Behind the Learning Curve: Linking Learning Activities to Waste Reduction

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This exploratory research on a decade of Total Quality Management in one factory opens up the black box of the learning curve. Based on the organizational learning literature, we derive a quality learning curve that links different types of learning in quality improvement projects to the evolution of the factory's waste rate. Only 25% of the quality improvement projects—which acquired both know-why and know-how—accelerated waste reduction. The other 75% of the projects either impeded or did not affect waste reduction. In complex and dynamic production environments, locally acquired knowledge is difficult to disseminate. The combination of know-why and know-how facilitates its dissemination.
(*Learning-Curve*; *Organizational Learning*; *Quality*; *TQM*; *Technological Knowledge*; *Experimentation*; *Knowledge Transfer*)

1. Introduction

Knowledge has become a critical resource for competition. Firms have to manage organizational learning efforts directed at building knowledge they can use in the future (Adler 1989). One approach that is particularly learning-oriented is to embark on a Total Quality Management (TQM) program. The link between learning and quality, however, is ill-understood. Little is known about the learning processes in TQM programs and their impact on bottom-line organizational performance (Hackman and Wageman 1995).

In a previous paper (Mukherjee et al. 1998), we started to explore this link between learning and quality. We analyzed 62 quality improvement projects undertaken in one factory over a decade. We identified two dimensions of the learning process that took place in these projects: conceptual and operational learning. Conceptual learning is the process of acquiring a better understanding of cause-and-effect relationships, i.e., the acquisition of know-why. Operational learning is the process of obtaining validation of action-outcome links, i.e., the acquisition of know-how. We found that conceptual and operational learning played a crucial role in changing factory personnel's attention as a result of the project. For example, projects that acquired know-why or know-how were more likely to yield new Standard Operating Procedures or changes in Statistical Process Control.

This paper extends the link between learning and quality from a *cross-sectional*, *project-level* analysis to a *longitudinal*, *factory-level* analysis. In it, we open up the black box of the learning curve, explicitly introducing the knowledge acquired by quality improvement projects. Given the role of conceptual and operational learning in changing factory personnel's attention after project completion, we use these two learning dimensions to identify four different types of knowledge acquisition: firefighting, artisan skills, nonvalidated theories, and operationally validated theories. We construct the cumulative number of projects of each type. We then use these cumulative number of project variables to explain changes in the factory's

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