The Improvement Paradox: Designing Sustainable Quality Improvement Programs

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Abstract

Why are quality programs so successful in some firms but not in others? Some point to difficulties in implementation or leadership. The problem is more fundamental, however. Quality programs are tightly coupled with other functions, routines and structures. Product development, marketing, accounting systems, human resource policies, employee morale, pricing policies, and financial results are all affected by and in turn influence quality initiatives. We hypothesize that the productivity gains from successful quality programs can interact unfavorably with existing routines and structures. Unrecognized interdependencies among different functions can reduce the benefits of process improvement. Under certain conditions these interactions may lead – or force – a firm to take actions that ultimately cause the demise of an otherwise successful program. Field study and formal models are used to test these hypotheses

Approach and methods: Designing sustainable quality programs has proven to be difficult, and the evidence linking quality improvement to financial benefits is mixed. Even highly successful quality programs can under certain conditions lead to significant short-run deterioration in financial results and subsequent loss of commitment to the quality program *(1)*. The cause appears to be unanticipated consequences of successful improvement arising from feedbacks between quality programs and other functions and organizational routines in the firm. Formal models of firm behavior grounded in extensive field study can identify these unrecognized interdependencies and relate them to the dynamics of improvement programs. Capturing complex interventions such as quality improvement programs in formal models requires a methodology that can (i) represent the physical and institutional structure of the firm and its markets; (ii) capture the decision processes of the various actors in the system, including the role of soft variables such as work force commitment, morale, and fear of job losses; and (iii) portray multiple functions and levels of analysis (e.g., the shop floor, product development, competitor reactions, and the stock market). We use the system dynamics method and related behavioral simulation techniques, drawing on extensive field study, relevant theory in economics, operations management, quality, simulation modeling, and organizational theory to formulate the models. We stress multiple data sources including interviews with key participants throughout the firm and archival sources such as internal data on the various metrics of quality, product histories, internal company materials, and financial results. Our research involves detailed field study with four partner organizations to ground the formal models in intensive longitudinal study of important improvement programs. The models will be synthesized into a 'management flight simulator' – a simulation environment in which managers and students will be able to explore the long-term dynamics of improvement programs and design more effective programs.

Research Partners and Initiatives Under Study: Each of the partner firms has made significant improvements in quality and productivity. Each also faces continuing challenges as they seek to maintain commitment to ongoing improvement at the same time they must respond to new pressures. In some cases the challenges to continuous improvement are the result of past success.

• ***Lucent Technologies (formerly AT&T):*** Lucent is the former network systems division of AT&T, winner of the Baldrige Award in 1992 and recently spun off into a separate company. We are examining three initiatives that have been central to their success: A supplier quality program, a program targeted at manufacturing quality, and one focused on reducing product development time.

• ***Ford Motor Company:*** Working with the electronics divisions, we are developing case histories of three improvement initiatives: a manufacturing cycle time reduction effort, a product development time reduction effort, and an internal awards program similar to the Baldrige award.

• ***Harley-Davidson:*** As a result of significant quality improvement in the 1980s, Harley has enjoyed robust demand growth, growth that has now outstripped capacity. Harley has launched major programs to boost productivity in the manufacturing organization, reengineer workflow, and speed product development. Our field study centers on the conflicts between the drive to boost output and the commitment to quality improvement.

• ***National Semiconductor:*** In addition to ongoing improvement initiatives in manufacturing, National is actively engaged in efforts to improve the product development process, a process tightly coupled with marketing and manufacturing operations. We are working with the South Portland, Maine facility, an integrated site responsible for new product development, wafer fab, and marketing to explore the interactions among the many different improvement initiatives they have undertaken.

Preliminary results: Though field work continues, preliminary results *(1-8)*, suggest a number of hypotheses:

• **Improvement rates vary with the complexity of the process:** The rate of defect reduction varies across processes according to their technical and organizational complexity.

Technical complexity refers to the engineering involved in a process. *Organizational complexity* refers to the number and type of different personnel and organizations that must be involved in a quality improvement process. The greater the technical complexity and the more organizational boundaries that must be crossed in the execution of an improvement program, the slower the potential rate of improvement will be.

• **Unbalanced Improvement can create excess capacity:** Most quality improvement tools were developed in manufacturing and are effective at the factory floor and operations level, where technical and organizational complexity are comparatively low. When quality programs are properly implemented, improvement rates for these processes are relatively high, leading to rapid productivity gains. In contrast, organizationally and technically complex activities such as new product development are likely to improve at slower rates. Processes where improvement is most rapid tend to boost productivity and augment capacity, while demand-generating activities such as learning to assess the voice of the customer, developing new products faster and more effectively, and forging customer/supplier partnerships are intrinsically slower to improve due to greater technical and particularly organizational complexity.

• **Feedback to employee morale and commitment to quality programs:** Thus successful quality programs are likely to increase capacity faster than demand. Firms are then presented with a short-term/long-term tradeoff: they can reduce costs by laying off the excess labor, or they can commit themselves to job security and seek to utilize the excess labor elsewhere. If the firm chooses to downsize, the resulting disruption to established work teams slows improvement, erodes morale and reduces commitment to quality programs as employees fear that they will 'improve themselves out of a job.' Alternatively, if a firm resists downsizing, financial results will, in the short-term, be worse. Unless management is aware of and prepared to accept this 'worse-before-better' tradeoff, they may abandon their initial commitment to job security, destroying morale and participation in the improvement program, disrupting established improvement teams, and halting progress.

• **Interactions with accounting metrics and systems:** Quality improvement can conflict with measurement and incentive systems. For example, successful improvement programs can dramatically alter a firm's cost structure. Direct costs are driven by the relatively fast-improving operations while the drivers of overhead and indirect costs are slower to improve. Successful improvement can cause unit direct costs to fall faster than unit indirect costs. Unless pricing policies adjust to these changes, gross margins and operating profit will fall. Management may then seek to restore profit margins through cost cutting and layoffs, triggering the collapse of commitment to the quality program. Even when a firm is aware of these dynamics, external capital markets are likely to interpret the decline in profit margin as a signal of poor cost control, eroding the firm's market value. The firm may then be forced to downsize to restore profitability or prevent hostile acquisition. The resulting disruption and decline in morale then undercut worker commitment to continued improvement efforts, reducing competitiveness.

Significance and Impact: The models and theory we are developing will provide firms with tools to develop richer understanding of the management challenges associated with the design and implementation of sustainable quality programs. A better understanding of the interaction of quality programs with other key systems including accounting and information systems, incentives, and other organizational routines will help practitioners design robust strategies for the implementation of quality programs, programs consistent with theory and grounded in relevant experience.

Reports Available (see also web site):

1. Sterman, J., N. Repenning, F. Kofman. (1994) Unanticipated Side Effects of Successful Quality Programs: Exploring a Paradox of Organizational Improvement. Forthcoming in *Management Science.*
2. McPherson, A. (1995) Total Quality Management at AT&T. MS thesis, MIT Sloan School of Management.
3. Repenning, N. (1995) Reducing Manufacturing Cycle Time at Ford Electronics. Case history available from author, MIT Sloan School of Management, Cambridge, MA 02142.
4. Krahmer, E. & R. Oliva. (1995) Improving Product Development Interval at AT&T Merrimack Valley Works. Case history available from author, MIT Sloan School of Management, Cambridge, MA 02142.
5. Repenning, N. (1995) Reducing Product Development Time at Ford Electronics. Case history available from author, MIT Sloan School of Management, Cambridge, MA 02142.
6. Johnsson, Fredrik. (1996) Sustainable Improvement Programs: Supplier Quality Excellence. MS thesis, MIT Sloan School of Management.
7. Oliva, Rogelio and Rockart, Scott (1996) History of Improvement Programs: National Semiconductor, South Portland Site. Case history available from author, MIT Sloan School of Management, Cambridge, MA 02142.
8. Krahmer, E. (1996) Supplier Quality Initiatives at AT&T Merrimack Valley Works. Case history available from author, MIT Sloan School of Management, Cambridge, MA 02142.