

Changing the New Product Development Process: Reengineering or Continuous Quality Improvement?

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ABSTRACT

Organizations are changing their new product development processes in order to introduce improvements to innovation performance. The purpose of this study is two-fold. First, we wish to characterize the change process to examine whether the approach taken represents reengineering, or continuous quality improvement. Second, we wish to compare the process of change to an ideal model of change, and see how closely practice followed theory. Case studies of six companies are developed from interviews of executives, reengineering team members, and other organizational members. The actual change process tended to consist of components of both reengineering and continuous quality improvement, and there were some significant gaps between practice and theory.

(NEW PRODUCT DEVELOPMENT; REENGINEERING; INNOVATION;
CONTINUOUS QUALITY IMPROVEMENT)

Success in new product development, both in terms of market share and cycle time, has become a key indicator of organizational success (Wheelwright and Clark, 1995). Improvement then in the NPD process should lead to improvement in a firm's competitive position. Reengineering (Hammer and Champy, 1993) is a common means to introduce radical performance improvement to a process.

Davenport et al. (1996) report however that an organization's NPD process is not easily reengineered. New product development change initiatives may have significantly different characteristics from those present in successful administrative and operational reengineering and CQI projects. First, it is often the case that the process is poorly understood and documented. Second, since "knowledge-work" is a large component of NPD, much relevant knowledge may be implicit rather than explicit. Third, because of the strategic importance of NPD, it is risky to change a process that is producing acceptable outcomes.

Additionally, new product development process improvement efforts do not follow the principles of CQI, where front-line employees continually examine and make changes to their own work processes. Stoddard (1991) found that strong loyalty to each employee's profession or discipline hinders the progress of continual change. Employees from groups such as engineering or manufacturing would create barriers surrounding their environment resisting change that promoted early cross-functional communication, even if it meant great savings for the process further down the line (Dougherty 1990).

Initial research results show that these change initiatives fall somewhere near the middle of the reengineering-CQI change continuum (Stoddard and Javenpaa 1995). NPD

process improvement teams typically use a participative approach, in which NPD employees participate in the change effort but have minimal control of the final process change decision. In a review of three NPD process change efforts, Davenport et al. (1996) identified that process improvement focuses more on process outputs, and less on activities and tasks. The project objectives consisted largely of eliminating outputs that customers no longer deemed useful or worth the cost.

Davenport et al. (1996) claim that an organization can benefit from a self-evaluation to determine their core competencies, and how their NPD processes are oriented to support those competencies. For example, NPD organizations that focus on radical, breakthrough design might find the CQI method of improvement to be most effective. Research has identified that employees of this organization configuration value their autonomous structure and are most resistant to micro-level activity design (Raelin 1989). At the opposite extreme are NPD organizations striving to eliminate excess administrative activity. In this case the organization might benefit more from a reengineering-oriented change effort, where a more autocratic approach streamlines and speeds decision-making processes.

Organizational culture also influences the perspective adopted for knowledge work process change. Organizations with long histories of leaving knowledge workers alone may not wish to engage in process change except under extraordinary circumstances. For example, in university-type settings where individual autonomy plays a key role, it may be more appropriate to take a CQI approach. On the other hand, when an organization is undergoing rapid and/or radical transformations, better outcomes might be expected from the quicker response of a more authoritarian approach. Finally, the

approach adopted depends upon the time and risk parameters for the project. CQI approaches may take longer to implement but involve a much lower level of risk; reengineering approaches might bear much greater risk but may be fully implemented within one or two years.

The purpose of this study is to (a) characterize the change process to examine whether the approach taken represents reengineering, or continuous quality improvement, and (b) compare the process of change to an ideal model of change, and see how closely practice followed theory. Case studies were used to answer these questions. Cases of six companies were developed from interviews of executives, reengineering team members, and other organizational members, and then analyzed against templates.

Methods

In order to understand how companies engaged in changing their NPD processes, case studies were developed for six different companies. Case study research can facilitate understanding of novel phenomena (Eisenhardt, 1989; Yin, 1984). The six companies were chosen so that we could examine key differences. First, three companies from a single industry, medical products, were chosen. Since we did not have longitudinal data, we found companies that were at the beginning, middle, and end of the change effort. Additionally, we sampled three other companies in order to improve the generalizability of the results. All six companies were medium-sized, technology-based companies. We believe that medium-sized (300-2000 people) companies would be the best size of company in which to study this form of organizational change; both very small and very large companies are subject to the effects of other factors that distort the

change process. The medical products industry was specifically chosen because there is intense competition, leading to a great deal of reengineering activity. Table 1 shows the companies (fictitious names are used to maintain confidentiality) in the research design, their product base, and their size.

--Insert Table 1 here--

The case data were obtained via one-on-one interviews. Between eight to fourteen people were interviewed in each of the six companies: one or two executives (CEO and/or VP of Engineering), three to six members of the NPD Reengineering Project Team, and three to six members outside of the project team. An interview guide was used to ensure that all topics were covered; however the order or form of the questions may have been different from person to person. Each interview was tape recorded and transcribed, and follow-up interviews were used for clarification as needed.

Reengineering or CQI?

Reengineering involves "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed" (Hammer and Champy 1993). Understanding what the customer requires and mapping out the current process is a critical first step for a reengineering project team (Andrews and Stalick, 1994). Benchmarking is also a typical step in a reengineering process (Davenport, 1993). Benchmarking and other methods are used to enact a creative process that leads to the formulation of an ideal, or "to-be" process, from which one can perform gap analysis

(Carr and Johansson 1995). Gaps indicate areas of opportunity for improvement, and change is planned and executed. One common mistake in reengineering is that goals and expectations are often ambiguous and final project success is idiosyncratic to each participant (Hout and Carter 1995).

Basic organizational change practice that is sometimes contrasted to reengineering is continual quality improvement, or CQI. Many organizational change theorists hold a common view of organizations "adjusting gradually and incrementally, responding locally to individual crises as they arise" (p. 868, Miller and Friesen 1982). Changes occur iteratively and incrementally, over a period of time (Black 1988, Choi 1995). Continuous improvement is defined as "the propensity of the organization to pursue incremental and innovative improvements in its processes, products, and services (Anderson, et al. 1994). CQI has its roots in TQM and Deming (1986). CQI processes can lead to a radical breakthrough (Kano 1993); however, CQI efforts typically focus on small, incremental changes, modifying them, and eventually creating a large, cumulative effect (Dertouzos et al. 1989). The incremental change is governed by the knowledge gained from each previous change cycle, thus CQI can be thought of as a form of "learning by doing".

Some authors contend that reengineering and CQI are essentially different forms of the same phenomenon while others contend that they constitute different interventions. For our exploratory purposes, we shall assume that both represent common underlying goals but differ by means. Reengineering involves radical one-time change through involvement of multiple functions redesigning the process in a top-down manner with a

clean slate. CQI involves incremental continuous change through the involvement of functions redesigning the existing process in a bottoms-up manner.

All of our respondents perceived the nature of their change process to be somewhere in between reengineering and CQI. Many of the managers interviewed discussed their apprehension with undertaking a radical reengineering effort on the NPD process. The managers cited that their "NPD process is simply too important to risk with radical change initiatives", and that the "survival and profitability of the company are at stake when change initiatives are undertaken on the NPD process." Similarly, senior managers stressed the importance of the NPD process. Many of the companies had already cut costs and improved efficiencies in many other parts of the organization – such as manufacturing and procurement processes. Therefore, NPD process improvement efforts represented one of the few untouched areas for senior executives to cut out inefficiencies, and improve company responsiveness. The results indicate that these companies were not excessive risk takers by undertaking radical reengineering initiatives with regard to their NPD process improvement endeavor, nor were they satisfied with making very small-scale improvements to their outdated NPD process. The results indicate that these companies were somewhere in the middle of the CQI – reengineering process change continuum.

Table 2 shows the characteristics of both reengineering and CQI. We analyzed each of the cases with respect to each of these characteristics, and the results of such classification are shown. One can see that, while it is not perfect, there is an overall pattern that suggests a hybrid change process. While the level of change is incremental and the existing process serves as a starting point (indicative of a CQI approach), the

amount and type of participation, the length of the effort, and risk involved in the process change is more indicative of reengineering.

--Insert Table 2--

There are two ways to describe this hybrid model of NPD CQI/Reengineering. One could view the process as "reengineering of a critical, knowledge-driven process". Whereas the typical reengineering project would start with a clean slate, and subsequently induce radical changes, this was not done in the cases we examined. We believe the reasons for this are because (a) the process is too important to run the risk of complete failure, and so incremental change is required to reduce risk, (b) the process has too much embedded, tacit knowledge, and therefore one must start off from the existing base of expertise and know-how, and (c) the process is very complex, and small changes in the process can have large-scale, unanticipated effects.

One could also view the process followed as continuous quality improvement of a critical, knowledge-driven process. Whereas the focus in CQI is typically narrow and within a function, the focus of CQI of the NPD process is necessarily broad, involving multiple functions. Because the process is knowledge-driven, complex, and large in scope, changes take place over a long period of time, involve many process elements, and are expert-driven. Whether one views this hybrid model as reengineering with some elements of CQI, or CQI with some characteristics of reengineering, it points to the limitations of the stereotypical categories of "continuous quality improvement" and "reengineering."

Comparison to an Ideal Model of Process Change

It is also useful to compare the characteristics of the change process observed to an “ideal” model of how organizational change should proceed. Hundreds of descriptive and prescriptive models of organizational change have been put forth. Reengineering and CQI, which are two of these models, can generally be described as teleological processes, where "an organizational entity proceeds towards a goal or end state. It is assumed that the entity is purposeful and adaptive; by itself or with interactions with others, the entity constructs an envisioned end state, takes action to reach it, and monitors the progress" (Van de Ven and Poole, 1995; p. 516). In proposing a general model of process change we adopt the elements of the Van de Ven and Poole teleological model, extracting activities of *designing a new process* ("constructs an envisioned end state") and *implement and measure results* ("takes action... and monitors the progress"). To this we add three activities specifically associated with reengineering: *motivate the need for change*, *secure resources*, and *evaluate the existing process* (Davenport, 1993; pp. 204-206).

Motivate the Need for Change Change is implicitly driven by motivation, which is fueled by the recognition of the need for change. The first step towards any successful transformation effort is to convey an understanding of the necessity for changes. Under-communication of this need to change is one of the greatest contributors to transformation failure (Kotter, 1995). A robust effort should be placed on measuring and articulating the ‘pain’ of the current process and the ‘gain’ of the desired process (O'Connor, 1994). This initial step involves the management of the organization’s

perceptions/expectations of and commitment to the process. O'Connor (1994) discovered that many firms undergoing NPD process improvements (to a stage-gate system) found it relatively easy to communicate to their organizations that their process would yield substantial benefits, but much more difficult to say when these benefits would be realized.

Secure Resources One key resource to secure is the support of senior management. Early commitment of senior management to the NPD change process is vital; it is at these early stages of the NPD change process that management's influence on process change success is greatest (Wheelwright and Clark 1992). Hershock et al. (1991) argue that continued senior management commitment and support is the single most important factor in increasing the likelihood of success. Through focus interviews with six companies who were implementing a form of the Stage-Gate NPD process, O'Connor (1994) uncovered two methods that teams were utilizing to accomplish this task: tying the change initiative to TQM, and detailing the cost of not implementing change. The six teams all agreed that tying the initiative to total quality management was useful and effective since senior management had already embraced TQM.

Another key resource to secure is a project team dedicated to the reengineering effort. Because of the nature of the NPD process, multiple functional perspectives (e.g. engineering, marketing, sales, etc.) must be considered when redesigning the process. While a cross-functional team is a practical necessity for successful NPD reengineering efforts, such teams have proved to often experience difficulties in the execution of their primary tasks: Cross-functional teams

are less often teams with a high degree of interdependence, a group task, and a strong group identity than they are co-acting work groups composed of independent, highly competitive individuals who pursue their own goals over those of the team. (Denison, Hart, & Kahn 1996, p. 1009).

Additionally, perspectives from outside the boundaries of the existing process may prove valuable. Hammer and Champy (1993) argue that "outsiders" help the team members expose the assumptions on which current business processes are based. Ancona (1990) has provided evidence that the relationship of teams with their external context is an important factor in team effectiveness. Hence, it is important to secure the support of top firm decisions makers – both those on the NPD reengineering team and those who interact with the team. Likewise, the resources that operationalize that support need to be obtained.

Evaluate the Existing Process It is common for the project team to perform an evaluation of the current "as-is" process. Such an evaluation may pinpoint specific areas in need of, or having the opportunity for, improvement. The existing process can be examined in terms of both outcomes (performance) and means (the activities constituting the process). The team may discover activities that are redundant and/or non-value adding, opportunities for streamlining and re-sequencing activities, and opportunities for executing activities concurrently in order to reduce overall cycle time. Such analysis will also help the team prioritize and determine where they should focus their improvement efforts. Because the NPD process is inherently an open system (rather than a closed, or closed-loop system), there must be consideration of the organizational environment within which it is situated (Katz and Kahn, 1978). Existing problems may not stem from

the process itself, but rather may be the result of other environmental factors such as lack of management direction, lack of cooperation from outside functional areas or suppliers, or inadequate diversity of skills.

Design the New Process The process team must design a logical and flexible workflow process that matches the nature of the organization's products, technologies, and markets. At a strategic level, the team must determine how customers and suppliers will be integrated into the process, how the process will integrate technology, manufacturing, marketing, and operations strategies (Wheelwright and Clark, 1995), and how creative ideas will be generated and pursued (Wheelwright and Clark, 1992). At a tactical level, the search for the "details" of the new process design often involves a search for best practices--those activities that have been successfully used by other organizations. For example, cross-functional development teams have been identified as a best practice appropriate to most NPD situations. The search for best practices may come from external sources, such as literature or consultants, or it may come as a result of informal or formal benchmarking. In benchmarking, the firm will purposefully study another organization's NPD process, and attempt to distill the important design characteristics and principles that it could also implement (Camp, 1995). One of the dangers of benchmarking is that context can play a significant role in the appropriate design of a process, and the difference between two contexts may not always be immediately discernable.

Implement and Measure New Results

Implementation of change is not simple in mission-critical, complex processes. Because the changes have as much (or more) to do with the social as the technical system, change cannot be "switched" on overnight-- individual behaviors must change. The complexity of the process provides challenges during the change process, because manipulation of one or a small number of factors can have strong, unanticipated effects on other parts of a complex system. Because of the criticality of the process, managers may tend to be conservative and introduce changes in increments and batches rather than all at once. Thus such change efforts may be slow. Reengineering research at Toyota measured the new product development process implementation time to be nearly seven years (Eureka, 1987). This timeframe is consistent with O'Connor's (1994) evaluation of six companies undergoing (stage-gate) NPD process implementation; his research suggests that complete implementation can take over six years (with an average near five years). After change is implemented, process performance should be measured to infer the results of the change process (Rohleder and Silver, 1997). Ideally this should be associated with a set of measures that is identified at the start of the project, and is linked to the key facets of the organization's strategy.

Table 3 contrasts the ideal change practices with those observed. We see that (in general) firms followed the "ideal" by: designing a customer-focused process, having top management involvement, considering the context of the company's culture when designing the new process, and learning from the literature; they did not follow the ideal process in regards to: communicating the need to the company, developing explicit success criteria, putting together a cross-functional team, involving outsiders, explicitly

determining strengths and weaknesses of the existing process, involving customers and suppliers, benchmarking other development processes, using external consultants, measuring success, and being realistic about implementation time.

--Insert Table 3 here--

One might argue that, even though there was considerable difference between what is prescribed and what these organizations did, that they followed the "ideal" in many important ways. They engaged in reengineering to improve competitiveness and increase customer focus in NPD, they had senior management commitment, they considered the idiosyncrasies of their own local context when considering changes, and they learned from the outside.

Two important deviations from the "ideal" were the inability to articulate success criteria early on in the process, and the limited involvement of functional areas outside of engineering and manufacturing. We can speculate that failure to follow prescribed practice may have caused projects to go more slowly than they should have. By not making success criteria explicit, teams may have floundered early on, not developing focused agendas and activities. Success criteria and associated metrics, even if they are not used in any explicit fashion, help team members prioritize their activities. By not involving marketing, sales, and other functional areas, the roll-out of the process may have encountered resistance from these other functional areas that were not involved in the change process as intimately as they might have liked to have been. Such resistance could be expected to generate delays by causing "rework" of the change processes to occur. Likewise, exclusion of customers and suppliers from change efforts may lengthen the ultimate reengineering effort for the same reasons.

Conclusions

We have found that NPD change efforts can be characterized by elements of both reengineering and continuous quality improvement. This perhaps will be indicative of all organizational change efforts aimed at knowledge processes: incremental change on an existing process, by using a top-down approach with a broad scope and cross-functional representation. Such a change process will harbor its own unique challenges. By working from existing processes, the new process will necessarily be constrained in its design, and may not yield the type of radical improvement levels sought. Conversely, by attempting to instigate incremental, continuous quality improvement through a top-down approach, incremental improvements may be delayed by bureaucracy and lack of buy-in.

In many senses, the cases demonstrate that the change process companies engaged in was fairly close to the “ideal” models described in the literature. Companies were changing their NPD process for the right reasons, were learning from the inside and outside, and attempted to fit their process within their culture. Problematically, these change efforts were denoted by their lack of functional diversity within their teams. This lack of functional representation may lead to lack of buy-in, and processes that are not fully integrated. Also, considering the long amounts of time involved in carrying out the change effort, companies run the risk of designing a new process that is obscure by the time it is implemented.

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Table 1 Summary of Company Demographics and Research Design

Company	Industry	Project Progress	Number of Employees
Private Products	Medical Products	Start	300
Med Devices	Medical Products	Middle	800
Technomed	Medical Products	Finish	1400
Aerotech	Aerospace	Start	2000
DoD Design	Military	Middle	1500
Tech Express	Industrial/Consumer (Non-Medical Products)	Finish	2000

Table 2 Reengineering or CQI?

	CQI		REENGINEERING	
<i>Level of change</i>	Incremental	Private Products, Aerotech, Technomed, Med Devices	Radical	DOD Design, Tech Express
<i>Starting point</i>	Existing process	Private Products, Aerotech, Technomed, Med Devices, DOD Design, Tech Express	Clean Slate	
<i>Frequency of change</i>	Continuous	Aerotech, Technomed, Med Devices	One-time	Private Products, DOD Design, Tech Express
<i>Time required</i>	Short		Long	Private Products, Aerotech, Technomed, Med Devices, DOD Design, Tech Express
<i>Participation</i>	Bottom-up	Med Devices	Top-down	Private Products, Aerotech, Technomed, DOD Design, Tech Express
<i>Typical scope</i>	Narrow, within function	Private Products, DOD Design, Tech Express	Broad, cross-functional	Aerotech, Technomed, Med Devices
<i>Risk</i>	Moderate	Aerotech	High	Private Products, Technomed, Med Devices, DOD Design, Tech Express

Table 3 Ideal Reengineering Process vs. Observed NPD Change Process

	IDEAL REENGINEERING PROCESS	OBSERVED NPD CHANGE PROCESS
Motivate the Need for Change	<p>Communicate need to company</p> <p>Develop explicit success criteria</p> <p>Focus reengineering on issues of customer involvement, competitive advantages</p>	<p>Communicated need to team</p> <p>No explicit success criteria were developed</p> <p><i>Followed ideal</i></p>
Secure Resources	<p>Management must commit time, expertise</p> <p>Put together broad cross-functional team</p> <p>Involve "outsiders" on team</p>	<p><i>Followed ideal</i></p> <p>Teams mainly consisted of product and process engineers</p> <p>No outsiders were used</p>
Evaluate Existing Process	<p>Explicit map existing process to understand strengths and weaknesses</p> <p>Consider company culture and norms</p>	<p>Identified strengths and weaknesses via ad hoc (expert) opinions</p> <p><i>Followed ideal</i></p>
Design New Process	<p>Involve customers and suppliers</p> <p>Benchmark other company's processes</p> <p>Learn from the literature</p> <p>Involve external expertise (consultants)</p>	<p>No customers or suppliers were involved</p> <p>Benchmarking was done informally</p> <p><i>Followed ideal</i></p> <p>No consultants used</p>
Implement and Measure Results	<p>Measure results of process changes</p> <p>Be realistic about implementation time</p>	<p>Results were measured sometimes</p> <p>Actual implementation times were 2-5X greater than expected</p>