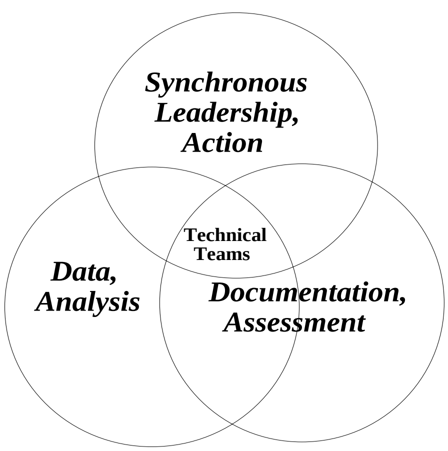

***Figure 1.* Relationships of universal technological behaviors.**

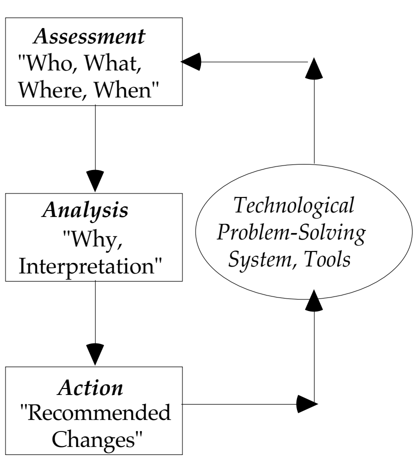

***Figure 2.* Assessment, analysis, and action behaviors in the problem-solving context.**

Documentation, Assessment

Figure 3 displays the documentation and assessment phase in problem solving. During the assessment phase of problem solving, technologists and others on the team must document circumstances that suggest opportunities for improvement. These may include demographic data such as persons and equipment involved as well as process flow charts of macro and micro processes. Much documentation will be involved to "flush out" the "who, what, where, and when" about the way things are currently done. If this were a total line or production job site, layouts, time and cost data, standard operating procedures, and flow charts on the current process and system would be required at either the micro or macro work levels. Product design and specifications documentation would also be a part of the assessment. Various tools for data analysis and documentation would be formulated in relation to the nature of the product and process. Data and documentation tools selected and used in the assessment phase will have a direct relationship to overall outcomes for both immediate problem solution and subsequent phases. This suggests that most technical problems will require several iterations and input from many different persons, functions, and levels, and certainly multiple tools for solution.

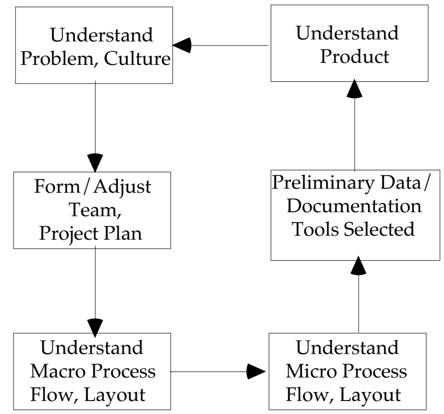

***Figure 3.* Documentation and assessment behaviors.**

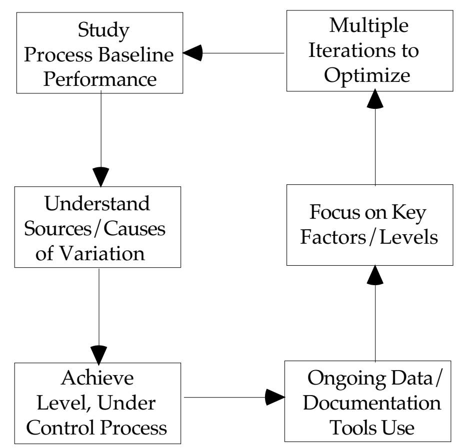

***Figure 4.* Data and analysis function behaviors.**

Data, Analysis

While the major focus for assessment is to determine the current methods for processing a product, data and analysis functions build on and around the assessment. The data and analysis functions, as technological behaviors, are also pivotal phases of the problem-solving process. Data and documentation begun as assessment phases are fine tuned, and multiple iterations may be required based on further analysis. Ultimately, various experiments or trials may be run to determine optimum conditions or to further analyze what was believed to be valid in the original assessment. In the analysis phase it is also important to establish data and documentation as performance baselines upon which to base measures of improvement. Baselines allow sources of variation to be identified and studied further with a view toward eventual optimization. Stabilization in process must be achieved in reasonable ways, facilitating a clearer understanding of broader relationships in production processes. As this occurs, factors and levels appropriate for further study will begin to surface. This assumes that under control conditions a sufficient analytical environment to demonstrate optimum conditions in process can be facilitated. The expectation is for a technologist to guide cross-functional team processes to generate and analyze data as shown in Figure 4. This represents another basic set of behaviors that are common or universal to technologists in their practice regardless of venue.

Conflicting views or information that emerge in the assessment may require various analytic tools to be applied to achieve clarification. Tools at this phase may cover such basic data as attribute and variable charts, gage repeatability and reproducability (R & R), and capability (Cpk). These statistical indices would be organized within the ongoing process control plan (OPCP) and failure mode and effects analysis (FMEA) documentation tools. More than likely, in most cases only one or two of the tools will be used. But the array of tools available for analysis should not be underrepresented. Likewise, the number of iterations with any one tool, to continue to interpret and understand the overall problem circumstance for improvement, will vary. The quality of the problem solution, and overall robustness, will determine the number of iterations that need to occur. This implies important technologist roles and relationships as a data analyst.

Synchronous Leader, Action

The final phase in a problem solution includes recommendations in the form of leadership and action, an important component of the professional development of the technologist. Actions may consist of new procedures to be followed, new equipment to be procured based on conclusions that processes analyzed were not capable, or others. This will drive the establishment of new standards, training approaches, and perhaps other studies. For example, if it is determined that new equipment is needed to implement a solution and improvement, new studies and iterations will likely be required. This is what ongoing improvement is about, of course, as depicted in Figure 5. It would be quite common, for example, to determine that additional training is required or better gaging is needed, or to identify shifts from one characteristic to another. Unquestionably, however, the costs of such actions will need to be detailed and presented with justifications for changes, and improvements brought forward.

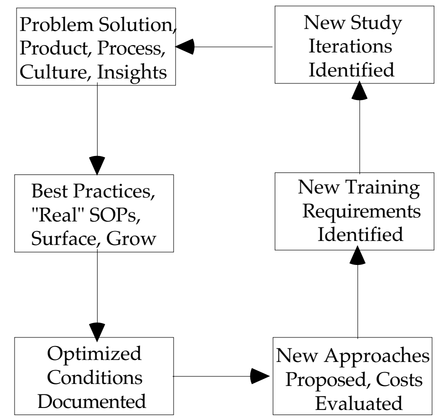

Figure 5. **Ongoing improvement systems result from technologists' leadership behaviors.**

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5. Teachers' Attitudes Toward Computer Use

by Sherry Hill Howie and Jia-Rong Wen

In recent years global demands for knowledge about and application of technology have greatly impacted educators. However, research shows a resistance of teachers to new innovations that affects their levels of usage and stages of concern (Hall, 1977; Kluever, 1992). Because technology in education is an innovation that impacts education, it is valuable to assess teachers' attitudes as they learn and adapt to changes in technology. A cross-cultural comparison of teachers' attitudes may lend more insight into areas affecting attitudes. By learning about teachers' attitudes toward using computers in education, teacher training may be planned better to address concerns and needs of teachers as they learn about technology.

For this purpose, we compared teachers in the Republic of China (ROC) and the United States in their attitudes toward using computers in teaching. We also sought information on the degree to which middle school teachers have accepted computers. Cultural and other differences prompted us to expect a significant difference in attitudes between the two groups of middle school teachers we surveyed, which included junior high school teachers of Taiwan, ROC, and San Bernardino County Schools, California—the latter group being surveyed six months after the first group. Taiwan geographically is 14,000 square miles in size with 716 junior high schools, while San Bernardino County is 20,000 square miles (largest county in the USA) with 37 school districts and 66 junior high/middle schools. For the survey in Taiwan, 100 out of 716 junior high schools (from the seventh to ninth grade) were selected by random sampling. Each of the 100 schools received five surveys for principals to distribute to teachers. Of the 500 surveys, 412 were returned, yielding a response rate of 82.4%.

For the survey in San Bernardino County, 66 middle schools were selected at the same time, each receiving 10 copies of the questionnaire. Of the 660 questionnaires sent, 203 were returned, which resulted in a response rate of 30.7%. The total number of surveys returned for both Taiwan and San Bernardino was 615.

The authors designed the questionnaire. The three psychological areas that affect attitudes are reflected in the survey questions. These areas, adapted from the research of Gardner (1993), Kluever (1994), and Massoud (1991), measure fondness for, confidence in, and perceptions of usefulness of computers in education. The questionnaire used 15 questions and a Likert scale of five options: Strongly Agree, Agree, Not Sure, Not Agree, and Strongly Disagree.

BACKGROUND

The Ministry of Education for the ROC of Taiwan started to infuse computer-assisted instruction (CAI) into education more than 20 years ago. Today, more than 4,000 teachers have been trained, and they have developed thousands of CAI materials that have been sent to every school of every level for teachers to use as teaching aids. However, despite much effort, including two Six-Year Plans for infusing CAI and training teachers, very few Chinese teachers used computers in teaching after 15 years of promotion (Wu, 1992).

A problem faced by Chinese teachers is using Chinese characters in a western-developed technology. The computer design follows western cultural backgrounds and living habits. Keyboards, for example, are developed by the orientation of the alphabetic