Dynamics of Multiple Improvement Efforts: The Program Life Cycle Model

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Introduction.

This paper is part of a series of studies on the subject of continuous improvement programs written by members of the System Dynamics Group at the Sloan School of Management at MIT. The research is supported through funding by the Transformations to Quality Organizations program of the National Science Foundation and by the partner corporations (Jones, Krahmer et al., 1996; Sterman, Repenning et al., 1996). The purpose of the entire series is to provide the basis for a dynamic framework, and formal models, through which to understand the key determinants of success or failure of quality improvement efforts. This particular study provides an overview of dynamics that emerge from deploying multiple improvement programs.

Firms frequently undertake multiple improvement programs simultaneously and in sequence. To understand the implications of implementing multiple programs, a set of dynamic hypotheses was developed from individual program histories and the interplay across programs at one research site. The core dynamic hypothesis and structural elements identified are captured in a system dynamics model to explore the improvement programs' life cycle (PLC). While the PLC model is being developed to help explain broad industry phenomena, it is primarily grounded in the experience of one of our research partners that launched more than thirty distinct improvement programs over the last fifteen years. See Oliva, Rockart and Sterman (Forthcoming) for a full description of site, research method, and findings.

Dynamic Hypothesis.

Program histories from our research site have clarified the importance of a few key resources, and the central role of employee perception of program value, in successfully launching and sustaining improvement programs.

Limited resources for improvement. Three basic resources appear to be needed to sustain an improvement program. Programs that lack any one of these three resources – employee time, managerial time, and skill with program tools – have shown to be unlikely to succeed.

Employee time available for improvement program effort is limited by the total available time and by the effort needed to achieve basic work objectives such as production throughput. If employees attempt to allocate too much of their time to improvement, throughput will drop bringing greater pressure on employees to reduce the time spent on improvement activity (loop B1 in Fig. 1).

Managerial time is another limited resource, only a portion of which is usually available for improvement activity. Managerial support of programs involves allocating time to understand, demonstrate support for, and clear obstacles to programs. Insufficient managerial attention can act to limit the effort allocated to each program by reducing the attractiveness of program involvement. As more effort is allocated to programs the available managerial support may become inadequate, lowering program attractiveness and constraining the growth of effort (B2). Time resources can be aggressively managed to help programs succeed. According to Deming (1982) the ideal of continuous improvement programs is to liberate resources for improvement through improvement of the process, creating a continuous and self-sustaining mechanism (R1). However, in the push for improved financial performance, management may be tempted to convert freed employee and managerial time into cost savings, thus cutting short the reinforcing process of improvement.

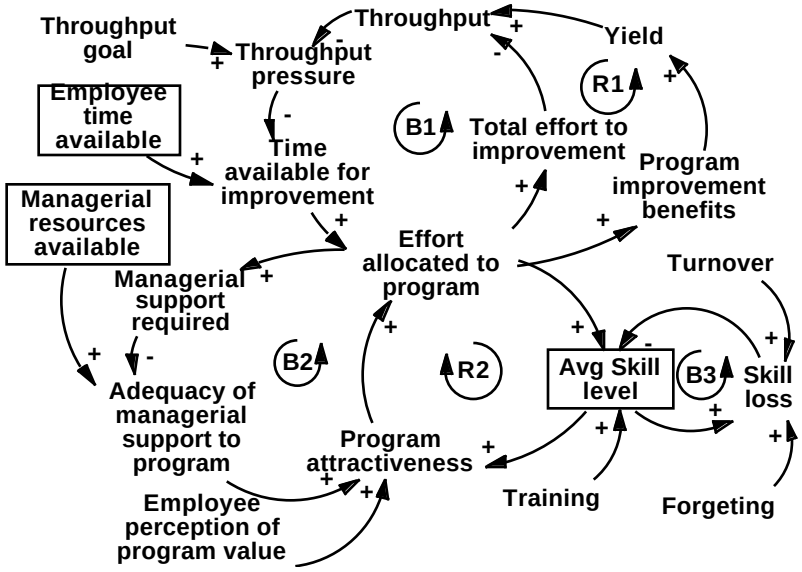

Fig. 1 - Resource limitations on improvement programs

The third key resource is the base of program-specific skills held by employees. A program becomes more attractive and opportunities to use the tools become more apparent as employees gain greater capability and confidence with the related skills. Skills are increased through experience with the program's tools, creating a reinforcing process that helps sustain an improvement program (R2). Nevertheless, the skill creation process also needs to be managed. If training takes place too early, employees not only begin to forget but may become cynical about management support for the program. Additionally, normal employee turnover will strip an organization of its experienced personnel making continued training critical.

The motivational driver. In addition to skills, managerial support, and available time, employees must believe in the value of a program to make them truly effective participants in

improvement efforts. Training and managerial support appear to be able to create temporary excitement. Once that excitement begins to fade it must be replaced by other sources of motivation. Command-and-control relationships can provide the motivation for programs that are easy to monitor, but are unlikely to work with programs where employee participation and contribution are more difficult to assess. Even where command-and-control relationships are possible to enforce, they cannot be successful in the long-run as it makes the initiative dependent on managerial supervision. A common theme within stalled improvement efforts is that those engaged in the program were unable or unwilling to see that the efforts were sustained once the program champion was removed. Furthermore, employees who work by following orders may never feel the need or take the time to truly understand the underlying purpose thereby limiting their effectiveness.

The prevailing alternative to command-and-control enforcement appears to be the conversion of initial excitement with a program to a long-term results-based belief in the program's value (R3 in Fig. 3). Once effort is allocated to a program, employees begin to look for tangible benefits that can be attributed to the program. As effort accumulates over time, the employees begin to trust their own experience with the program more than statements made by managers or trainers. If the benefits cannot be observed, then employees begin to lower their perception of a program's value and their motivation drops accordingly (B4 in Fig. 3).

Model Scope and Structure.

The PLC model was designed to provide insight into the pattern of program commitment and success observed at the site. The modeling effort has helped the authors to understand why programs gain the number of adherents they do when they do, and why they grow or shrink at different time periods. The model consists of 216 equations – of which 41 are state variables and eight are table functions – with 59 system parameters. Most of the model structure is arrayed to represent the multiple improvement programs. The model includes considerations such as the potential value of a program, the level of management support it receives, the reputation it builds for efficacy, business pressure, and the influence of contemporary programs. The model does not include market forces, support infrastructure, nor job security concerns. The model is organized around two decision-making groups. Managers determine when to launch programs, how much support to give a program, how many people to train, and state an improvement goal for the program. Individual employees then perceive that support, and combine it with other factors, such as their skill level and time available, to decide how to allocate their time among efforts. Figure 2 shows a subsystem diagram of the model’s structure and its main variables. The model has been turned into a flight simulator for players to take the managerial role and preliminary tests were

performed with a group of managers from our partner corporations. Some insights from the model building process, simulation results and the gaming sessions are described in the following section.

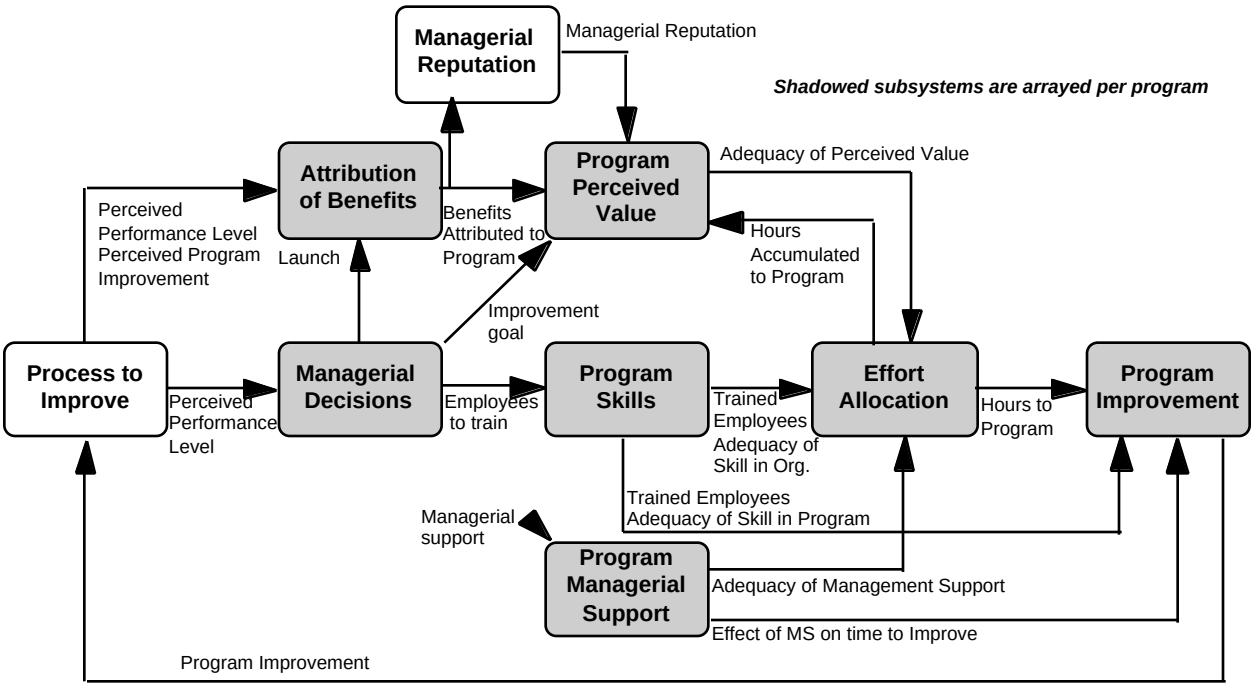

Fig. 2 – Subsystem diagram of PLC model structure

Findings.

Programs are initiated for a variety of reasons. Often firms launch programs when they perceive that firm performance is below that of a reference group, when the rate of performance improvement is declining, or simply when employees encounter a persuasive methodology for improvement. Although we have managed to replicate the macro-behavior of program launches from simple behavioral policies, we are continuing to explore the reasons for program initiation and the ties between why programs are launched and how likely they are to succeed. The experience of our research site and the results of the model simulations have lessons not only for sustaining individual programs but for managing the interrelationships among multiple programs. Significant complementarities and competition across programs are apparent.

Inter-Program Complementarities. It is easy to overlook the benefits that a program indirectly provides to the organization by supporting later improvement efforts. Reflecting on the individual program histories it is possible to extract instances where one program, eventually successful or not, benefited from previous efforts in two dimensions. First, the tools and skills learned, and mindset changes achieved, from one improvement program are often the same ones

needed for other initiatives. Second, complementary bodies of knowledge and information specific to the company or task that are created during one effort are often used to carry out later programs.

Inter-Program Competition. Beyond the obvious competition for limited resources to sustain an initiative, we identified three interaction dynamics that affect the overall improvement rate.

Fragmentation of effort and attention. When a company takes on multiple programs it may find that it has people working with vastly different mental models. This "Tower of Babel" effect leads to frustration and reduces program effectiveness. One obvious solution would be to train virtually all employees in all programs. Simulation results, however, show that this strategy results in low skill levels and therefore minimal accomplishment in every program. This dilution of skill and understanding is evident in the lack of clarity frequently expressed by people who had been trained in several programs simultaneously.

Cynicism and erosion of management's reputation. Initial participant motivation relies on the perceived potential of an improvement program. The perception of potential for a program is normally created by management through improvement promises and goals. When programs have a history of failure, management's reputation and ability to build a strong initial perception of program value declines. With no expectation of improvement results, employees tend to ignore programs, thus fulfilling the low improvement expectation and eroding management's reputation even further (R4 in Fig. 3). Management's inability to generate initial motivation for programs results in a series of program launches that are not taken seriously by employees – "the program of the month".

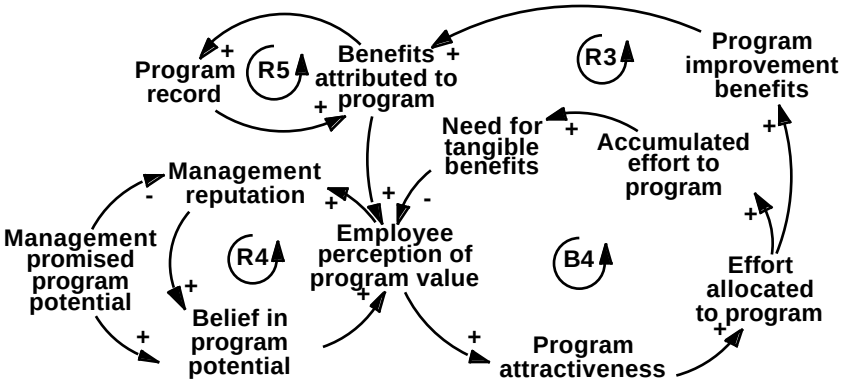

Fig. 3 - Interactions Among Programs

Competition for credit. Continued participant motivation relies on the ability to attribute recognizable benefits to individual programs. The attribution process, however, is likely to be imprecise and biased when multiple programs are involved. There are at least three reasons for attribution errors. First, at an aggregate level, the total perceived improvements are likely to be less than the actual improvements. Since a high-level scan of operations can only compare the current performance level to a prior performance level, managers can only evaluate the *net* change in problems. However, new problems are introduced in

accommodating new products and adopting new technologies. By looking only at the *net* changes the improvement benefits will be underestimated. Second, the benefits from a program are likely to be perceived with a delay. Since one way people determine causation is proximity in time (Hogarth, 1980), these benefits are likely to be attributed to later programs that are enjoying high visibility during their initiation phases. Third, because of saliency effects, historically successful programs will be attributed with the benefits achieved by programs that have yet to build their reputation (R5). This underestimation and biased attribution of benefits reduces the strength of loop R3 in building motivation.

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