

Quality Engineering Handbook

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edited by

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ADDITIONAL VOLUMES IN PREPARATION

*To my family: my wife Carol,
my daughters Amy and Angie and my son Andrew.
Writing a book is a lonely task—by being there for me
my family made it bearable.*



Preface and Acknowledgements

This work was written to fulfill my long-held desire to provide a single source that covers every topic in the body of knowledge for quality engineering. In teaching courses in the past I found that literally every text book had to be supplemented with materials from other sources (including some massive tomes!). Students were constantly being referred to technical journals, magazine articles and other books. My goal for this book is for it to serve as the single best resource for information about the field of quality engineering, serving as a teaching tool, a desk reference and as a base for certification training, for the student or the quality professional.

It was difficult deciding where to draw the line on including material in the book. My personal library contains literally hundreds of relevant books, not to mention the articles in technical journals and magazines. Virtually every major element in the quality engineering body of knowledge is the topic of entire college courses. It is even possible to obtain college degrees in some quality engineering subject areas, such as statistics. My challenge was to digest this material while providing enough detail to present a coherent picture of the whole. I believe that I have succeeded. Of course, you, the reader, must be the final judge. I welcome your suggestions.

This book is based on one of my previous books: *The Complete Guide to the CQE*. It has been revised and expanded to accommodate the expansion of what is expected of a quality professional. I would like to thank Bryan Dodson and Dennis Nolan for material excerpted from their book: *The Reliability Engineering Handbook*.



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I

Management and Leadership in Quality Engineering

I.A PROFESSIONAL CONDUCT AND ASQ CODE OF ETHICS

Quality engineers, like other professionals, are expected to conduct themselves in a manner appropriate with their professional standing. In this context, ethics are defined as the rules or standards governing the conduct of a person or the members of a profession. The basic principles of ethical behavior have been very nicely summarized in the Code of Ethics for Members of the American Society for Quality, which are shown in Figure I.1.

Table I.1 lists a number of conflict-of-interest situations likely to be encountered by quality engineers. The appropriate response to these and other situations can be determined by referring to the appropriate item in the ASQ code of ethics. Violations of the code of ethics by a quality professional may be brought before the ASQ Professional Ethics and Qualifications Committee. In extreme cases of ethics violations, ASQ membership privileges may be revoked.

The American Society for Quality Code of Ethics

*To uphold and advance the honor and dignity of the profession,
and in keeping with high standards of ethical conduct I acknowledge that I:*

Fundamental Principles

- I. Will be honest and impartial and will serve with devotion my employer, my clients, and the public.*
- II. Will strive to increase the competence and prestige of the profession.*
- III. Will use my knowledge and skill for the advancement of human welfare, and in promoting the safety and reliability of products for public use.*
- IV. Will earnestly endeavor to aid the work of the Society.*

Relations with the Public

- 1.1 Will do whatever I can to promote the reliability and safety of all products that come within my jurisdiction.*
- 1.2 Will endeavor to extend public knowledge of the work of the Society and its members that relates to the public welfare.*
- 1.3 Will be dignified and modest in explaining my work and merit.*
- 1.4 Will preface any public statements that I may issue by clearly indicating on whose behalf they are made.*

Relations with Employers and Clients

- 2.1 Will act in professional matters as a faithful agent or trustee for each employer or client.*

- 2.2 Will inform each client or employer of any business connections, interests, or affiliations which might influence my judgment or impair the equitable character of my services.*

- 2.3 Will indicate to my employer or client the adverse consequences to be expected if my professional judgment is overruled.*

- 2.4 Will not disclose information concerning the business affairs or technical processes of any present or former employer or client without consent.*

- 2.5 Will not accept compensation from more than one party for the same service without the consent of all parties. If employed, I will engage in supplementary employment of consulting practice only with the consent of my employer.*

Relations with Peers

- 3.1 Will take care that credit for the work of others is given to those to whom it is due.*

- 3.2 Will endeavor to aid the professional development and advancement of those in my employ or under my supervision.*

- 3.3 Will not compete unfairly with others; will extend my friendship and confidence to all associates and those with whom I have business relations.*

Figure I.1. ASQ code of ethics. From American Society for Quality.

Table I.1. Conflict of interest situations.

- Audits: failing to accurately report audit findings.
- Releasing non-conforming items to a customer without the customer's knowledge.
- Accepting non-conforming supplier materials without proper authorization.
- Ignoring or failing to report unsafe conditions, either in a product or a workplace.
- Plagiarism by yourself or another (e.g., a co-author).
- Revealing proprietary information.
- Failing to reveal a conflict of interest when knowledge of it would affect an important decision.

I.B MANAGEMENT SYSTEMS FOR IMPROVING QUALITY

STRATEGIC PLANNING

Management has no choice but to anticipate the future, to attempt to mold it, and to balance short range and long range goals. The future, however, depends entirely on what is done *now*. The decisions, actions, resource allocation, and work done *now* will create the future. The present and immediate short range require strategic decisions as much as the long range. The long range is based largely on short range plans and decisions. Conversely, unless the long range is considered when making short range plans and decisions, the result will be a lack of direction that will eventually ruin the organization.

The terms “short range” and “long range” are not determined by a span of time. A decision is not short range simply because it can be implemented quickly, nor is it a long range decision to “decide” that we will take some action a decade from now. The range of a decision is the period of time over which the decision will have an effect. If we decide that our business requires that we grow Giant Sequoias, then it is a long range decision indeed.

Despite the inevitability of the future, it cannot be predicted. How can one plan for the unpredictable? The short answer is that one cannot. However, long range planning can still provide valuable benefits. Long range planning’s benefits include preventing managers from uncritically extending present trends into the future, from assuming that today’s products, services, markets, and technologies will be the products, services, markets and technologies of tomorrow. Above all, long range planning will prevent managers from devoting their energies and resources to the defense of yesterday (Drucker, 1993).

WHAT STRATEGIC PLANNING IS NOT

There are many misunderstandings relating to strategic planning. To avoid confusion, these are listed here.

1. It is not a bundle of techniques. Strategic planning involves answering two simple questions: “What *is* our business?” and “What *should* it be?” The answers cannot be programmed into a computer. Although models and quantitative methods may be used, they do not constitute *planning*. At least one well-known text on planning defines strategic planning as “application of scientific methods to business decisions.” This is not correct.
2. Strategic planning is not forecasting. As stated above, the future is unpredictable. Perhaps Drucker said it best: “Forecasting is not a respectable human activity and not worthwhile beyond the shortest of periods.” Strategic planning’s value is not in its (nonexistent) ability to see into the future; to the contrary, it is necessary precisely because we cannot forecast the future. Strategic planning is an entrepreneurial activity that deliberately seeks to upset the probabilities by innovations and changes to the way people work and live.

3. Strategic planning does not deal with future decisions. *It deals with the futurity of present decisions.* Decisions exist only in the present. Yet our decisions may commit us for a long time, perhaps even permanently.
4. Strategic planning is not an attempt to eliminate or minimize risk. It does, however, seek to assure that the risks taken are the right risks. The end result of successful strategic planning must be capacity to take a greater risk by choosing rationally among risk-taking courses of action.

WHAT STRATEGIC PLANNING IS

Strategic planning is the continuous process of making present entrepreneurial decisions systematically and with the greatest knowledge of their futurity; organizing systematically the efforts needed to carry out these decisions; and measuring the results of these decisions against the expectations through organized, systematic feedback (Drucker, 1993).

Planning starts with the objectives of the business. What do we have to do *now* to achieve our objectives *tomorrow*? Planning must go beyond simply coming up with new things the business can do in the future. The first step is to ask of each present activity, product, process, or market “If we weren’t already doing this, would we start?” If the answer is “No,” then the organization should stop doing it, ASAP.

After identifying what old baggage to dump, the next step in the planning process is to ask “What *new* and different things do we have to do, and when?” Both the what and the when are important. The essence of planning is to make present decisions with knowledge of their futurity. It is the futurity that determines the time span, not vice versa. Futurity answers the question “What do we have to do today if we want to be in some particular place in the future? What will not get done if we don’t commit resources to it today?”

There is no easy way to determine how long “long” is. The question must be answered by each organization.

Strategic planning aims to make changes in the way people work today. The changes are designed to make things different tomorrow than they were yesterday. Plans *must* result in changes in work. If a manager admits that none of her best people are working on the plan today, then she has no plan. A plan shows how to assign scarce resources, and the most scarce resource is always good people. Of course, whenever our most precious resources are being used we must assure that they are used properly. This means accountability must be built into the plan. Deadlines are necessary, as is feedback on progress and measurement of the final result.

FORMAL APPROACHES TO STRATEGIC PLANNING

Unfortunately, most of what has passed as “Strategic Planning” fails to comply with one or more of the fundamental principles just presented. This has resulted in disappointing results and an increasing lack of respect for the practice of strategic planning. This section will present the most popular approaches to strategic planning. We will then discuss the problems with these approaches. Finally, we will present ideas for rescuing strategic planning; after all, as stated earlier, management has no choice but to plan for the future.

There are three main schools of thought on strategy formation:

The design school—Sometimes called the SWOT school, the basis of strategy formation is the comparison of internal Strengths and Weaknesses to external Opportunities and Threats. As shown in Figure I.2, strategy is created at the intersection of an external appraisal of the threats and opportunities facing an organization in its environment, considered in terms of key factors for success, and an internal appraisal of the strengths and weaknesses of the organization itself, distilled into a set of distinctive competencies. Outside opportunities are exploited by inside strengths, while threats are avoided and weaknesses circumvented. Taken into consideration, both in the creation of the strategies and their subsequent evaluation to choose the best, are the values of the leadership as well as the ethics of the society and other aspects of so-called social responsibility. And once a strategy has been chosen, it is implemented.

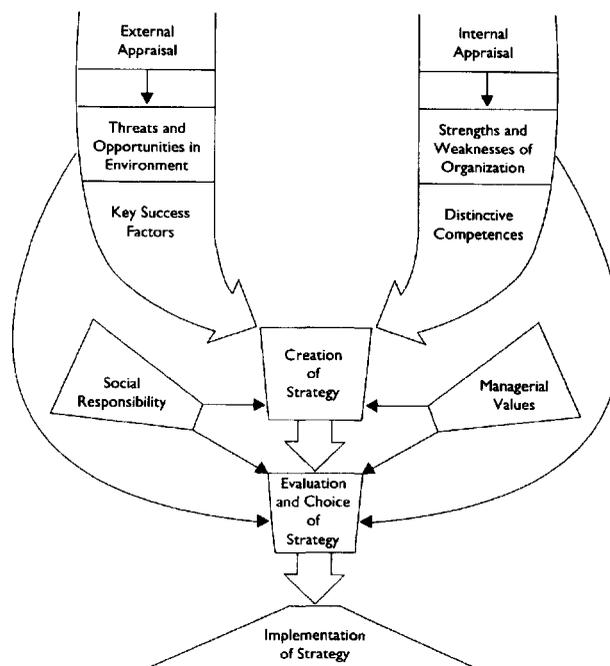


Figure I.2. Design school model of strategy formulation.

From Mintzberg, H. (1994). *The Rise and Fall of Strategic Planning*. Copyright© The Free Press.

A number of premises underlie this model:

1. Strategy formation should be a controlled, conscious process of thought.
2. Responsibility for the process must rest with the CEO, who is *the* strategist. The CEO is seen as the architect whose plans everyone else builds.
3. The model of strategy formation must be kept simple and informal.
4. Strategies should be unique: the best ones result from a process of creative design. Strategies are built upon distinct, core competencies.
5. Strategies must come out of the design process fully developed.
6. The strategies should be made explicit and, if possible, articulated, which means that they have to be kept simple.
7. Finally, once these unique, full-blown, explicit, and simple strategies are fully formulated, they must be implemented.

The planning school—Accepts the premises of the design school, except the assumptions that the process be simple and informal and that the chief executive be the key actor. The basic premises of the planning school are:

1. Strategy formation should be controlled and conscious as well as a formalized and elaborated process, decomposed into distinct steps, each delineated by checklists and supported by techniques.
2. Responsibility for the overall process rests with the chief executive in principle; responsibility for its execution rests with the staff planners in practice.
3. Strategies come out of this process fully developed, typically as generic positions, to be explicated so that they can then be implemented through detailed attention to objectives, budgets, programs, and operating plans of various kinds.

The positioning school—Focuses on the content of strategies (differentiation, diversification, etc.) more than on the process by which they are prescribed to be made (which are generally assumed to be those of the planning school). In other words, the positioning school simply extrapolates the messages of the planning school into the domain of actual strategy content. An example of this approach is the Boston Consulting Group's growth share matrix of cash cows, stars, dogs, and wildcats. This model categorizes companies according to the growth of the market and the company's market share, the company then determines its strategy based on the category it is in.

PLAN FORMATION

The term “strategic plan” was first used by H.I. Ansoff in a 1965 book entitled *Corporate Strategy*. In this seminal work the strategic plan consisted of a product-market strategy, and objectives which, combined with an administrative and design strategy, produced a strategic budget. These relationships are illustrated in Figure I.3.

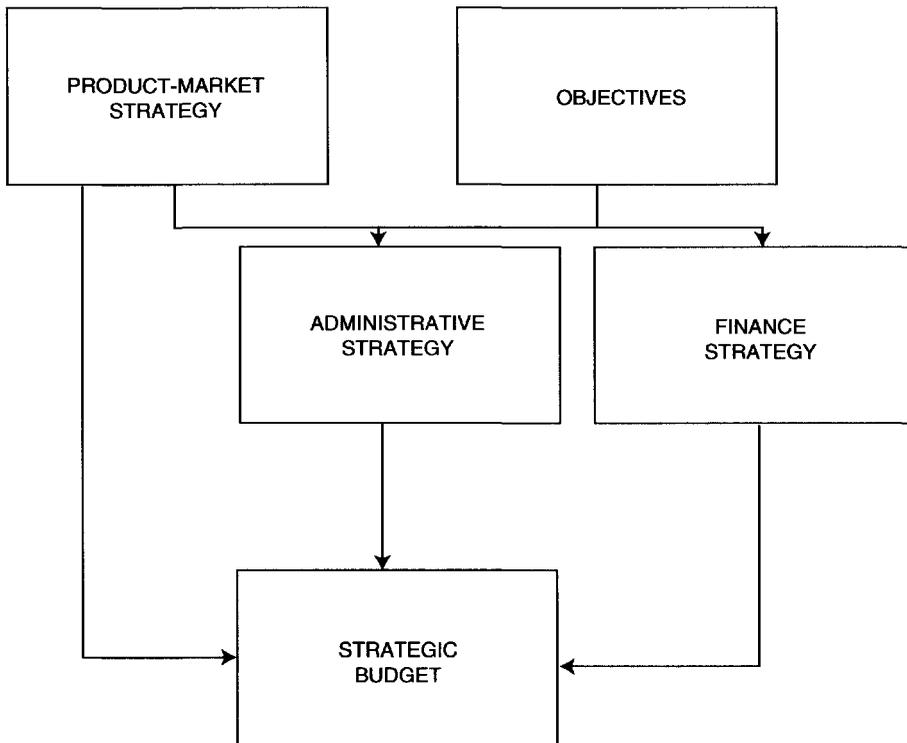


Figure I.3. Ansoff's strategic plan.

The strategic plan is the end result of an elaborate planning process.

RESULTS OF STRATEGIC PLANNING

Strategic planning made its appearance on the business scene in 1965. The results since then have been disappointing. An extensive meta-analysis of empirical studies covering nearly 2,500 organizations concluded that “the overall effect of planning on performance is very weak” (Boyd, 1991). Mintzberg summarizes over twenty years of strategic planning practice and research by stating “At the very least, we have found that planning is not ‘the one best way,’ that it certainly does not pay in general, and that at best, it may have some suitability in particular contexts, such as larger organizations, those in mass production, etc.” (Mintzberg, 1994, p. 97).

In short, the evidence on strategic planning leads to the conclusion that it often doesn't work. Mintzberg postulates that this is so because strategic planning (of which capital budgeting is a part) is based on “The Grand Fallacy:” *Because analysis is not synthesis, strategic planning is not strategy formation.* Analysis may precede and support synthesis, by defining the parts that can be combined into wholes. Analysis may follow and elaborate synthesis, by decomposing and formalizing its consequences. But analysis cannot substitute for synthesis. No amount of elaboration will ever enable formal procedures to forecast discontinuities, to inform managers who are detached from their operations, to create novel strategies. Ultimately, the term “strategic planning” has proved to be an oxymoron.

PROPOSED SOLUTIONS TO THE STRATEGIC PLANNING PROBLEM

The first order of business in “fixing” strategic planning is to reintegrate analytic and intuitive thinking. Indeed, before integrating the two, we must first *allow* intuitive thinking, since the conventional approach dismisses it as “too biased.” Research indicates that intuitive thinking leads to decisions that are less often precisely correct than analytical thinking, but that have fewer extreme errors. Thus, each approach has advantages and disadvantages. Since normal human beings are capable of performing both types of thinking, why not let them? Since planners tend to be more analytic, and managers more intuitive, the “planning dilemma” may well suggest its own solution. Planners have the time and technique to engage in the analysis. Managers have the intuition and detailed knowledge to suggest projects and to detect possible errors in the analysis. If the two work together, as equal partners, the two modes of thinking can be combined to produce better decisions than either could do without the other.

Mintzberg calls this combined approach to thinking “soft analysis.” Soft analysis suggests an approach in which it is more important to pose the right question than to find the precise answer, to incorporate an appreciation for soft data alongside the necessary analysis of hard data. Judgment takes its place alongside formal procedures, and a mutual understanding is allowed to develop between staff planner and line manager. Soft analysis forgets about optimization, accepts the absence of sharply defined goals, downplays

elegance in technique. Each issue is approached as a unique, creative challenge. The approach is systematic, but seldom rigorous, distinguishing between “analytic thinking” and “analytic technique.”

STRATEGIC PROGRAMMING

One approach to strategic “planning” that incorporates soft analysis as well as hard is called *strategic programming*. Strategic programming provides a framework that delineates the roles of planning, plans, and planners. This framework constitutes an operational definition of planning.

The central premise of strategic programming is that effective organizations engage in formal planning not to create strategies but to program the strategies they already have, that is, to elaborate and operationalize their consequences formally. Thus, strategy is not the result of planning, but its starting point. Programming is a management activity which translates decisions into specific action patterns for implementation. The primary tasks involved in programming are:

1. Scheduling activities in support of decisions
2. Assignment and scheduling of resources in support of decisions (i.e., budgeting)
3. Establishing patterns of work flows in the firm
4. Establishing patterns of authority and responsibility
5. Establishing communication flow networks

Early authors on strategic planning viewed strategic programming as a “narrow context” in which to define planning. However, after decades of experience with planning, strategic programming is coming to be seen as planning’s preeminent role. General Electric’s chief planner stated in an interview:

I make a distinction between planning and strategy—they’re two different things. Strategy means thinking through a company’s basis of competitive advantage . . . Planning, on the other hand, focuses on making the strategy work.

Strategic programming produces action plans. These plans serve two primary purposes: communication of the strategy, and control of behavior. Plans, as communication media, inform people of intended strategy and its consequences. As control devices, they specify what behaviors are expected of particular units and individuals in order to realize strategy, and then being available to feed back into the strategy making process comparisons of these expectations with actual performance.

Strategic programming involves a series of three steps:

1. **Codifying the strategy**—Planning refines the central strategic concepts of management into a relatively few principal thrusts around which the organization can pattern its resource commitments and measure its managers’ performance.