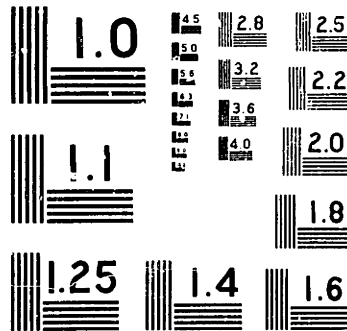


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**Evolution of the Entrepreneurial Firm:
Product Strategy and Organization Design**

by

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Bachelor of Science in Mechanical Engineering
University of Illinois at Urbana-Champaign
(1987)

Master of Science in Mechanical Engineering
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(1991)

Submitted to the Sloan School of Management
and the Department of Electrical Engineering and Computer Science
in Partial Fulfillment of the Requirements for the Degrees of

Master of Science in Management
and
Master of Science in Engineering

in conjunction with the
Leaders For Manufacturing Program
at the Massachusetts Institute of Technology
June, 1996

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Abstract

This thesis documents the evolution of organization, technology strategy, and product development at a rapidly growing, medium-sized firm engaged in the design, manufacture, and distribution of capital equipment to the electronics industry. It captures ideas, thought processes, and knowledge developed during a six month Leaders For Manufacturing Program internship.

Perspectives in organization design, the economics of organization, models of organization, and change theory are reviewed. We apply these ideas in the context of the firm. Experiences in engineering and manufacturing projects with the firm highlight the need for change. A tiered-team organization, supporting improved business processes, is created. Preliminary results of the change effort, including the implementation of a technology and product strategy process, are provided. Finally, we reflect on the results in light of the problems we set out to resolve and the theories that shaped our efforts.

This thesis documents the application of existing ideas. It provides some insight into the problems faced by a rapidly growing, entrepreneurial firm as it transitions into a larger organization.

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Rebecca Henderson
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Acknowledgments

The work presented in this thesis was performed under the auspices of the Leaders For Manufacturing Program, a partnership between fifteen major U. S. manufacturing companies and MIT. I am grateful to the Program for providing the opportunity to return to school -- for its support of this work and my education.

I would like to thank my host at EquipTech for sponsoring the internship and for allowing a significant degree of latitude in pursuing this project. His counterpart in Marketing deserves thanks for allowing me to participate in an effort they jointly championed. The project would not have been successful without their guidance and ownership. When I say “we” in this thesis, I am referring to the people at EquipTech that co-owned the project on a day-to-day basis. Many of the ideas and most of what was eventually implemented are theirs.

I wish to thank both of my advisors at MIT for the patience, guidance, leadership, and wisdom they have shared with me in this endeavor. Rebecca Henderson is truly an amazing person. Her insights and participation were instrumental in shaping my perspective. I would like to thank Tom Eagar for helping me to recognize the value in having a strong technical foundation and that the difficulties in resolving problems are usually technical- as well as people-related.

Finally, and most significantly, I would like to thank my wife Heidi. Without her support, humor, and encouragement, this adventure in returning to school would not have been possible or successful. I thank her for her patience and her perspective in caring for our new daughter during my frequent absences to deal with the challenges of graduate work, research, and a job search.

I dedicate this thesis to my classmates. Thank you for making this adventure a unique and most valuable experience. The past two years have fundamentally changed the way I view myself, my abilities, and the opportunities that lie before me.

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1. INTRODUCTION

How do successful, technical, entrepreneurial firms develop the managerial capabilities and business processes that are necessary for sustained growth? How do they evolve into broader organizations, spanning new markets and geographies? This thesis is an exploration of ideas for the design and change of rapidly growing organizations.

The work documents ideas, thought processes, and knowledge developed during a 6 month Leaders For Manufacturing (LFM) internship. In particular, we review ideas in organizational development and change. We apply these ideas in the context of a EquipTech¹, a rapidly growing, medium-sized, technical firm. Ultimately, we helped the leaders at EquipTech begin to organize their company for the future, transferring responsibility to less senior managers and leveraging the abilities of a broader cross-section of the firm.

1.1 Larger Issues Raised

We believe this thesis provides some insight into the type of problems faced by an entrepreneurial firm as it makes the transition to a larger organization. Larger issues raised in the study include:

- the effects of rapid growth on the development of an organization, as highlighted in the study of specific engineering- and manufacturing-related problems,
- the process of identifying culture in an organization and the impact culture can have on competitive capability,
- theories and processes for the design of organizations,
- the organizational change process,
- the application of frameworks for product development,

¹ By disclosing the name of the firm, we are able to present insights and data that would otherwise have been retained as confidential.

- and the application of frameworks for technology and product strategy.

1.2 Thesis Organization

Ideas are put forward in three major sections:

1. The first major section of the thesis provides context and background, supporting the subsequent work. A review of culture, perspectives in organization design, the economics of organization, models of organizations, and change theory are provided.
2. We introduce a project at a specific firm that will allow us to test many of these ideas. The culture of the organization is described. Experiences with the firm, including product development and new product introduction, are reviewed. Specific concerns related to culture and future capability are put forward.

A hypothesis for organizational change is put forward. More specifically, a proposal for change, laying the foundation for improvement at many levels of the business, is proposed. A design for the organization is discussed. Details from the implementation are shared.

3. Preliminary results of the change effort are summarized. The initial iteration of a new Technology and Product Strategy process is covered. We reflect on our experience in light of the theories. Concerns related to the need for coherent change in all aspects of organization are put forward.

1.3 Personal Perspective

In exploring these ideas and supporting EquipTech in their quest for growth and competitive dominance, I was interested in developing more than an academic thesis. I've learned some great things during my studies at Sloan and MIT, but I accept them from the perspective that management and engineering are ultimately processes. What counts is not just how one thinks or what one knows, but the results one can achieve and what one can do.

Although we talk a lot about process and “process thinking” in this work, we do so with the perspective that at least 90% of the effort and time one puts in as a successful manager is likely

to be spent dealing with people and resolving differences, perceived or otherwise, between people. In fact, people are at the heart of the models of process, organization, and change we discuss. People are at the heart of the implementation efforts that we undertook. We mean to present frameworks, strategies, and results in this light.

2. DESIGNING AND CHANGING ORGANIZATIONS

... the future of an organization may be less determined by outside forces than it is by the organization's history²

In this chapter we review ideas from the literature of organizational culture, evolution, design, and change. Guidelines for the design of “lateral” organizations are covered in more detail. An overview of organization change theory is provided. We draw from this review a perspective for designing and changing organizations. In subsequent chapters, we apply these ideas to evolve the culture and organization at EquipTech.

2.1 Defining “Business Process”

Most business people are not “process oriented”; they are focused on tasks, on jobs, on people, on structures, but not on processes.³

A business process is a set of activities that, taken together, produce a result of value to a customer.⁴ Examples include:

- strategy development (converting customer requirements into business requirements)
- product development (converting business requirements into satisfying and manufacturable product designs)
- manufacturing capability development (converting business requirements and product designs into the capability to produce products)
- order fulfillment (acquiring an order request, then converting the order request, a product

² Larry Griener, “Evolution and Revolution as Organizations Grow”, *Harvard Business Review*, Jul-Aug 1972.

³ Hammer and Champy, Reengineering the Corporation: A Manifesto for Business Revolution, New York: Harper Business, 1993, p. 35.

⁴ Ibid., Hammer and Champy, pp. 3, 118-121.

design, and manufacturing capability into product, then putting that product in the customer's hands)

- customer inquiry and problem resolution (receiving and resolving customer inquiries, concerns, or problems in a manner that reinforces their satisfaction)

Business processes are the operational nuts and bolts of a business. They are where the work actually gets done. They are the fundamental sets of related tasks that a business must perform, regardless of what its strategies are, what its policies are, or how it is organized, in order to deliver value to customers.

2.2 Defining "Culture"

Culture evolves. It is difficult to consciously create, replicate, or change culture. When matched to the needs of the market, culture can be a source of serious leverage over competitors. In changing circumstances, culture can be a serious rigidity.

Culture is the pattern of basic assumptions and beliefs that explain an organization's behavior.⁵ These basic assumptions are derived from the influences of early leaders as well as shared experiences and patterns of success and failure in dealing with internal challenges of integration and external challenges of survival.

Culture can be analyzed at three hierarchical levels:

1. visible artifacts and symbols
2. espoused values, rules, and behavioral norms
3. tacit, basic underlying assumptions

In order to understand and decipher what is happening at the level of artifacts or espoused

⁵ definition drawn from Bob Thomas, lecture on Organizational Culture, course 15.316: Leadership and Organizational Change, Sloan School of Management, Spring 1995.

values, one must dig down and develop an understanding of basic assumptions.⁶ Basic assumptions often surface in the study of organizations at apparent anomalies between artifacts and espoused values.

2.2.1 Dimensions of Culture

This section provides an overview of the dimensions of culture, categorized according to deeply held beliefs, challenges of internal integration, and challenges of external survival.

2.2.1.1 Assumptions Derived from Deeply Held Beliefs

Assumptions following from the deeply held, intrinsic beliefs of founders and early leaders include those regarding the nature of reality and truth, the nature of time, the nature of space, the nature of human motivation and perspective, and the nature of human activity (the right thing to do, given the other assumptions). Examples include the following:

- Is truth revealed or discovered? How is truth ultimately determined? Is it that which survives conflict and debate or is it wisdom from authorities?
- What are the appropriate definitions of soon, on-time, and far-off? What is the appropriate degree of accuracy in time measurements? Is time a monochronic or polychronic medium?⁷
- What are the rules for allocating space? What are the symbolic meanings of space around a person? What are the appropriate norms for intimacy distance, social distance, etc.?
- How are people motivated? Are humans social animals with social needs or are they problem solvers and self-actualizers with the need to be challenged and use their talents? Is human nature intrinsically good, evil, or neutral?
- What is the appropriate level of activity or passivity? Is it proper to take charge, control,

⁶ Schein, Edgar, Organizational Culture and Leadership, San Francisco: Jossey-Bass, 1992. The sections of this thesis that deal with culture are based heavily on the ideas of Schein.

⁷ In monochronic time, defined by a linear ribbon that is infinitely divisible, events are scheduled and pursued in a serial fashion. Punctuality and efficiency are valued. In a polychronic perspective of time, defined by what is accomplished rather than by the clock, several things are pursued simultaneously. Relationships are more important than deadlines -- each task is held in suspension until it is finished.

and manipulate your environment or to adapt and react to realities, accepting what is given?

Does the organization as a whole dominate the environment or coexist with it?

- Who is the source of good ideas? Is life basically cooperative or competitive? Is authority derived by tradition, charisma, or moral consensus? How is authority to be exercised? What is the appropriate level of participation and involvement for authorities?
- How important are individual people relative to the organization? Is there a psychological contract between employer and employees?
- How should conflict be resolved? How should decisions be made?

2.2.1.2 Assumptions Derived from Internal Integration Issues

Leadership within companies is often focused on the need to integrate internal processes that allow the organization to survive and adapt. Confrontation with issues of survival often stimulates a rapid consensus on the internal integration issues.

Many of these issues are related to the difficulties inherent in group formation and work. If issues of internal integration are not sufficiently resolved, people will spend a large proportion of their time dealing with insecurity and uncertainty in their positions and identities. They will strive to define rules that will allow them to better understand and cope with what is going on.

Examples of the type of assumptions that derive from issues in the internal environment include the following:

- Is there commonality in language or conceptual categories that allows people to communicate?
- What are the boundaries of the group? What are the criteria for inclusion or exclusion?
- How is power distributed? What is the pecking order? What are the rules for gaining, maintaining, and losing power?
- What are the norms of friendship and intimacy within the organization?
- What are appropriate behaviors, rewards, and punishments?

- What shared beliefs have developed to allow the group to deal with the unexplainable or uncontrollable?

2.2.1.3 Assumptions Derived from External Survival Issues

External leadership concerns include boundary management, survival, and growth for the organization. These are the most significant of all leadership responsibilities. They are the primary basis on which leaders are usually assessed; organizations have a very low tolerance for external failure.

Examples of the type of assumptions that derive from challenges in dealing with the external environment include:

- What is the primary mission or strategy for the group? What are the primary tasks and purpose for the organization? What are the group's core competencies?
- How are stakeholders' needs to be balanced? What are the organization's responsibilities and functions in society?
- What are the goals of the organization? Goals are derived from the mission. Goals are concrete and facilitate decision making.
- What is appropriate day-to-day behavior? What are the appropriate skills, technologies, and knowledge? How are they developed and exercised?
- Which groups within the organization have higher status or dominate the others?
- What are the appropriate reward and incentive systems? How is information developed and shared?
- Who decides truth or acceptability? What are the appropriate criteria for deciding? What is the appropriate time horizon for making evaluations?
- What are the appropriate means for correcting or reconciling problems? Are they local, focusing on the individual problem or are they global, focusing on the organization or system? Do they avoid confrontation (brush the problem under the rug, move people into

different jobs) or do they rely on confrontation?

2.3 Perspectives of Organization

What are the forces that have traditionally shaped the design and evolution of organizations? In this section, we look at some of the ideas that have been proposed over the years. Our goal is to develop a historical context and a perspective for evaluating organization design and change problems.

Schein, in his work on the development of culture, suggests all organizations are shaped by the following factors:

- the deeply held beliefs of founders and early leaders,
- dealing with the integration of internal processes that allow a firm to survive and adapt, and
- dealing with survival and adaptation to the external environment.

2.3.1 Organizations are Designed From the Top Down

Almost all frameworks for the design of organizations are based on the belief that market opportunities shape a firm's strategy and that strategy determines the appropriate form of organization structure.⁸

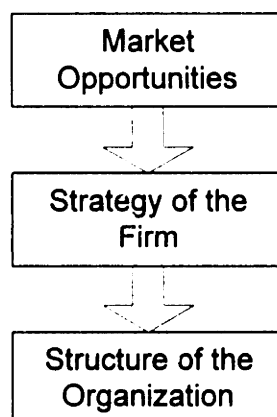


Figure 2-1 Organization Design Follows From Strategy

⁸ Galbraith, Jay, Competing with Flexible Lateral Organizations, 2nd ed., Addison Wesley, Reading, MA, 1994.

In dealing with the need to survive, adapt to, and perhaps shape the external environment, the firm must be able to marshal resources and accomplish tasks. The firm must be able to develop, harbor, and apply competencies. Furthermore, it must do so in an efficient manner. It makes intuitive sense that organizations should be deterministically shaped by managers in order to accomplish goals in the external environment.

Market opportunities and the evolution of the markets in which a firm competes will thus determine or “result in” an appropriate structure and capabilities for an organization. Managers determine and shape the evolution of the organization from the top-down. Organizations are designed primarily to accomplish the strategy and goals of the firm.

2.3.2 The Mechanistic Organization

Ideas in the design of organizations have traditionally followed from an assumption first articulated by Adam Smith in the *Wealth of Nations*. “Productivity can be improved tremendously if work can be broken down hierarchically into its simplest and most basic tasks.”⁹ The basic assumption has evolved over the years, but has not changed substantially.

Disciples of Frederick Taylor broke down the assembly of complex products into simple, repeatable steps requiring very little in the way of specific knowledge or skills on the part of assembly “operators”. In doing so, they created a scaleable system of production; production was no longer subject to the availability of a skilled workforce. Carnegie and railroad firms created operating policies, breaking down operating activities into formalized command and control procedures that could cover every contingency that might arise. Workers were trained to execute the rules mechanistically (bureaucratically), allowing organizations to grow larger than the span of one person’s control. Sloan applied the same principle to management, segmenting the work and creating functional specialists and staffs. This innovation put in place the capability to manage large, sprawling conglomerate organizations overseen by senior executives that would manage by the numbers. In each of these instances, the organization

⁹ Hammer and Champy, Reengineering the Corporation: A Manifesto for Business Revolution, New York: Harper Business, pp. 12-15.

becomes more and more like a machine – capable of running well, but in a deterministic and rigid fashion.¹⁰ Each of these innovations put in place capability that allowed organizations to grow rapidly in the post World War II era of economic expansion in the United States.¹¹

Assumptions underlying an organization based on traditional, mechanistic framework are:

- Goals and direction are set at the top of the organization. They are deployed through a hierarchy.
- Tasks are given.
- People are perceived mechanistically, as filling roles in the organization.
- Roles and hierarchy define capability.
- The challenge is one of assignment -- define the hierarchy and boundaries for organizational units in such a way as to maximize efficiency in performing all of the tasks.

Organization design, from this perspective, is reduced to “administrative science” or “theories of departmentalization”. Some of the principles have evolved into mental models that are still used today.

“The most efficient results are obtained at least expense when we coordinate related effort and segregate unrelated effort.”¹²

Mechanistic frameworks, however, do not account for the motivational influences on individualistic and organizational behavior¹³ or the impact of environmental and social factors.

¹⁰ Ibid., Hammer and Champy, pp. 12-15.

¹¹ Ibid., Hammer and Champy, p 16.

¹² Oster, Sharon, Modern Competitive Analysis, 2nd ed. New York: Oxford University Press, 1994, p. 163, referring to an internal DuPont memo, quoted in A. Chandler, Strategy and Structure, Cambridge, MA, 1962, p 69.

¹³ March & Simon, Organizations, New York: Wiley & Sons, 1958. The authors were among the first to point out the limitations of the traditional, administrative theories in that they lacked concerns related to individual behavior and motivational influences.

And clearly the capabilities of an organization are founded on more than roles and hierarchy. In the uncertain business environments faced by most companies today, tasks cannot be perceived as given. It has become widely recognized in some industries that people and knowledge are the primary sustainable sources of differentiating competency. Mechanistic theories of the design of organizations are thus incomplete.

2.3.3 Environment Affects Organization

Environmental factors strongly influence the design and evolution of organizations. In 1967, Lawrence and Lorsch presented an idea that would forever after shape the design of organizations.¹⁴ Until this time, much of the research in the design of organizations focused on improving or implementing an optimal structure. People adhered to a basic assumption that there was one right way to design an organization.

Lawrence and Lorsch suggested, in fact, that the environment in which a firm operates strongly influences how the structure should be designed. Environmental factors include market conditions, product variety and rate of change, and competition as well as social and economic forces.

An example they presented contrasts the organizations for a brewery and a plastics company. A brewery makes the same recipes over extremely long product life cycles to an exacting process. In their framework, this company is best operated in a hierarchical, vertically integrated structure emphasizing control mechanisms and functional specialization. The plastics company, with custom formulations and individual customer needs, requires a heavier emphasis on cross functional coordination. Rules and control mechanisms will not suffice. This type of company is best organized in a flatter, more fluid, cross-functional type of structure.

These ideas are still relevant, as exemplified by the recent excitement surrounding

¹⁴ Lawrence and Lorsch, Organization and Environment: Managing Differentiation and Integration, Boston: Harvard Business School Press, 1967.

reengineering. More and more, customers are demanding specialized or specific products and services. Competition has intensified in the increasingly global marketplace; international firms have invaded traditional mass markets with more customer specific, quality goods. Product life cycles have shortened in many industries. Environmental factors have thus been pushing mature, hierarchical companies toward the more fluid, cross-functional model.

The basic premise in reengineering is that business processes need to be designed specifically for the environment in which a firm competes. Supporting structure, measurements, and policies are implemented in order to optimize the firm's ability to execute the processes (see Figure 2-2 below). Maximization typically precludes fractionating the processes to take advantage of vertical or functional specialization.

Regulatory, social, and economic forces also shape the design of organizations. For instance, it is unlikely that Henry Ford would have embraced the concepts of empowerment and teaming or partnering in his day. The very vertical, hierarchical organization he implemented was reinforced and shaped to a large degree by the social and economic forces present at the turn of the century.

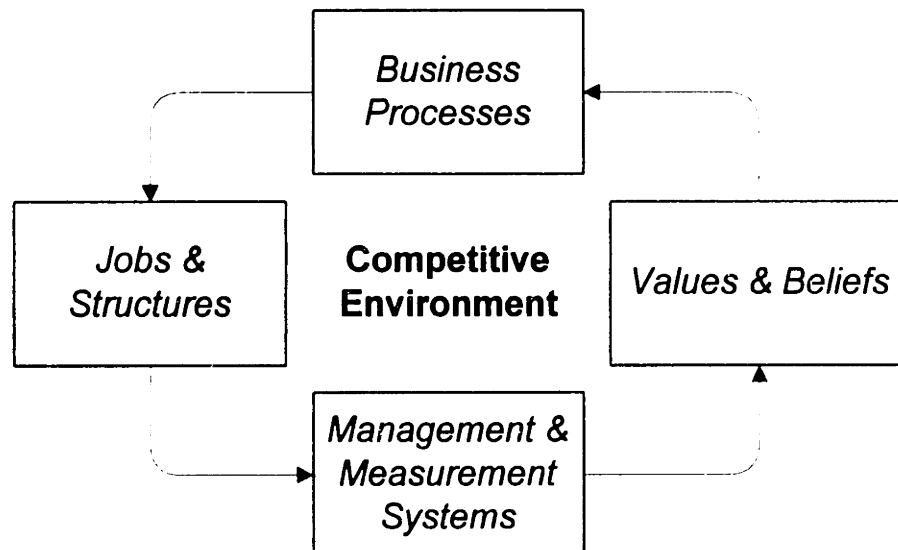


Figure 2-2 Organization Design in Reengineering

Organizations may be shaped initially from the top down, but there is no one best way to design or structure an organization. Subsequent evolution is predominantly influenced by the environment in which the firm competes.

2.3.4 Organizations Evolve

Larry Griener, in his work on the stages of organization development, suggests that structure does not just evolve from the top down. To the contrary, he suggests that organization structure strongly influences the development of corporate strategy.¹⁵ Success for a growing company often lies in its ability to focus inward as well as outward -- to recognize that it will, at times, be faced with the need to overcome culture, entrenched power bases, and historical forces that limit the firm's ability to adapt to its environment or address new market opportunities.

Managerial processes and the development of organizational capability in a young or rapidly growing firm are often taken for granted -- until problems surface in the form of a crisis. Griener proposes a structured process of evolution that firms follow over the course of their lives. He describes five phases of development that a successful firm will negotiate. Each phase is characterized by a prolonged period of evolutionary growth followed by a subsequent period of substantial organizational turmoil.

The framework is obviously simplistic -- it presents a set of stages that he deems to be universal for all firms. It suggests that all parts of a firm evolve at the same rate. It relates the stages of development for a firm to age, rather than size or dynamics in the market. In fact, it may be more plausible that different parts of a firm coexist in different stages of development along somewhat related trajectories. Griener also ignores the impact of key early decisions and leadership actions that will uniquely shape the development of a firm.¹⁶

In Griener's first phase, leaders of the fledgling organization are technically or

¹⁵ Ibid., Griener.

¹⁶ For example, see Schein, Organizational Culture and Leadership, 2nd ed., San Francisco: Jossey-Bass, 1992, pp. 228-254.

entrepreneurially oriented. They focus predominantly on making and selling a new product. They disdain management activities. Communication among employees is frequent and informal. Commitment is developed through the promise of ownership benefits. Control is immediate and reactive to information in the marketplace. Individualistic and creative leadership allows a sustained period of success and growth as the firm's products find success in the market.

Individualistic and creative leadership eventually causes problems. Increasing numbers of employees cannot be effectively managed through informal communication. Larger production runs require knowledge of the efficiencies of manufacturing. New accounting procedures and a managerial outlook are needed for effective control. Harried leaders become burdened with unwanted managerial responsibilities. Conflict becomes significant and the firm is faced with a crisis of leadership.

[The organization is thus faced with] its first critical developmental choice -- to locate and install a strong business manager who is acceptable to the founders and who can pull the organization together.¹⁷

Decisions made in resolving this crisis set the stage for the next phase of growth. "Able and directive" leadership allows a second, sustained period of evolutionary growth, eventually resulting in a crisis of autonomy. Lower level employees "come to possess more direct knowledge about markets and machinery than do the leaders at the top; consequently, they feel torn between following procedures and taking initiative on their own."¹⁸ Grierer's framework and phases are reproduced in Figure 2-3.

Although all firms may not subscribe perfectly to the framework, periods of evolution and revolution should be rather plausible with anyone who has spent time in real organizations. In Grierer's framework, the nature of management's solution to the crisis in each revolutionary

¹⁷ Ibid., Grierer. This section paraphrases some of the material in his paper in order to provide a concrete example of the framework.

¹⁸ Ibid., Grierer.

period not only determines how successful the firm will be in transitioning into the following evolutionary period, but sets the stage for the next revolutionary period. Evolutionary phases are essentially periods of organizational development and learning. Although a manager might be able to predict and even prepare for problems, the problems cannot be avoided. Organizations learn by resolving problems; the stages of learning cannot be skipped.

Organizations thus may be shaped initially from the top down, but subsequent evolution is predominantly influenced by the history, entrenched power bases, and stages of organizational learning inside the firm. Strategy and capabilities often follow from organization.

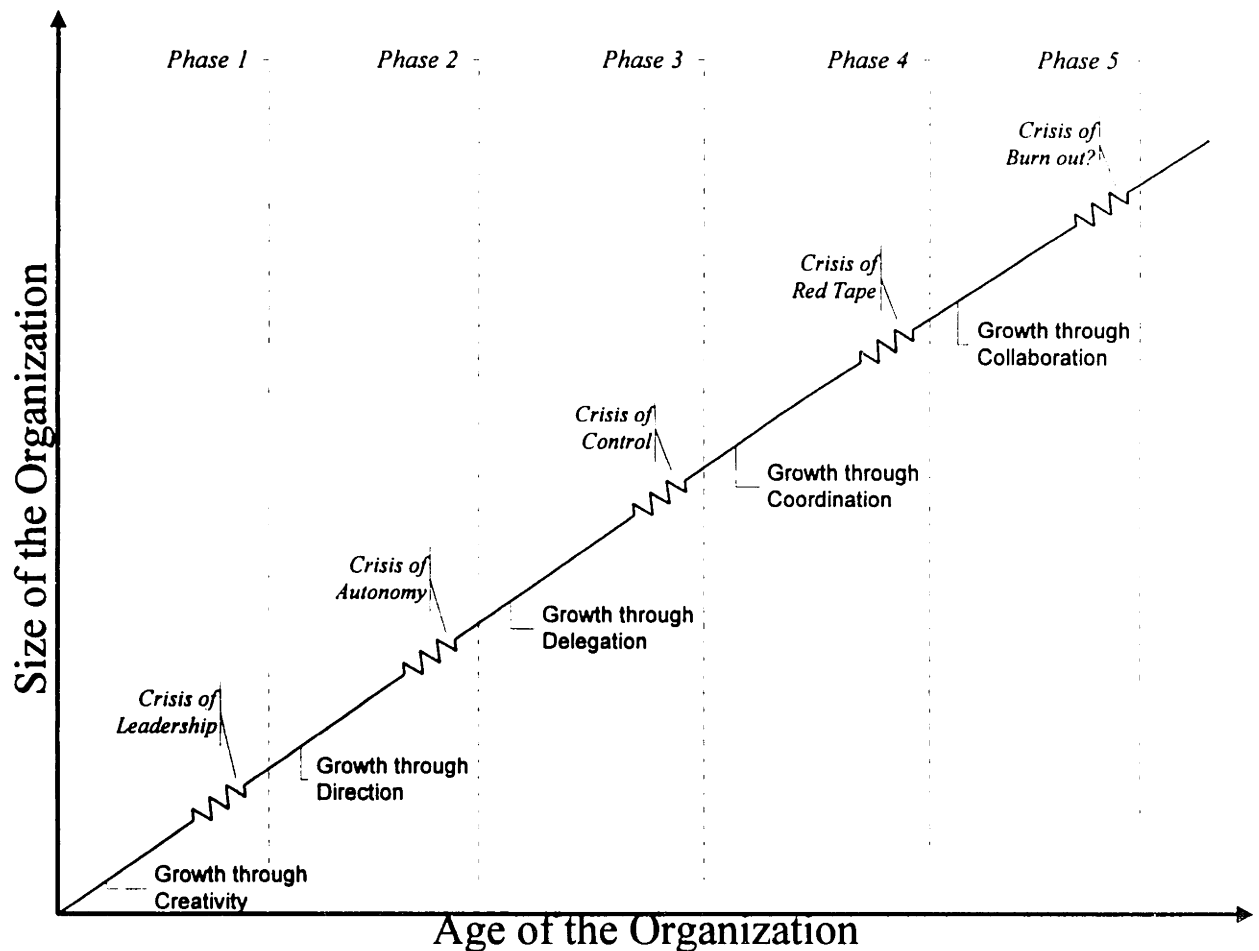


Figure 2-3 Griener's Phases of Organization Development

Some of the framework rings true in the history at EquipTech. After an initial period of growth under the leadership of very entrepreneurial and technical founders, the skills of an organizational business leader were sought out.¹⁹ This transition was rather turbulent, with the founders accepting and rejecting one leader before settling on another. Under the guise of this leader, additional people were recruited to lead the firm through a sustained period of rapid growth. Currently, however, parts of the firm face what could be construed as a crisis of autonomy. In fact, one could argue that this internship project dealt, in part, with a crisis of autonomy.

2.4 Economics of Organization

The design of organizations has also been influenced by the study of economics inherent in organization structure decisions. This section reviews concepts from the economics of organization.²⁰

The dilemma posed is one of “distributed” organizations versus “centralized” organizations. Distributed organizations can minimize the costs associated with a lack of responsiveness or bureaucracy. Centralized organizations, on the other hand, can reduce costs due to failures of coordination or alignment.

2.4.1 Types of Knowledge

In any organization, regardless of the structure, information and knowledge are required in order to make good decisions.

Information is proposed to exist along a spectrum, the two ends of which are “specific knowledge” and “general knowledge”. Specific knowledge is costly to transfer among agents. Understanding of detail and local context are needed to make a good decision. General

¹⁹ Personal discussions with senior managers of the firm, Sep-Dec 1995.

²⁰ This section is influenced heavily by Jensen and Meckling, “Specific and General Knowledge, and Organizational Structure,” in Werlin and Wijkander, *Contract Economics*, Oxford: Blackwell, 1992, pp. 251-273.

knowledge is inexpensive to transfer. A good decision based on general knowledge does not require an understanding of contextual factors or specific capabilities.

2.4.2 Allocation of Decision Rights

The goal in allocating decision responsibilities is to minimize costs to the organization. Information can be brought to those having centralized decision responsibility or local decision responsibility can be granted to those with information. The following factors are to be taken into consideration when judging costs.

- costs of generating and transferring knowledge
- how the assignment of decision rights influences incentives to gather information
- agency costs: the sum of costs of designing, implementing, and maintaining incentive and control systems + the residual loss to the firm due to lack of complete control

In general, we are concerned with situations in which the cost of a poor decision is high. We want to give decision making responsibility to those having specific knowledge because specific knowledge is difficult (expensive) to transfer. When decisions are made locally, we get locally optimal decisions and more flexibility. On the other hand, we want to give decision making responsibility to a centralized authority when the knowledge is general (easy to transfer through information systems, etc.). Centralization and control result in a more globally optimal solution. But centralization and control can also lead to bureaucracy. The tradeoff faced is essentially an agency problem: incentives are needed to ensure that self-interested decision agents exercise their rights in a way that contributes to the broader organizational objective.

*...the key to efficiency is to assign decision rights to each agent
at each level to minimize the sum of the costs owing to poor decisions resulting
from the lack of specific information and the costs owing to conflict
resulting from inconsistent objectives.²¹*

²¹ Ibid., Jensen and Meckling.

2.4.3 Types of Decision Rights

Decision rights can be granted to people through the following means:

- Job Descriptions, Internal Common Law: formal task responsibility (e.g.: pricing, hiring, or promotion decisions), informal position power, committee memberships, project assignments
- Budgetary Control: discretion in development and use of monetary budgets, use of physical resources (capital equipment, building space, etc.)
- Policy Responsibility: responsibility for rules, regulations, or fiat that shape others' behaviors or commit resources for the organization

2.4.4 Control Systems

An effective control system must provide performance measurement and evaluation for each subdivision of the firm and each division agent as well as a reward and punishment system that relates individual's rewards to their performance.

In almost all measurement and control systems, people observe what is done, not what is stated as the reward.

2.4.5 Factors Affecting Decentralization

In light of the principles we have reviewed in the economics of organization, Jensen and Meckling identify the following factors as significant in affecting the optimal degree of decentralization in a firm:

- **Size of the firm:** Larger firms are more difficult to align and control. Larger firms also have more difficulty making speedy decisions. In general, if the marginal cost of poor information exceeds the marginal costs due to inconsistent objectives, then a firm should decentralize.
- **Effectiveness of information technology:** If it becomes easier to share specific knowledge, then a firm should become more centralized.

- Rate of change in the firm's environment: Firms competing on the basis of agility and flexibility should be more decentralized.
- Capabilities existing within the firm: If capabilities are decentralized, then decision responsibilities should be more decentralized.
- Government regulation: Dealing with government regulations usually requires an increase in specific knowledge at headquarters, leading to centralization.

2.5 People-centric Designs and Models of Organization

Jay Galbraith, in a practical work on the design of organizations, suggests that organizations should be designed around people.²² In other words, capability rests fundamentally on the capabilities of people and the relationships between people in an organization.

In designing organizations from this perspective (versus, for instance, a hierarchical division of labor perspective), one can leverage lateral relationships to create flexibility and responsiveness (we will touch more on the definition of 'lateral' in subsequent sections). In Galbraith's terms, one can create "general management" focus and capability at the local level.

Lateral organizational capability can be a source of significant competitive advantage:

- Peer-to-peer collaboration is better and faster than using a hierarchy. Actors possess local knowledge and can better respond to the issues at hand.
- By definition, it stresses broad organizational, rather than local, goals.
- Lateral organizational capability is designed to be multi-dimensional. It can focus on whatever issue is currently salient without the need for significant intervention or reorganization.
- Lateral organizations promote learning and change because they are based on multiple

²² Galbraith, Jay, Competing with Flexible Lateral Organizations, 2nd ed., Addison Wesley, Reading, MA, 1994. ISBN 0-201-50836-2.

dimensions and multiple constituencies. Entrenched power bases and core rigidities are distributed. There is always a voice for change.

Fundamentally, in Galbraith's perspective, the primary focus in developing an organization should be on the development of people. Peoples' capabilities are shaped through the definition of tasks, the development of metrics and information flows, and formal as well as informal relationships. All of these aspects work together as a reinforcing system to provide organizational capability (see Figure 2-4).

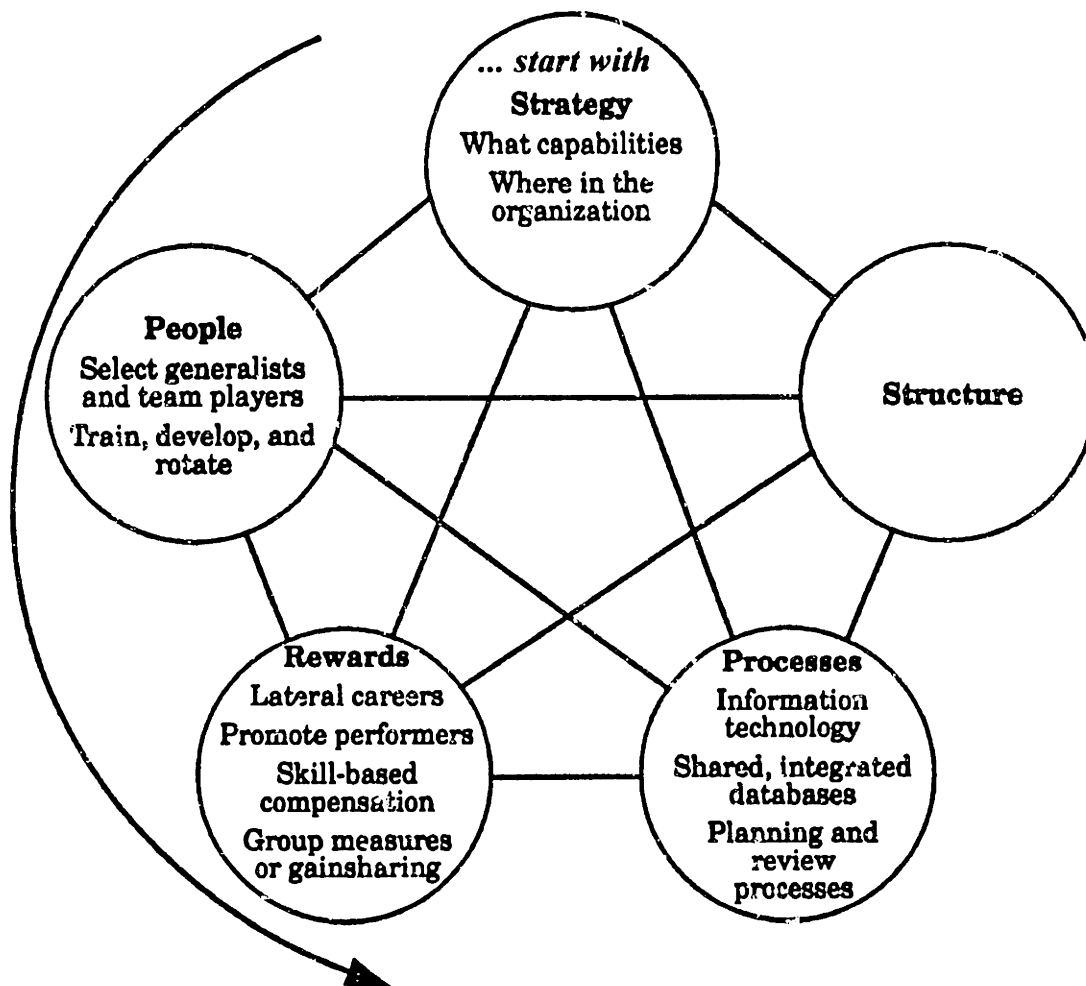


Figure 2-4 Lateral Organization Components and Linkages²³

²³ Galbraith, Jay, Competing with Flexible Lateral Organizations, 2nd ed., Addison Wesley, Reading, MA, 1994. ISBN 0-201-50836-2.

Costs are incurred in the development and maintenance of organizational capability. Only the minimum sufficient level of capability to enable realization of the firm's strategy need be developed. Varying strategies and business contexts will required varying levels of "general management" capability in business processes and parts of the organization. Galbraith presents three categories of lateral capability in categories that exist along a spectrum:

- Voluntary Organization,
- Formal Groups, and
- Dedicated Integrators.

Creating additional capability is a cumulative process. For example, a Voluntary Organization must be in place before Formal Groups can be effectively implemented. As we move along the spectrum, more management time is required and more difficulty is experienced in implementation.

2.5.1 Voluntary Organization

2.5.1.1 Description

The Voluntary Organization is one in which collective action is informal, yet organized. Incentives, policies, and culture stress grass-roots responsiveness: problems are solved with the involvement of those closest to the work and those most knowledgeable with local data. Top management is usually informed, but not directly involved in the resolution of tactical issues. The level of lateral capability can be minimal or extensive in scope, depending on strategy requirements.

The primary weakness in a Voluntary approach is that local actors may not have enough global perspective. It can be difficult to ensure alignment with the larger strategy of the firm. Additionally, lateral capability does not spontaneously arise to meet every need in the firm.

2.5.1.2 Creating the Voluntary Lateral Organization

In creating Voluntary lateral organization capability, one wishes to increase the probability that *important* relationships are created and exercised in the form of voluntary contracts to support

organizational goals. A number of tactics can be employed to increase Voluntary Lateral capability (see Figure 2-5).²⁴

| Tactics for Creating Voluntary Lateral Capability |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><i>Interdepartmental Rotation</i></p> <ul style="list-style-type: none"> · develop perspective required for general managers · concentrate across the key interfaces and work-flow paths for informal networks · requirement: eliminate patronage systems · requirement: skill-based pay (pay the person, not the job) to encourage learning |
| <p><i>Physical Co-location</i></p> <ul style="list-style-type: none"> · tradeoff: increases communication with one group, but decreases it with others · base the decision on strategy and work flow |
| <p><i>Information Technology Networks</i></p> <ul style="list-style-type: none"> · can be used to break down barriers · must be complemented by informal personal networks to be effective |
| <p><i>Interdepartmental Events</i></p> <ul style="list-style-type: none"> · training · off-site business meetings |
| <p><i>Mirror-Image Organizational Structures</i></p> <ul style="list-style-type: none"> · clarifies the lines of communication, responsibilities · reduces the number of interfaces and barriers · can be costly (duplication of positions) but ultimately more efficient |
| <p><i>Consistent Reward and Measurement Practices</i></p> <ul style="list-style-type: none"> · clear, acceptable, understandable · align individual incentives with organizational goals · mutual payoffs to promote cooperation · “overarching goals” -- consistent across units (total quality program helps) |

Figure 2-5 Tactics for Creating Voluntary Lateral Capability

²⁴ Ibid., Galbraith.

2.5.2 Formal Groups

2.5.2.1 Description

In building Formal Group capabilities one adds formal mechanisms for coordination and accountability. An example would be to charter a team and give it formal responsibility and collective accountability for addressing a certain type of need.

Formal Group capability is typically developed for one or more of the following reasons:

- Informal capability does not emerge to address a situation that requires lateral coordination.
- Management recognizes the need to act on an issue before the rest of the organization is aware of the need. This should be expected in some situations, given the perspective managers often have across the business.
- Management recognizes the need to ensure alignment with global strategy.
- Formal groups can be a vehicle for defining priorities for efforts of the broad community. Usually the teams are defined along work flows for the organization (core processes).

Formal Group capability can be:

- single or multi-dimensional (organized around profit center, functional competency, customer requirements, technology, product subsystem design, etc.)
- based on very few or many groups
- single level or hierarchical in the levels of groups

Galbraith suggests that Formal Group capability should only be created when strategy requires additional decision making capability and only when a Voluntary level of capability already exists. Although the addition of lateral mechanisms makes it easier to ensure that capability is aligned with global strategy, it complicates decision making and increases costs. Additional time and management effort are needed to maintain Formal Group capability.

2.5.2.2 Adding Formal Group Lateral Capability

If strategy requires additional lateral decision making capability at the local level and Voluntary capability is well established, one should consider the implementation of Formal Group capability. Galbraith suggests that one consider the items presented in Figure 2-6 below.

| Considerations in the Design of Formal Groups |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basis: <ul style="list-style-type: none">• select dimension(s) of lateral coordination<ul style="list-style-type: none">- for example, can be functional-, geographic-, business-, supplier-, and/or customer-based.• selection should be guided by the strategy of the organization. |
| Charter: <ul style="list-style-type: none">• purpose should be clear and not overlap significantly with other efforts.• scope and authority must be defined.• must be compatible with and augment any existing hierarchical structure. |
| Staffing: <ul style="list-style-type: none">• at least one representative from each unit with a primary stake in the issue.• each participant from a level and position that possesses relevant information.• must have sufficient authority to commit the home unit. |
| Conflict: <ul style="list-style-type: none">• conflict is inevitable -- the reason for having a group is to bring cross-functional perspectives to bear on an issue.• group should define and manage its own process for resolving conflict. |
| Rewards: <ul style="list-style-type: none">• must be sufficient to overcome a natural desire to avoid confrontation and group conflict.• group outcome-based rewards should be included in individual evaluations. |
| Leader Role: <ul style="list-style-type: none">• tasks: plan agenda, convene the group, lead discussions, formally communicate w/ outsiders.• not necessarily a full time position, but is more difficult to implement when not full time.• depending on strategy, source from a dominant group or a group most affected by the issue.• required unless small numbers and previous self-management experience<ul style="list-style-type: none">- can rotate lead within the group depending on the issue if well performing.• can be formally rotated (i.e.: project w/ different managers depending on phase)<ul style="list-style-type: none">- but leaders should always be sourced from within the group |

Figure 2-6 Design of Formal Groups

2.5.2.3 Lateral Coordination Between Business Units:

In designing formal groups, one must carefully consider how individual groups will work with other groups as well as the existing functional hierarchy. Coordination needs to be based on a shared understanding of a credible, higher-level corporate strategy. The strategy for cross-unit cooperation, following from corporate strategy, should be clearly articulated.

- strategy for generating and planning the use of resources and shared competencies
- strategy for developing, managing, and leveraging core competencies across units
- strategy for leveraging basic R&D investments

The normal tendency for a business unit is toward autonomy and self-determination.

Information flows and systems can be key to maintaining a consistent focus across the business. It is especially critical that incentives, accounting systems, personnel systems, and other policy-based systems promote both business unit and cross-business unit (cross-team) performance that is in-line with global strategy for the organization.

2.5.2.4 Management in a Formal Group Structure

Management must fulfill a number of key responsibilities if the Formal Group lateral capability is to be functional and efficient. Figure 2-7 summarizes the responsibilities and concerns for managers in creating and maintaining Formal Group capability.

2.5.3 Dedicated Integrators

2.5.3.1 Description

If the strategy of the firm requires significant local decision making capability, integrative roles and mechanisms can be added. In this scenario, a dedicated person (i.e. World-wide Business Manager, Program Manager, Brand Manager, Product Manager) is assigned to provide general manager perspective while guiding the lateral group in activities. This capability must be built on a foundation capable of supporting Formal Groups.

In general, because formal authority in most firms rests in the line organization, the Dedicated Integrator structure requires a process for developing and selecting people who are capable of

influencing without formal authority. Additionally, the organization may have to consciously develop and manage power bases for these people.

| Management Roles in a Formal Group Structure |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><i>Strategy Formulation: develop and address the explicit criteria that drive design choices.</i></p> <ul style="list-style-type: none"> • What capabilities are needed to achieve competitive advantage? • Where in the organization are lateral capabilities needed? • What are the goals that will guide decisions and trade-offs among units? • How will lateral coordination produce business results? |
| <p><i>Building Capability</i></p> <ul style="list-style-type: none"> • sustained focus (constancy of purpose) is required • define structure: people and incentives first, then processes, then structure. Once measurements are reliable (have been tested), can be used to evaluate and reward performance. <ol style="list-style-type: none"> 1. <u>human resource practices</u>: selection of appropriate people from new or existing employees (generalists, affinity for team work), training, development, and rotation 2. <u>rewards</u>: lateral careers, performance-based promotion, skill-based compensation, group measures and gain sharing 3. <u>information flows</u>: planning and review processes, communication networks, information technology |
| <p><i>Design of Formal Groups, Implementing Capabilities</i></p> <ul style="list-style-type: none"> • design elements: basis, charter, staffing, conflict resolution, rewards, group leader role |
| <p><i>Review Group Performance</i></p> <ul style="list-style-type: none"> • performance reviews and group accountability to goals <ul style="list-style-type: none"> • individual member sub-goals can be defined to support broader team goals • group incentives (based on team outcomes) must be strong enough to overcome conflict • review groups' work for compatibility • resolve conflicts among the multiple dimensions of the organization |

Figure 2-7 Management Responsibilities in Formal Group Structure

Conflict is inevitable in this type of structure. For a Dedicated Integrator structure to work well, an efficient process for resolving conflicts between groups must be established. This capability can be difficult to create and maintain.

The addition of integrative mechanisms and dedicated coordinators increases costs. For these reasons, Galbraith argues that Dedicated Integrator capability should only be considered when

strategy requires significant additional decision making capacity.

2.5.3.2 Adding Dedicated Integrator Roles

Strategies requiring significant lateral coordination may benefit from a full-time, neutral manager to provide the required level of integration across organizational units. This person is essentially acting in a “local general manager” capacity. Considerations for the formation of a Dedicated Integrator capability are provided in Figure 2-8.

Although dedicated integrating roles can provide powerful and focused lateral capability, one must trade the capability against the costs associated with the creation of a new role. If the strategy is to be successful, the organization must be built and maintained in addition to Voluntary and Formal Group capability.

2.5.4 The Distributed Organization

The Distributed organization is a specific implementation of Dedicated Integrator lateral capability. The design eventually implemented at EquipTech drew heavily from this model. In this design, the firm is organized along alternative dimension (i.e., product line and region). Key positions along the dimensions are not created as separate roles, but are distributed to existing managers who then fulfill two roles. For this reason, the distributed structure is often referred to as a “two hat” model of organization.

In implementing a distributed structure, we strive to optimize the trade-off between centralization (neutral scale, alignment, and expertise) and decentralization (local knowledge, speed, and flexibility) as previously described in **Economics of Organization** on page 24.

In a project or process under the two-hat structure, scale is maintained, but is distributed across the firm to those areas having the most expertise or the most at stake in a particular competency or process. Local owners of scale service the rest of the organization. Characteristics of distributive organization structures are presented in Figure 2-9.

| Design Issues for a Dedicated Integrator Structure |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Power Base for Influence and Neutrality</p> <ul style="list-style-type: none"> primary concern is power base from which the integrator is to influence decisions amount of power dictated by strategy requirements vs. the existing lateral capability neutrality is required for effectiveness and legitimacy |
| <p>Staffing</p> <ul style="list-style-type: none"> the most important decision to be made in implementing an integrative role integrator is a very scarce resource: general manager capability + ability to influence without authority experience in many of the units to be integrated interpersonal skills to build teams and influence without authority low ego needs -- respect for "face needs" of others neutral knowledge (sometimes based on technical competence) tradeoff is usually made between technical competence and interpersonal skills -- the interpersonal skills should dominate should be actively selected, developed, and trained to influence w/o authority need to be an insider: must understand the culture and have an interpersonal network inside the firm <p>Implication: need to be developed from within</p> |
| <p>Structure</p> <ul style="list-style-type: none"> to whom the person reports affects power base, level of influence, and neutrality usually reports to a general manager alternatives: integrating dept. (if span of control too large) or "two-hat" model |
| <p>Role Status</p> <ul style="list-style-type: none"> status of the role affects power and the ability to influence assign a high rank and title or choose a high status person |
| <p>Information Systems</p> <ul style="list-style-type: none"> information power from cross-functional or multi-dimensional information systems information power by having control of project schedules and data want a common database to avoid dysfunctional conflicts and data brokering a continuous flow of information is required to sustain the integrator's expertise and power |
| <p>Planning Processes</p> <ul style="list-style-type: none"> build on a multi-dimensional information system foundation the planning process can serve as a conflict resolving arena for making multi-dimensional trade-offs (if based on valid data) gives integrators a voice and an arena in which to exercise influence requirements for the process to serve as conflict resolving arena include: <ul style="list-style-type: none"> information system capable of displaying data along multiple dimensions provide timely resolution of the issues before actions are implemented tied to a conflict management process and capability at higher levels of the organization |
| <p>Reward System</p> <ul style="list-style-type: none"> tightly coupled to the information and planning systems evaluation and rewards based on planned outcomes |
| <p>Responsibilities</p> <ul style="list-style-type: none"> assign specific decision responsibilities and authority must be made clear and legitimate within the organization lack of clarity is a major source of problems and conflict in multi-dimensional organizations |
| <p>Budgets</p> <ul style="list-style-type: none"> budgetary control and discretion is power can be limited to the level required (flexibility and speed vs. control) can be focused to allow influence along specific parts of the workflow(s) |
| <p>Dual Authority and Two-Boss Matrices</p> <ul style="list-style-type: none"> a two-boss matrix should be clear and simple prefer only one person in a unit reporting to two managers, have the rest report to her works only if an informal lateral capability has been developed in the organization integrator evaluations should be collective, including managers, peers, subordinates, customers |

Figure 2-8 Dedicated Integrator Structure Considerations

This type of structure is, increasingly, being applied in international companies to solve the dispersion/coordination dilemma. The structure allows these firms to better coordinate actions across a broadly distributed geographical base, yet maintain a competitive local presence in each of the markets they serve.

| Design of the Distributed Organization |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><i>Responsibility and Power</i></p> <ul style="list-style-type: none"> • The structure is distributive in terms of responsibility and power, rather than binary or win-lose. The organization is thus more flexible over time. It is easier to shift priorities from one dimension to another. |
| <p><i>Coordination Mechanisms (Agency Issues)</i></p> <ul style="list-style-type: none"> • Distribution of scale across the organization can result in smaller corporate overhead and more responsive service. • Because the power base in the firm often shifts from centralized staffs to more decentralized operating units, it can be more difficult to ensure that actions are aligned with the global strategy of the firm. Mechanisms for coordination need to be built into the structure. |
| <p><i>Interdependence and Balance</i></p> <ul style="list-style-type: none"> • Cooperation is based on mutual reciprocity: interdependence that is both balanced and reciprocal. • Choose policies for the other dimensions of the “star model” to counter structural weaknesses introduced by distributing scale. <ul style="list-style-type: none"> • budgeting for the function can still be centralized • separate (parallel) planning process can be implemented for shared activities • global goals in the plan become measures for the unit |
| <p><i>Neutrality of Integrating Units</i></p> <ul style="list-style-type: none"> • Design neutrality into integrating units for core processes that span units (e.g.: scheduling, R&D, etc.). • Can staff with people from different units as needed on a rotating basis. • Incentives (reviews and rewards) should be tied to integrative roles. |
| <p><i>Personnel Development</i></p> <ul style="list-style-type: none"> • Requires focused development of managers with the capability to hold integrating positions (general mgrs.). |
| <p><i>Communication and Information Flows</i></p> <ul style="list-style-type: none"> • Communication and information needs are intense. • Develop interpersonal and information networks. • Information Technology can be leveraged to provide significant benefits. |

Figure 2-9 Considerations in the Design of Distributed Organizations

2.6 The Organizational Change Process

This final section provides a brief overview of what is arguably one of the more prominent frameworks for introducing change in organizations.²⁵ Ideas presented were originally developed in the field of psychology and behavioral counseling.

The change process can be broken down into three basic steps as follow:

1. **Unfreezing:** One must help the organization to recognize that the status quo is unacceptable and that change would be attractive. One does this by making the disconfirming stress in an organization recognizable and safe to address.
2. **Cognitive Redefinition:** One next helps the organization to redefine its approach, cognitively restructuring the situation. Essentially, one is helping the target search for and identify a solution that will eliminate the source of stress.
3. **Refreezing:** One next helps the organization adopt and refreeze around the new approach.

2.6.1 Unfreezing

In the unfreezing process, we get the target to recognize and accept that all of their assumptions and the forces shaping their perspective are not in equilibrium. The goal is to motivate the target to look for new solutions that will bring things back into equilibrium.

In order to unfreeze an organization, one must simultaneously convey the following ideas.

2.6.1.1 *Reassurance of Psychological Safety*

Schein cites this as the most often neglected portion of the change process and the primary reason for most failed change efforts. Basic human needs for security must be addressed before the target will actively seek change. People inside the organization need to open up and expose vulnerability, perceived or otherwise, before they can effectively learn new behaviors, attitudes, or processes.

²⁵ The material in this section is paraphrased from Schein, *Process Consultation Volume II*, Reading, MA: Addison-Wesley, 1987, pp. 92-114.

Genuine inquiry in the service of helping the target accept and make a change is the most crucial aspect of creating psychological safety. It is also the most difficult to manage interpersonally.

2.6.1.2 Disconfirmation:

Present behaviors, attitudes, or processes are unacceptable. They clearly will not provide intended results or will fall short of accepted standards. The target must clearly and unequivocally recognize reality. If the change agent is not sure that the target is ready to consider alternatives, she should inquire with open-ended exploratory questions. The goal: let the target slowly draw their own conclusions that a disequilibrium exists.

2.6.1.3 Induction of Guilt or Anxiety:

The target must be concerned that what they are doing is not acceptable. They must care that the attitude or behavior in question is violating standards or is causing them to fail in getting the job done. One needs to be supportive, yet inflexible when it comes to negotiation on the need to address specific concerns.

2.6.2 Cognitive Redefinition

Once unfrozen, a target is likely to become more attentive to information, ideas, suggestions, or even orders that were previously ignored. They become active problem solvers and are very motivated to change. At this stage of the process, one focuses on helping the target to cognitively restructure the situation to incorporate an acceptable solution that will bring things back into equilibrium.

In the behavioral psychology analogy, two behaviors are common at this point in the process.

1. The quickest and easiest way the target can locate a solution is to identify with a role model, friend, or other trusted person and to see things from his or her perspective. This approach can be positive if the role model has relevant experience and insight into the problem. It can also be detrimental, however, in that the target is focused on a single source of information. The target often identifies with the doctor or person that is responsible for

their unfreezing.

Stepping back from the analogy, we note that after unfreezing has successfully occurred, charismatic or inspirational leaders can often leverage the desire of people in an organization to identify with a role model. Often, change proceeds very quickly in this circumstance.

2. If a role model is not readily available, or if she refuses to cooperate, the target will scan his environment to locate information and ideas for solving the problem. Only information that is relevant will be taken in by the target. This approach is slower and more difficult, but can result in a better long term solution to the problem(s).

2.6.3 Refreezing

It is not uncommon for the converted to lose faith soon after adopting new ideas... especially in the face of adversity. In the behavioral psychology analogy, refreezing is the portion of the change process that embeds the change in the psyche of the target and in relationships with significant others (in order to create mechanisms for reinforcement).

Gradually over time in the development of an organization, basic assumptions, people's skills, relationships, incentives, business processes, and management policies evolve to reinforce each other in a complex, but stable system. In changing only one part of the system, we create an instability. We often leave in place significant mechanisms that reinforce old ways of doing things. Even if the change is for the better, disconfirming information can overwhelm the target, causing the target to revert back to old practices. If a change to part of the system is to have lasting significance, reinforcing processes must be adjusted or put in place. The target must be able to move forward with confidence in the validity of the new solution.

A suggestion made by Schein is that one work closely with the target, not as a "doctor" offering prescriptive advice, but as process consultant, allowing the target to accept those ideas that are most congruent with the existing system. One should work with the target to identify and

remediate those portions of the existing system that need to be changed to eliminate disconfirming stress.²⁶

²⁶ Ibid., Schein, p 110.

3. THE PROJECT AT EQUIPTECH

The remaining portion of this thesis reviews the application of the ideas in the context of a rapidly growing, medium-sized firm engaged in the design, manufacture, and distribution of capital equipment to the electronics industry. This project was conducted under the auspices of a six month long Leaders For Manufacturing internship.

3.1 Context for the Project

By the end of 1995 and my internship, EquipTech was a 500 person company. The firm had grown at an average annual rate exceeding 60% in both revenue and headcount over the past four years (see Figure 3-1 and Figure 3-2 below).

The firm's products, although complex and rich in technology, do not often push the envelope of science. To the contrary, the firm has built competitive competencies and a knowledge base in the process nuances related to the manufacture of circuit boards. EquipTech's high end machine occupies about half the footprint of a Zamboni (the ice maker vehicle at hockey games) and is about half as tall. It is predominantly electromechanical and contains 2500-3000 parts. The current assembly process is manual in a continuous flow, fairly low volume (~1800/yr.) operation. Occasionally, EquipTech will produce a custom machine or platform from the ground up to address semiconductor or laboratory electronics packaging needs.

Approximately 70% of revenues for EquipTech's products are derived from less than 20 customers. Potential customers include Motorola, Intel, HP, Digital, Solectron, Ford, Delco (GM), and virtually anybody else that manufactures circuit boards in high volume. EquipTech is currently the largest player in terms of market share in its niche and the firm believes strongly that it is the technology leader and visionary for this industry. Approximately 55% of sales are international and EquipTech's presence in Europe and Asia is currently being strengthened.

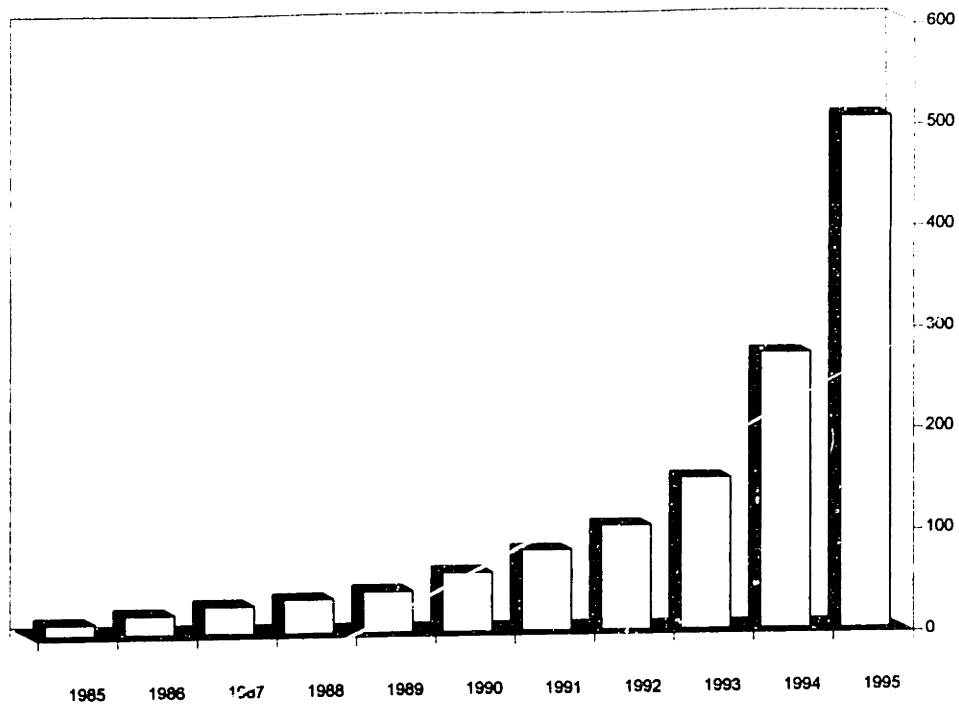


Figure 3-1 Employee Growth at EquipTech

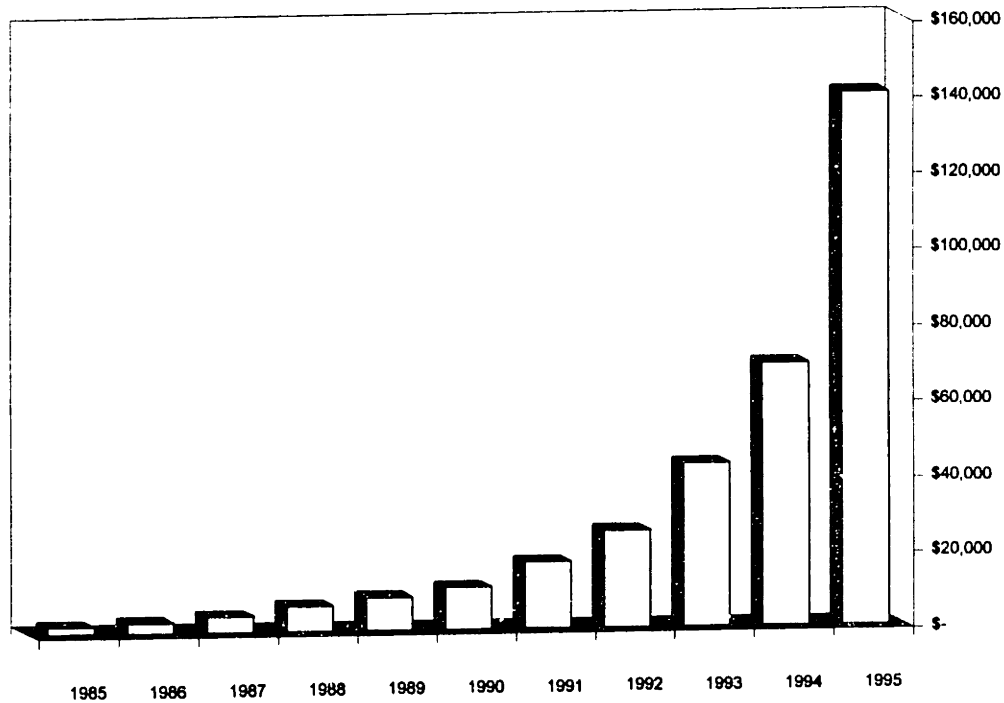


Figure 3-2 Revenue Growth at EquipTech

3.2 Structure of the Project

My sponsor for the project, and direct supervisor, was the Vice President of Engineering at the firm. He had been a leader in the firm since the early days and was personally responsible for much of the firm's success. He also personally championed the project at the executive level of EquipTech.

As we began the project, he and the other leaders in the organization were predominantly concerned with two things: "improving the way our products are transitioned into manufacturing", and "ramping a field organization fast enough to keep pace with the rapid acceptance of new products". He was particularly interested in improving the way products were transitioned into manufacturing.

3.3 The Internship Process

The thesis could thus have been developed in more depth around one single aspect or another of the work we performed at EquipTech. Such a thesis would be presented in a top down manner, suggesting a process of clean, orderly, focused research. It would also have been entirely misleading.

By definition, the problem we were to address spanned functional departments within the organization. In fact, the problem lied at the boundary between Engineering, Marketing, Manufacturing, and the other functions having a stake in new product development and introduction. Although my sponsor had considerable influence in the organization, none of these other groups had participated in the definition of the project. This would strongly influence the work I would perform on-site at EquipTech and the direction the project would take.

The position I assumed within the organization was structured so that I reported directly to my sponsor. Initially, I was responsible for projects related to the recent transition of a new product into manufacturing. The responsibilities I assumed would allow me to become familiar with both the products and the organization.

I was subsequently allowed a significant degree of freedom in addressing the problem. Responsibilities that followed, to a large degree, were selected at my own discretion. Some of the roles I assumed were technical in nature, exposing me to engineering design problems and manufacturing processes. Some were more managerial in nature, exposing me to the organizational issues that underlay difficulties in new product development and introduction. Each of the experiences allowed me to create relationships with and understand the perspectives of the various stakeholders in the organization. Ultimately, we were able to develop the Vice President of Marketing and the acting leader in Operations as champions as well. A more in-depth review of experiences that had a direct bearing on the outcome of this project is provided in subsequent chapters.

The seemingly straightforward problem we set out to solve at EquipTech was, in fact, a symptom. Resolution of their true concerns would require an organizationally-focused and more challenging effort. In some instances during our tenure with the firm, the projects that had been undertaken were frustrating. Either the efforts seemed misguided, or the organization was not ready for the results. In the end, however, experiences along the way to root causes provided opportunities for organizational learning and development. Ultimately, these events prepared the organization to move forward.

We pursued the project from a perspective of helping the organization to help itself. The strong relationships that were built allowed us to be effective in bringing together the various stakeholders at EquipTech. We helped these stakeholders to recognize root causes and begin the transformation of their organization.

3.4 Effectiveness As An Intern

Six months was not long enough a period of time to complete all of the work that has been initiated. As we completed the internship, the organization had evolved into a tiered team structure and four key business processes were in various stages of development or implementation. More specific results and conclusions are presented in subsequent sections of the thesis.

4. THE CULTURE AT EQUIPTECH

*What ever happened to the days when things just happened around here!
Remember when [the current V.P. of Engineering] and I locked ourselves
in a room and developed [Product X] in one weekend! Enough of this [messaging around]...
Just do it!*²⁷

In this chapter, the culture of the firm is described. This representation of the EquipTech culture is by no means universal; it is limited to portions of the firm in which I worked. Furthermore, it is biased by my own experiences, perspectives, and interpretations of what was happening in the immediate surroundings.

Conclusions in this thesis regarding culture are thus based on personal observations and interpretations drawn from six months intensive interaction with personnel at the firm.²⁸ The context of the firm is presented in order to support the subsequent understanding of how culture can impact organizational performance.

4.1 The Culture at EquipTech

EquipTech has a history rich in technical achievement and entrepreneurship. Founders have strongly imprinted their values and beliefs on the early history of the firm. They have resolutely shaped the development and subsequent evolution of this particular organization. The culture that I describe is not unexpected, given the age, size, and growth rate of the firm.

The culture at EquipTech can be described as follows:

- Hire the talented people and hire them in your own image. The product engineering staff is

²⁷ Proclamation by one of the founders at EquipTech during a high visibility, high stress meeting to resolve conflict surrounding the delayed launch of a new development project.

²⁸ Much of the thinking underlying this analysis follows from ideas developed in Schein, Edgar, Organizational Culture and Leadership, San Francisco: Jossey-Bass, 1992.

both committed and competent, but has developed primarily through a network of local, personal contacts. Above all, competency, commitment, and the ability to get the job done are highly valued.

- The person is the process. Communications are face to face. Problem resolution is informal and personal. Data are singular and verbal. Ideas are communicated across departments through personal relationships.
- Time is the present tense and immediate future (today, this week, maybe this month). There appears to be very little tracking of data over time. Longer-term trends, plans, and solutions are often subjugated to immediate concerns. Get the products out the door! What are the immediate challenges we face?
- Truth is often expected to emerge from conflict. People are expected to volunteer their concerns and vocally support them in driving to decisions.
- Truth is practically defined: what works locally and today is true.
- No formal socialization process exists. Very little active definition or management of the culture is apparent, although “hire the best people and task them with challenges” has resulted in a dedicated engineering staff (at least for now).
- Authority and responsibility are informally distributed (vs. tied to position or title). People are expected to step up to the tasks at hand and “Just do it!”.
- Task focus and a bias for action are strong. Productivity within the engineering group is assumed to be everyone working at a 160% level on immediate tasks. Action items are emphasized and responsible individuals are assigned. The focus on task (vs. process) combined with assumptions regarding the nature of time often results in reactive and immediate solutions.
- Anyone can suggest ideas for resolving problems. However, not everyone is invited to suggest ideas -- successful people in the firm are those that take initiative. This follows from the “just do it” nature of the firm and is reinforced by the assumption that the person is the process. Those who take the initiative must often follow up in person. Action items are

not always completed.

- Heroes are crisis solvers and can be martyrs to their jobs. This is reinforced by “successful” crisis management as well as basic assumptions that productivity is people working 160% on tasks, the appropriate time horizon is today and next week, and truth is practically defined. Authoritarian leadership and decision making styles can be thrust upon a team if someone who is respected as a “hero” is operating in crisis mode.

4.2 The Impact of Culture

Culture at EquipTech has been a source of serious competitive leverage. Enthusiastic employees and a “just do it” attitude have formed a solid basis for meeting the needs of an evolving marketplace. However, examples where the culture may present concerns for EquipTech can also be described:

- Field Service “emergencies” are often handled by the engineering staff. In many cases, customers have long established relationships and call the engineering staff directly to resolve their problems. A basic assumption within the firm that technology and innovation are sources of competitive value may create a perspective that suggests this is a “natural” situation.

However, customer purchasing decisions, more often than in the past, are being made on the basis of the whole solution being offered. Service levels and perceptions of security are important. The firm may, increasingly, be providing only technical interaction to customers that prefer perceptions of certainty, hands-off robustness, security, and confidence. Personal relationships with the engineering staff may not be the best front-line resource for meeting these needs. In some cases, by the time Engineering is involved, problems have escalated and a crisis exists.

This is not to say that technical support or interaction with the engineering staff is bad. In fact customers may value this in certain situations and it may also be valuable for EquipTech to maintain an understanding of customer context within Engineering. However, the relationship may best be maintained by an organization that has dedicated

responsibility. This organization can oversee the “whole” process, monitoring the pulse of the customer and all of the aspects of the relationship.

- At a time when the firm is experiencing explosive growth, investment of resources to coordinate action between disciplines is often seen as bureaucratic and not value-adding.

During my internship project, the lack of coordination between disciplines had led to divergent strategies in the form of mismatched capabilities in key functional departments for supporting product development. There was the equivalent of one full-time manufacturing engineer to support in excess of 15 “cross-functional” development projects.

- The “just-do-it” attitude is generally a very positive aspect of the culture -- people usually do step up to the tasks.

However, a local bias for action can also result in stealing of responsibility from appropriate departments, peers, or subordinates. Longer term learning and development are often sacrificed for the sake of short term solutions. Implementation of balanced solutions or long-term, process-based solutions that address the larger issues and root causes is often neglected.

- Getting things done as a manager means acting locally and fast. Heroes solve the immediate crises.

On more than one occasion I had been told by a relatively senior manager that “this is the real world... We know it’s not the right way to do things but we don’t have time [to coordinate or plan]... We need to focus on getting things done.” Implicit is the statement: “We don’t have time to put root-cause solutions in place.” His concern, although not universally shared, emanates resoundingly from the entrepreneurial culture and history of the firm.

- The engineering staff is over-tasked and cannot support all of the current development projects (more on this later). This follows from assumptions that productivity is everyone working 160% and that true priorities will surface as conflicts work themselves out.

Too often this results in poor performance for most of the projects. Whoever can scream

the loudest gets the resources and attention. Projects are often started without key resources and are often started late. Ultimately, this leads to pressure during the transition of the new product into manufacturing and poor or late launches in the market.

The point of this section is not that EquipTech's culture is deficient or lacking. In fact, EquipTech has one of the most charged and aggressive cultures I have had the pleasure of experiencing. When problems surface, they get put on the table and addressed. The concern I raise is that EquipTech has a strong culture of entrepreneurship; they possess a bias for focusing on tasks and a bias for immediate and local action. Some of the basic assumptions need to evolve if the firm is going to be successful in leveraging their traditional strengths and managing processes across a broader organizational structure.

This section lays groundwork and context for evaluating the experiences presented in the following chapters, including the organizational change hypothesis that was ultimately put forward and adopted.

5. THE NEED FOR CHANGE

People involved in a process look inward toward their department and upward toward their boss, but no one looks outward toward the customer.

The contemporary performance problems that companies experience are the inevitable consequences of process fragmentation.²⁹

In addressing the immediate request to improve the way products are transitioned into manufacturing, we could have just defined a check sheet: a set of rules or requirements that should be met during the manufacturing transition. No doubt, I would have learned something in the process. This approach, however, assumes that improvement is needed in the process of launching the product. The approach would be dysfunctional if the fundamental causes for inconsistency in performance lay elsewhere. This chapter presents relevant experiences and insights at EquipTech that eventually led us to address root causes.

EquipTech prides itself on innovation and the ability to react quickly to the needs of customers. The firm's traditional, market-leading platform had been introduced over 4 years ago. After a somewhat difficult launch, the product rapidly gained acceptance and had become an industry standard. In the year immediately preceding the LFM project, the firm had introduced two new platforms.

Two weeks before we began our project, one of these machines was craft built in individual work areas. Inventory was held in a large central store. By the end of the project, a discrete, cell-based, flow manufacturing system, with point-of-use inventory, had been implemented. Some of the more costly material was being supplied on a just-in-time basis. Cell teams had responsibility for quality and were developing rapidly. Quality systems had improved noticeably: cell-level responsibility, assembly process standardization, and feedback from

²⁹ Ibid., Hammer and Champy, p 28.

acceptance testing and field service were leading to significant reductions in performance variation, acceptance testing time, assembly cycle time, and the number of field issues. Manufacturing capability at EquipTech was developing quite rapidly.

5.1 Manufacturability of the Products

In light of this fact, a number of experiences with the firm suggested that specific capabilities emerging in Manufacturing and Service could be more effectively applied in the design of future machines.

5.1.1 A Critical Part

In one of the new platforms, a major part was causing significant problems in manufacturing. The vendor could not manufacture the parts to specification in sufficient quantity to supply EquipTech. Specifications for the part were considered critical to the functional performance of the machine. On more than one occasion, EquipTech's entire manufacturing line had to be shut down, resulting in significant productivity losses and shipment delays to customers.

This clearly presented a chance to look for opportunities in the new product introduction process at EquipTech. Additionally, the project would also allow us to better understand the working relationships between Engineering, Manufacturing, and other functional groups at EquipTech.

The Purchasing department at EquipTech had, not surprisingly, come under significant pressure to improve vendor performance. The original price paid for the part had quadrupled in order to cover low yields and the special efforts that were required to produce the part. Tensions grew and the relationship with the vendor became strained.

The vendor, through trial and error, had determined that he could only get the parts to meet specification by subcontracting to another vendor with lapping expertise. EquipTech's Purchasing department subsequently learned that only one machine large enough to handle the part existed east of the Mississippi river. Furthermore, lapping was not as deterministic as other machining processes, even for those who designed the equipment.

Personal visits to the primary vendor and subcontractor were enlightening. The primary vendor was extremely frustrated. He no longer wanted to produce the part, but felt he had to because he had significant other business with EquipTech. At the subcontractor, the shop owner had far surpassed the age when most people consider retiring. In fact, he was arranging to sell the business and did not seem to particularly care if the part was critical to EquipTech. He emphasized strongly that parts required random levels of processing and that yields were approximately 50%. Yet, a back of the envelope capacity analysis suggested that the bottleneck machine was being employed at less than half of theoretical capacity. An analysis of data received from EquipTech's Receiving/Inspection group reinforced this finding. Output from the supply chain varied substantially -- it appeared to be correlated with the level of pressure applied by EquipTech's buyer on the primary vendor for the part.

The history of the design, as recounted by the primary design engineer for the part, was equally enlightening. The part was originally to be fabricated as a honeycomb structure. However, as prototypes were being assembled, the part was found not to be robust enough to handle the environment it would encounter during manufacturing and service. For functional reasons, the part was subsequently redesigned as a bi-metallic. An aluminum casting was adhesively bonded to a stainless steel plate. Originally, specifications called for a grinding operation to ensure flatness.

Engineering knowledge led me to believe that the bi-metallic nature of the part could be the source of the problems. As the temperature of the part varies, the stainless and aluminum components expand or contract at different rates. Yet displacement at the bond interface between the components must be identical. Resulting shear stresses can be extremely high, resulting in part distortion and even failure. Indeed, an analytical thermal stress analysis of the assembly led me to conclude that temperatures in processing would affect geometry. In fact, the result of a parametric design space study indicated that the sensitivity to temperature could not be adequately reduced. In fact, with minor dimensional variations, the shear stresses would exceed the yield point in the aluminum alloy, leading to failure. Details of the analysis could not be provided due to the proprietary nature of the part. The important insight was that the

parts were, at best, marginally manufacturable.

Understanding the technical problem did not resolve the issue. Redesigning the part would most likely require the redesign of an entire subsystem in the machine. Subsequently, we convened a review of the functional requirements for the part involving Marketing, Manufacturing, Purchasing, Quality, and Engineering. Together, we were able to redefine specifications for the part in a manner that not only more closely addressed functional requirements, but better accommodated manufacturing capability. Engineering and Quality personnel worked with the primary vendor to improve their understanding of EquipTech's needs and their ability to deal with the problem. Although the part remains difficult to manufacture, it is currently yielding in quantities sufficient to meet the level of demand for the product.

What, at first, appeared to be a problem with a non-performing supplier was, in fact, a technical problem with the design. This experience highlights that the root causes for problems are often technical as well as organizational in nature. Resolution of the problem would require specific technical expertise as well as the joint efforts of Engineering, Manufacturing, Purchasing, and Quality.

Why weren't these same sets of skills applied up front, during the design project? How did the inadequate honeycomb part make it into the production version of a machine? How did an unmanufacturable design then come to be accepted as the production part? Specific capabilities residing within Engineering, Manufacturing, Service, and other functional groups must be proactively applied during the development process in order to prevent costly problems at and after product launch. If Manufacturing, Service, and the other stakeholders do not have sufficient responsibility for the design, or their needs are considered to be secondary to functional performance, problems will invariably surface later, during the new product introduction process. As was the case with this part, problems that surface later can be more difficult, and invariably more expensive, to remedy.

5.1.2 Fasteners and Design Standards

An audit of a major subassembly in one of the two machines revealed the following:

- it contained 577 pieces of hardware (screws, bolts, washers, etc.),
- 46 different types of hardware (sizes and families) were employed,
- build time exceeded the target by a factor of 2.5X.

An effort to standardize on fasteners clearly had not been considered. The build time for this particular subassembly should not have been surprising, given the level of complexity and resulting variation. The proliferation of fasteners is inefficient for a number of reasons:

- the level of complexity is unnecessarily high, potentially leading to increased process variation, higher costs, and lower quality,
- manufacturing inventories and handling needs are high and procedures are unnecessarily complicated,
- service inventories are high and procedures are unnecessarily complicated.

A proliferation of families and sizes suggests that design and process standards do not exist, even for rudimentary details of the product. A review of the manufacturing practices suggested that this was, in fact the case. Standardized processes, tools, and torque settings were being discussed, but the high degree of variation in design would make implementation for more than the current, special assemblies difficult.

This observation of the large degree of variation in fastener use suggests, again, that problems are technical as well as organizational. Specific capabilities in Manufacturing and Service could be better applied during the development process.

5.1.3 Calibration and Adjustment are Difficult

Manufacturing and Service personnel associated with this same product suggested that the material handling subsystem was unnecessarily difficult to align and calibrate. This had serious implications, both for assembly variation and costs in the factory as well as service time and

costs in the field.

This experience, like the previous two, suggests that problems are technical as well as organizational. Specific capabilities being developed in Manufacturing and Service could be better utilized upstream in future development projects.

5.2 Development Process Performance

Of the two new platforms, one (D1) had been developed, launched, and delivered smoothly to the market in only 12 months. The other (D2) had taken in excess of 3 years. A significant portion of the organization was currently preoccupied with the product launch.

The firm had demonstrated the capability to innovate successfully in D1. What was it about D2 that caused such difficulty and allowed the project to consume so much of the firm's resources? Subsequent discussions with people that had led the projects and with those that had been directly involved created the following picture.

- D1 had initially been conceived as a cost reduction of the firm's existing, market leading platform. Ultimately, however, almost all of D1 was redesigned.

D2 was to be the next generation platform. D2's architecture was new; the design was to be fresh from the ground up. D2 would include significant improvements in technology over the traditional platform, offering new capabilities to the customer

- D1 had incubated informally (outside of normal working hours), with one or two people from Marketing, Sustaining Engineering, and Sales discussing needs with customers over an extended period of time.

On the other hand, D2 was to be the firm's next generation platform, in many cases meeting the latent needs of the customer.

- Because existing people were devoted to D2, D1 had to be staffed predominantly with new hires from the outside. D1 had incubated in Sustaining (manufacturing) Engineering. D1 was championed by a new senior manager.

D2 was staffed primarily with existing people at the firm. Likewise, it was led and championed by the existing development organization.

- The scope for D1 was explicitly defined at the start of the project. Deviations and creep were minimal.

D2 experienced a major architectural change 2/3rds of the way through the project. The change was deemed significant enough to warrant immediate inclusion as well as a significant delay in the planned launch of the product.

- D1 adopted new development practices and new process technologies (development process, CAD systems, etc.).

D2 employed existing practices and systems.

What were the causes of inconsistency? Following are reflections on the specific observations from D1 and D2 at EquipTech.

5.2.1 Market-In Versus Product-Out Focus

Customer requirements for D1 and D2 were clearly initiated from different perspectives.

D1 began as an effort to cost reduce the traditional, market-leading platform. In fact, key engineers from the Sustaining group later transferred into R&D Engineering to form the core of a new subgroup. As market studies for D1 gained momentum, the project became a product family extension from D0. In addition to cost reduction, the platform would address the needs of a slightly different, but significant customer segment. Those having ownership of the project spent a significant amount of time with the customer segment in order to determine customer requirements as well as how the machine would be positioned in the marketplace.³⁰

D2, on the other hand, was to provide the “latest and greatest” technology to a customer segment demanding flexibility, high throughput, and near “lights out” operation. This was the

³⁰ Drawn from personal conversations with the Marketing Group Leader, the Engineering Manager, and the Engineering Program Manager for D1 at EquipTech, Sep - Oct, 1995.

next step for a company that prided itself in technology innovation. Some of these requirements were latent; customers were not currently accustomed to or expecting a machine with many of the features that would be offered. Nor had EquipTech ever produced such a machine.

5.2.2 Architectural Versus Subsystem Innovation

Product architecture is the scheme by which the functions of a product are allocated to physical components, including the specification of interfaces between interacting components.³¹

Architecture decisions are made in the early phases of a development project and usually have serious implications for the organization. Among other things, architecture decisions determine:

- how the product can be changed (both within a life cycle and across generations),
- the potential for product variety and manufacturing flexibility,
- the degree of standardization achievable within the product,
- the degree of optimization of local versus global functional performance,
- the degree of modular testing versus global tuning in manufacturing,
- and the degree of decentralization allowable in project management and the organization.

Consider the impact of architecture in light of the history at EquipTech. Although D0 had been launched with some initial difficulties 4-5 years ago, the product was rapidly accepted in the market and had served as an engine of growth for the company. As volumes grew, we believe that innovation within the organization may have shifted, quite naturally, to emphasize incremental improvements to components and subsystems of the existing architecture. In this scenario, the firm develops competencies in innovation at the component or subsystem level. Over time, the architecture of the product became increasingly embedded in the structure of the organization.

³¹ Karl Ulrich, "The Role of Product Architecture in the Manufacturing Firm", *Research Policy*, vol. 24 (1995), pp. 419-440.

D1 was a generational improvement of the existing architecture, albeit with some major changes to subsystems. The assembly process, although different in some cases at the subsystem level, was similar to that of D0. This type of innovation may have been inherently less stressful on the organization. D2, on the other hand, required that the firm innovate architecturally. From this perspective, one might have expected that an architectural product innovation would stress the organization -- architectural innovation cuts across embedded capabilities.³²

5.2.3 Process Tools and Technology

The D1 project employed newer technology and tools. The development team pushed for and had been given permission to use Parametric Technology's Pro/E CAD system. Pro/E is solid modeling software that allows, among other things, parametric design³³, easier interface with structural analysis (FEA) and other tools, reduced need for a drafting department, better visualization and analysis of packaging and manufacturing considerations, direct bill-of-material generation for subassemblies, and direct transfers of 3D views of the product design for illustration and documentation purposes.

One could easily hypothesize that the use of new tools, providing the ability to visualize manufacturing problems and deliver Bills of Material, may have led to a more tightly integrated functional development effort. Although D2 was still using the firm's traditional 2D CAD systems, the benefits of 3D parametric design were widely recognized during the D1 development effort and the entire Engineering community was pushing to bring the new tools on line. Unfortunately, the tools would not be immediately applicable to anything related to the D2 project because of the need to port legacy data into the new systems. Use of the new tools

³² Henderson and Clark, "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms", *Administrative Science Quarterly*, v. 35, March 1990. This article also provides a historical perspective of innovation in the semiconductor capital equipment industry. Although somewhat more technically driven, the operations, customers, and market dynamics for these firms draw an interesting parallel to those faced by EquipTech.

³³ Part dimensions can be linked through algebraic or logic formulas to input parameters, other dimensions on the same part, or other dimensions in a subassembly. Additionally, analysis tools (for specific design problems like wire harnesses, etc.) are available at the individual or assembly level.

would have to wait for a new project (possibly a derivative of D2).

Tools and technology used in D1, no doubt, contributed to team work and productivity. Tools, however, were not the primary reason behind inconsistency in development performance. We believe the firm was not disciplined in adhering to a development process for D2.

5.2.4 The Development Process

To put the development challenge into proper perspective, the firm employed 58 people at the beginning of 1991. By the end of 1995, the firm employed 505 people. Their traditional market leading platform had been developed in a very entrepreneurial environment -- everyone in the same room, understanding the same context of the business. This same process cannot work as well when the firm is 350 people and growing. Scope creep and a lack of discipline would cause serious problems for D2.

Arguably, D1 benefited from time, the expertise of a strengthened management staff, and a growing organization. The design team for D1 was composed mostly of new hires from the outside. Most of the firm's existing design resources were being consumed by the D2 project, which was already over one year in progress at the inception of D1. With the space constraints endemic to a firm growing in excess of 60% per year, the team was collocated rather tightly in their own room.³⁴ With a new champion in senior management and a hiring network particular to the core D1 group, the team formed and bonded rather quickly with a "we are the new kids on the block" attitude.³⁵ Additionally, a new Vice President had been brought on board. With him, he brought a "contract book" development process.

In the contract book approach, a core, cross-functional, concept development team is launched

³⁴ There is a higher probability that people physically located within 10 meters of each other will communicate regularly. Outside of 10 meters, the probability that communication will increase by virtue of collocation is practically nil. For additional information, see Allen, Thomas J., *Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information within the R&D Organization*, Cambridge, MA: MIT Press, 1977.

³⁵ Attitude quote was given by one of the team members, Sep 95. As may be the case with many rapidly growing smaller firms, most new hires were identified by virtue of their interpersonal relationship(s) with existing members of the firm.

with responsibility for defining and articulating for a project the following:

- market strategy and competitive positioning,
- customer requirements for the product,
- product concept and architecture,
- manufacturing concept and strategy,
- sales and service requirements,
- a cross functional plan (milestones, manpower, schedule, prototypes, and budgets),
- an assessment of risk

These data are assembled in a "contract book" that is approved by the general manager (in this case the president of the firm), as well as the responsible functional managers. In theory, the book serves as a contract. Each of the people signing the book agrees to the terms in the book (including project scope) and to commit the specified resources necessary to accomplish the job. The core team agrees to complete the project as planned. In practice, the contract is mostly symbolic. Each of the functional managers has publicly indicated agreement with the plan and has made a psychological commitment to support the project.

The contract book worked well for the D1 project. In the words of the project manager "this was the bible... if it wasn't in here, you'd have to be God to get it into my project!". He and others also indicated that it worked because the new V.P. forced people to live up to their commitments. Strong cross-functional participation had been obtained early in the project.

5.2.5 Disciplined Management

Technology more than crept in the D2 project. Most notably, the fundamental architecture had been modified 2/3rds of the way through the project and a major subsystem had been redesigned.

Even four months after the D2 product had been launched to the market, it was not clear when the project would be completed. To put it another way, the development was still creeping -- it

was not clear, even then, that anyone knew what would constitute a completed D2 development effort. The original team was still in place and growing as ideas were added to a continuously regenerating list of potential options and enhancements. Rather than scope a more focused derivative project (incorporating a defined set of requirements, best practices, newer tools and technologies, etc.), each new feature or option idea was being handled in a piecemeal fashion. Overall, the project continued to consume a significant portion of the engineering resources at EquipTech.

In keeping with EquipTech's goal to be most responsive to customers, the Service organization struggled to achieve consistent performance in bringing each new D2 machine on-line. Simultaneously, they struggled with a growing list of machine retrofits for the early sites. To make matters worse, the service organization was already behind the growth curve at EquipTech.³⁶ In fact, Service was so consumed that they felt they did not have the time to actively drive or participate in any of the continuing development efforts. It seemed sometimes that the attention of the entire organization was required to bring the new machines on-line. And the list of machines was growing rapidly.

5.3 "Make the Trade Show or Bust!"

D2, arguably, had been launched early. Most of the annual sales for EquipTech and other electronics capital equipment vendors in this industry are derived at a major trade show held once per year. The Marketing staff at EquipTech had created expectations within the customer base, building a pent-up demand for the D2 product.³⁷ As scope and schedule for D2 crept, the ship date did not. In fact, the D2 team put forth a heroic effort to make the show. Beta testing, manufacturing documentation, and service training were still being developed as the first orders for the product were being taken.

With hindsight, some inside the firm have suggested this was a calculated decision. In the

³⁶ See the last paragraph in **Figure 6-6**, for instance.

³⁷ personal conversations with a Marketing manager and others at EquipTech, Nov, 1995.

words of one person, “the engineering team had been working for almost 3 years... if they weren’t held to this milestone they would still be working today”. In the words of another person, “If we had missed the show, we would have significantly jeopardized market share and competitive position. Our competitors would have capitalized on the pent-up demand we had created for this product.”

EquipTech faced a difficult decision and time may ultimately tell whether they made the right choice. I don't believe that anybody in the firm suspected the launch and ramp following the release would be as difficult or consuming as they have been. I believe managers in the firm will think twice, should they be faced with a similar situation in the future.

5.4 In the End... Reflections

By the end of the internship project, almost all of the early D2 machines in the field had been retrofitted. The design had stabilized and initial launch pains had subsided. Manufacturing was turning out a consistent product and new installations were going relatively smoothly. Words from the customer base began to take on a more positive tone. Once the machines were up and running, they ran well.

In light of these experiences, we were in a position to believe strongly that the root causes for difficulty in launching new products lay upstream in product development. Opportunities to improve the process at EquipTech were clearly evident:

- Is there an articulated, working, and disciplined process for product development?
- Is the level of cross-functional ownership and responsibility during development adequate? Manufacturing and Service procedures or documentation were not as developed as they could have been by the time beta prototypes were built. Success for the development team was considered “getting to the show”, not “consistent, satisfying product out the door”.
- Are incentives well aligned for the project managers? More disciplined management of engineering projects (scope, milestones and schedule, etc.) appears to be needed.

- Had anybody quantified the benefits and costs of the trade-offs that were being considered?³⁸ For instance, how would income be affected by the deletion or addition of scope? How much income would be lost over the product life cycle with a 1 month extension to the development schedule? A business model may have shown that attending the show, but delaying the initial ship date for D2 would have made sense.

This type of experience is not uncommon.³⁹ It might even be expected, given the entrepreneurial origin of the firm and the extreme rate of growth. To be fair to the D2 team, the project was undoubtedly more challenging than D1 would have been for the existing organization. A different team clearly might have had better or worse performance, but that is not the issue. Ultimately, root causes for what had occurred lie not within the team, but in the lack of a well understood, accepted process and the lack of management focus on process.⁴⁰ If one does not take steps to reduce the level of variability inherent in EquipTech development projects, one will be faced with a future stream of difficult management problems.

5.5 Implementing a Development Process

How can a company in this situation improve organizational capability and processes so that this type of costly, consuming effort does not repeat itself in the future?

We have so far looked at product development at EquipTech as a series of isolated projects. In fact, developing products is a process.

³⁸ Examples for this type of analysis are provided in Preston Smith and Donald Reinertsen, Developing Products in Half the Time, Van Nostrand Reinhold, New York, 1991. ISBN 0-442-00243-2.

³⁹ In fact, subsequent conversations with some of EquipTech's primary customers regarding the performance of their capital equipment vendor base suggested that EquipTech is among their best performers.

⁴⁰ In a culture where people are the process, Engineering felt that Manufacturing had not "pulled its weight" during the development project. Manufacturing felt that "Engineering scope had crept so often that Manufacturing was repetitively sweeping work off of the table". Both felt that "Service was reactive and needed to take a stronger role in developing and launching products". Individuals were expected to step forward and solve problems on a case by case basis as they arose. Unfortunately, many of the problems occurred in the gray area that lies between each functional responsibility.

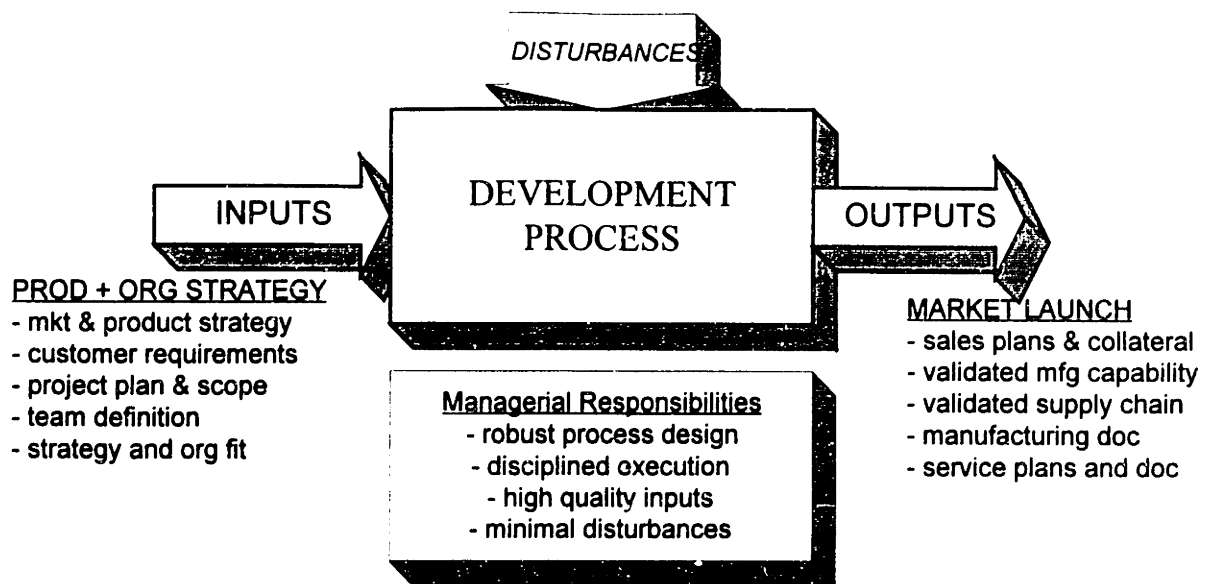


Figure 5-1 Product Development as Process

Viewing the particular cases at EquipTech from this more systemic perspective, the problem is one of robustness. The development process and managerial practices that EquipTech follows for all of their product development efforts do not provide consistent output in the face of disturbances to the process (i.e., unanticipated market or organizational inputs) and noise (i.e., uncertainty in the plans and assumptions).

An internship project that did not address process capability would be akin to improving the way product designs, some ready and some not so ready, are thrown over the wall into the factory. Can the existing development and management processes at EquipTech be enhanced to promote consistency and robust performance?

After discussing our ideas with senior managers at the firm, we agreed that steps taken to articulate a development process and build cross-functional support would benefit the firm. In the following sections, we review the development of such a process and the results of the implementation effort.

5.5.1 A Process We All Can Support

Unlike many of the firms currently reengineering their business processes, EquipTech was not

saddled with significant outdated assumptions or historical rigidity in terms of organization structure.⁴¹ It just needed process focus. The firm simply needed to identify and settle on basic processes before stages of learning could occur.

Our objective in developing a process was thus not to invent the ideal development strategy for EquipTech, but rather to clearly articulate something that everyone would accept and truly support. Once the process had been articulated and accepted (as evidenced in a trial project), it could serve as the basis for improvement. The goal of the project would be to develop a focus on process, cross functional ownership of the process, and a mindset of continuous improvement.

The unfreezing part of change (see page 38 for additional information) clearly would not consume the energy that it might otherwise take in a more established firm. One of the engineers at EquipTech described the situation as follows: “we’re like a bunch of soldiers standing around at the bottom of a hill. We all know that we need to take the hill [improve development and new product introduction capabilities], but we’re waiting for the general to ... lead us through the process”. People were entering the organization at an extremely rapid rate. In fact, the organization had been evolving so fast that change was truly the norm, rather than the exception.

In changing or evolving organizations, it is often easier to augment things that are currently done well, channeling or redirecting existing systems and behavior in the organization.⁴² The strategy I had scoped for the project was as follows:

1. With the knowledge I had gained while studying the firm’s practices in D1 and D2, I could develop a basic model of the de-facto process.

⁴¹ Business process reengineering, has been a subject of great interest in recent times. In reengineering, one first designs the processes in an organization, and then redesigns (from a clean sheet) a more focused, efficient structure that allows the organization to better execute the basic processes. The idea is most applicable in inefficient, hierarchical, bureaucracy-laden, organizations.

⁴² Thomas, Robert, course notes from “Leadership and Organizational Change”, Sloan School of Management, Summer, 1994 and Spring, 1995.

2. To this basic model, I could add rudimentary steps or ideas from the literature, being careful to add only where the new ideas provided significant leverage and did not significantly conflict or detract from current practices or ideas.
3. I would then discuss this basic model with the D1 Program Manager. I could reconcile the model with his understanding of the firm's culture and practices from previous major development efforts.

The result would be a legitimate model. It would already be partially accepted by the Engineering organization and would be more readily accepted by the broader organization.

4. I would review this basic model with operating managers from each of the core functions that have a direct stake in development projects (Marketing, Engineering, Manufacturing, Service, Purchasing, Documentation, Finance) to gain a 360 degree perspective of product development within the firm.

Using the basic process as a point of reference, I would provide an opportunity for each of the functional managers to contribute until the process met the needs of his or her organization. The reference process would serve as a focal point for cross-functional dialogue and reconciliation. It would evolve as I understood and captured each of their ideas and concerns.

This step would be crucial -- the goals would be not only to improve the articulated process, but to further legitimize the process with ownership by all of the key stakeholders.

5. A pilot project would be run under the basic process. An ideal project would be something vital to the firm but with limited scope. Limited scope would ensure that focus on the process would not be easily lost, given the firm's propensity for focusing on immediate tasks and technical content. By selecting a project with limited scope and a high degree of visibility, I hoped to provide a reinforcing experience for the firm. The goal would be to get through at least one iteration of the basic process before the end of the internship.
6. After completing the project, I would get the operating managers to review the process and incorporate their suggestions for improvement. At this point, I would present for

consideration additional ideas from the literature and best practices that might conflict with current practices.

5.5.2 A Process We All Do Support

The contract book approach EquipTech used in the D1 project provided a solid foundation for articulating an EquipTech development process. Steps 1 - 4 of the project strategy were executed over a period of 5 weeks. Managers within the firm invested effort and ideas into the project with varying, but positive levels of enthusiasm.

A summary of the resulting development process is provided in Figure 5-2. Deliverables, milestones, and functional responsibilities in the development process can be more easily viewed in Appendix B: Structured Development Process on page 128.

Five major development phases were articulated:

- A more structured project launch phase was articulated at the front end of the process. Both the Engineering and Marketing functions felt that improvement was needed at the front end of the process. Additionally, it became apparent in the course of discussions with Manufacturing and other groups that their level of visibility and involvement in the up front processes precluded sufficient planning for support in latter stages. Although much of the work was currently being done, it was not being done in a consistent or coordinated manner.
- Following the initial project strategy phase, a core team would be launched with responsibility for developing the contract book. This was consistent with the espoused development process at EquipTech.

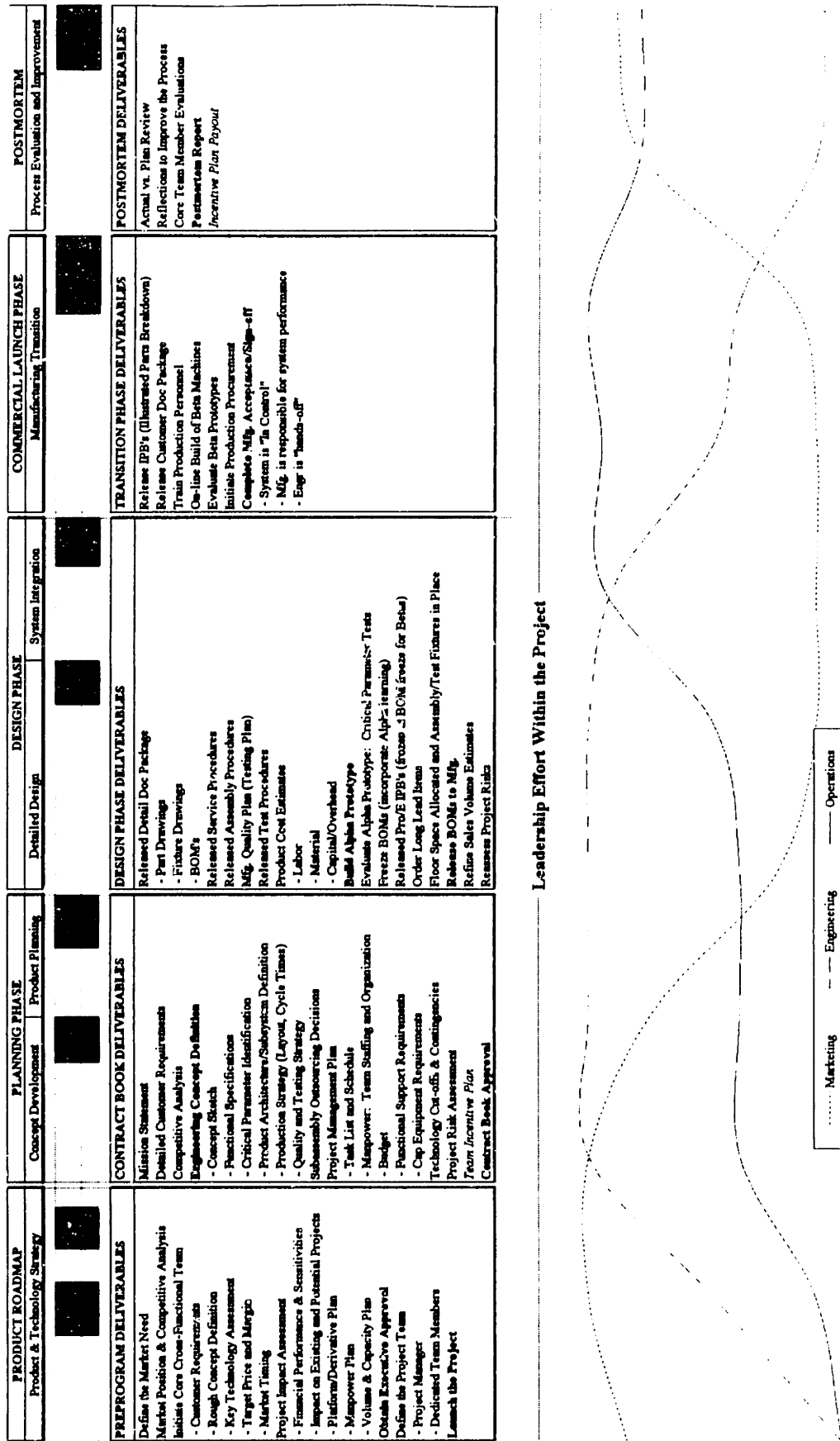


Figure 5-2 New EquipTech Development Process

- The third phase was essentially the current EquipTech detailed design process. We emphasized the existing, but sometimes neglected, idea that all functional documentation and training plans would be completed by the end of this phase. An engineering (alpha) prototype would be built and evaluated. Bills of material would be released into the manufacturing planning system.
- Following the design phase, an on-line beta build would commence as part of the manufacturing ramp. The assembly and quality processes would be debugged and validated on-line. This phase would end with Manufacturing acceptance of the processes, line, and supply chain as being "in-control".
- A "reflection" phase was added at the end of the process. I included this step in order to emphasize the process nature of development and to provide a basis for discussion with the functional managers.

Although core planning and design phases remained close to those currently espoused to be in use at the firm, the overall process differed at the very early and latter stages of development. A lack of up-front planning in D2 had resulted in scope creep and compression of schedules during the later phases of development. The firm then struggled to get products through manufacturing at the time of product launch.

Leadership expectations were also clearly articulated to stress responsibility and a stronger team role for Manufacturing as the project moved into the final phases of development.

5.5.3 Testing The Process...

In keeping with the original plan, a high priority project was selected. We selected, for redesign, the subsystem containing the bi-metallic part. The D1 program manager, now relatively free in terms of responsibilities, was assigned to the project. He was a strong proponent of the contract book process and had helped articulate the basic development process. I would assist him. Things were really rolling, except that...

Only one additional team member, a lead engineer, could be assigned. And he would be on

vacation for the next four weeks. As much as the Marketing, Manufacturing, Applications, and Service managers supported the concept, they would not commit resources to the project, given their current list of priorities. Diligent efforts to initiate the project culminated in a high visibility meeting with senior managers. One of EquipTech's founders finished the meeting with the following proclamation:

*"What ever happened to the days when things just happened around here!
Remember when [the current V.P. of Engineering] and I locked ourselves
in a room and developed [Product X] in one weekend! Enough of this [messing around]...
Just do it!"*

Unfortunately his impression of development remained "get the prototype to the show". The D1 Program Manager and I agreed that starting the project without dedicating at least the core cross-functional team members would be a disaster. Not only would it cause problems with this particular development as it moved into the field (the potential for retrofits was among the major concerns), but with such visibility we would reinforce existing bad practices. We spent two weeks struggling to get the project off the ground. My partner took a considerable amount of heat for sticking to his position.

It became clear to me and many other people in the firm that not all of the functions shared priorities or were working from the same plan. Manufacturing and Service, for instance, were clearly not staffed to support development projects. Discussions with various functional managers over this time period indicated that available development resources for all design projects at EquipTech could be crudely (order of magnitude) estimated as shown in Figure 5-3. Obviously, the problem we faced was not limited to this particular development.

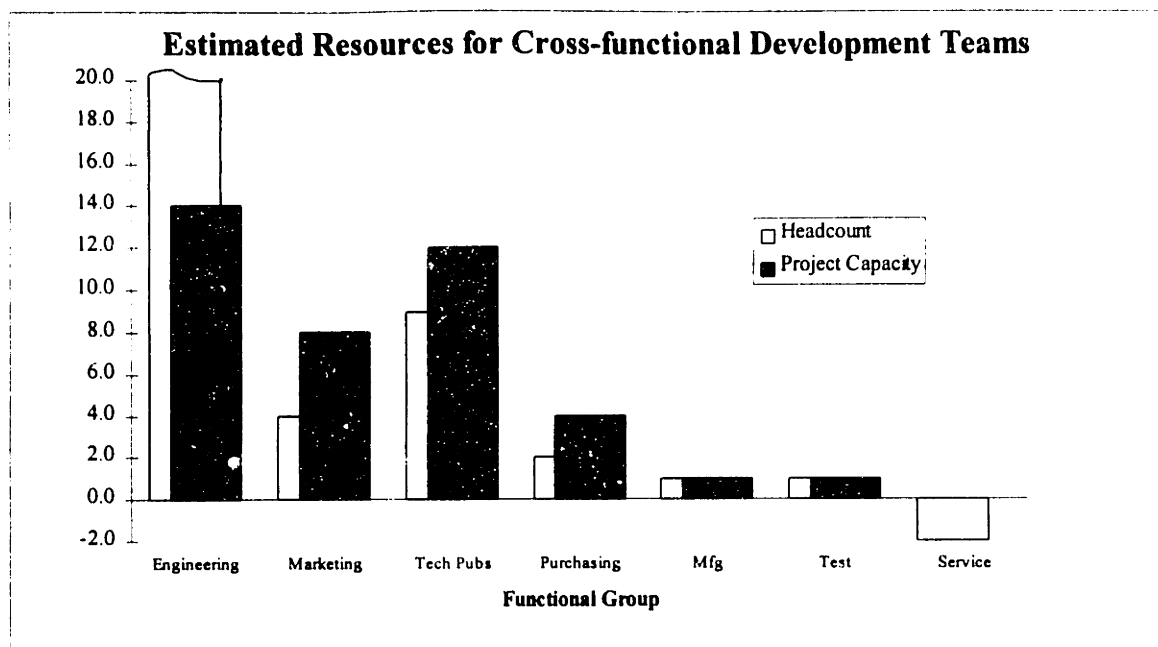


Figure 5-3 Estimated EquipTech Development Resources By Function

I began to consider alternatives. I had, by now, built strong relationships with most of the key functional managers in the firm. All espoused a belief in the process we had developed. Furthermore, most of their superiors supported the effort and felt that things needed to improve. Yet most of these people felt the immediate needs within their functions dictated that resources could not be “spared” for a development project.

I began to consider the basic issues that would need to be addressed before focusing on process and improving product launches could become a reality at EquipTech.

6. TRANSFORMING THE ORGANIZATION

It is no longer necessary or desirable for companies to organize their work around Adam Smith's division of labor. Task-oriented jobs in today's world of customers, competition, and change are obsolete. Instead, companies must organize their work around process.⁴³

In this chapter, we present an assessment of the root causes underlying many of the concerns that surfaced during the product development process experience. A specific plan for change that will help EquipTech address these root causes is articulated. Preliminary results and concerns for the future are presented.

6.1 Opportunities for Improvement

As highlighted in the previous chapter, business processes at EquipTech had become fragmented as the firm rapidly evolved from an organization of individuals collectively working to meet the needs of the business to functional departments having a more specialized, parochial focus. More specifically, the following opportunities are identified in light of our experiences with the firm.

6.1.1 Parochial Functions

As sales at EquipTech grew, the organization was stressed tremendously. The business had once been an entrepreneurial organization of 30 or 40 people doing whatever it took to get the product off the ground. Overnight, it had become an organization of 400 or 500 people. The firm naturally evolved into a functional structure. Span-of-attention concerns dictated that management would become more parochially focused. Specialists, with experience from other

⁴³ Hammer and Champy, Reengineering the Corporation: A Manifesto for Business Revolution, New York: Harper Business, 1993, pp. 27-8.

firms, were brought on board to help organize functional areas. Additional people were brought in at the bottom of a growing, pyramid shaped structure. As presented in The Mechanistic Organization on page 17, mechanistic principles of organization are often the easiest way to provide the control and competency scalability required to deal with rapid growth.

In this environment, managers have been consumed by the need to control and support rapidly growing departments. They have been challenged by the need to keep their departments staffed and working correctly. Business processes became the responsibility of those functions most closely related inside the firm. Process ownership and management focus, like management responsibility, became parochial in nature. With hindsight, it should not have been surprising to us that the manager of Manufacturing or any other discipline couldn't "spare" people to work on a development project. Most are not directly responsible for the results.

Inherently cross-functional business processes have become functionally owned and driven. EquipTech is suffering from a lack of stakeholder responsibility for the complete business processes that span functional departments.

6.1.2 Task Focus vs. Process Focus

EquipTech has grown on the shoulders of individual people. The firm has a history rich in entrepreneurial activity and leadership. As evidenced in the product development process experience, original leaders of the firm maintain a strong interest and still take an active role in managing the firm. The ability of the firm to react quickly and definitively to the needs of customers and immediate market demands is what has established EquipTech as the successful firm that it is today.

Unfortunately, strong entrepreneurial roots and strengths in the culture can sometimes act as rigidities when the structures of the market and organization change. "Hallway engineering", as one person at the firm aptly described the existing product strategy process, doesn't cut it anymore. It may have been a strength at one time, allowing the firm to react quickly to the needs of customers. However, reacting to anybody's needs and ideas when the firm is 400 or

500 people is a recipe for disaster. Top down strategy, including proactive planning and some degree of resource management are also needed.

The culture of the organization inherently stresses tasks and people, rather than process. Entrepreneurial focus is naturally a focus on task, rather than process. Communications are word of mouth; people are the process. Once again, when everybody sits in the same room, this can be an advantage. Informal, voluntary lateral capability (see page 29) arises quite naturally and everybody shares a similar perspective of the business. When people are removed from each other and spread across disparate, functional locations, voluntary lateral capability does not arise as often. If it does, it is much more difficult to coordinate or control.

EquipTech suffers from a lack of process focus and capability. Increasingly, cracks are widening between functional groups and processes, the nuts and bolts of the business, are getting fragmented.

6.1.3 Coordinating Mechanisms

Organizational units at EquipTech are growing apart because coordinating mechanisms necessary to bring specific expertise to bear in the business processes have not evolved or grown with the organization. What used to get done by commonality of context is no longer getting done. If EquipTech is to remain primarily functionally organized, the experiences I have mentioned all point to a need for mechanisms and capability in coordinating strategy, planning, and action, across the departments.

Short of reorganizing the entire firm around processes, adequate mechanisms to ensure functional coordination need to be put in place. Business processes thus offer the potential for providing some of these mechanisms. Metrics and incentives can be designed to emphasize results that follow from basic business processes spanning the functional groups (budgeting, forecasting, product development, and product strategy for instance). Cross-functional development of personnel and cross-functional career paths can also strengthen the ties between functional groups.

The coordinating glue that fills the cracks in a functional organization is currently in short

supply at EquipTech.

6.2 Creating Process Capability

In this section, we will summarize details of a plan to evolve the organization in order to address needs outlined in the previous section. The design is based on the “distributed organization” concept and other ideas presented in section People-centric Designs and Models of Organization on page 27.

6.2.1 Ideas for Change

We hypothesize that the following actions will benefit the firm.

- **Create Platform Teams.** General or cross-functional management focus can be implemented to coordinate action and better manage business processes across functional departments at a local level.
- **Create a Steering or Operating Team.** General or cross-functional management focus can be implemented to coordinate action at the senior operating level. This group will be responsible for, among other things, the development and maintenance of business processes.
- **Implement Metrics And Incentives.** The current system of metrics is functionally focused and, at best, is inadequate. Operating measurements can be implemented and significantly improved. Measurements should stress results that matter to customers and process accountability.
- **Improve Human Resource Planning And Development.** Bonuses should reward performance and promotions reward capability. Proactive competency planning and skills development can better prepare the firm to address the stresses associated with growth, as well as future strategic priorities. Personnel and career paths should be developed across functions so that future process capability is strengthened.

Essentially, we suggest that process (the nuts and bolts of the business) responsibility be clearly assigned to teams that span the current functional hierarchy.

6.2.2 Steering and Product Teams

A Steering Team and a number of Product Teams, held accountable to the Steering Team, are to be created. The team organization concept is presented in Figure 6-1. Each person in this structure wears two hats, similar to Jay Galbraith's model (see page 35).

The Steering Team is staffed with senior functional managers from key departments. Given the process nature and time horizon of the issues this team would be dealing with, we proposed that the core team have representatives from Marketing, Engineering, Manufacturing, and Finance. Marketing, Engineering, and Manufacturing are currently key operating disciplines and de-facto owners of the business processes. Because Finance at EquipTech plays a central, rather than a supporting role at the executive level, we include Finance for ease of coordination and reporting. Given the focus on business processes and the need for metrics, the team is augmented with full-time participation from a Customer Satisfaction specialist.

In our initial proposal, Sales and Service were to be represented by Marketing. Sales and Service have, by definition, a shorter term, tactical horizon. Manufacturing would represent the voices of Purchasing, Quality, Test, Manufacturing Engineering, Shipping/Receiving, and the various other operating disciplines. In the end, executive management felt strongly that Sales and Service should participate directly. This should not have been unexpected, given the cultural bias for a short term focus on tasks and immediate action. Direct participation would not hurt the team as long as we could manage to keep the focus on longer term issues. In fact, we felt that initial participation would probably strengthen ties between Marketing and these organizations.

The Steering Team is responsible for intermediate-term strategy, the business processes that span the organization (forecasting, budgeting, order fulfillment, developing product strategy, etc.), and a number of Product Teams having cross-functional responsibility for major market segments. We appoint relatively senior managers to the Steering Team to provide legitimate authority and conflict resolution capability.

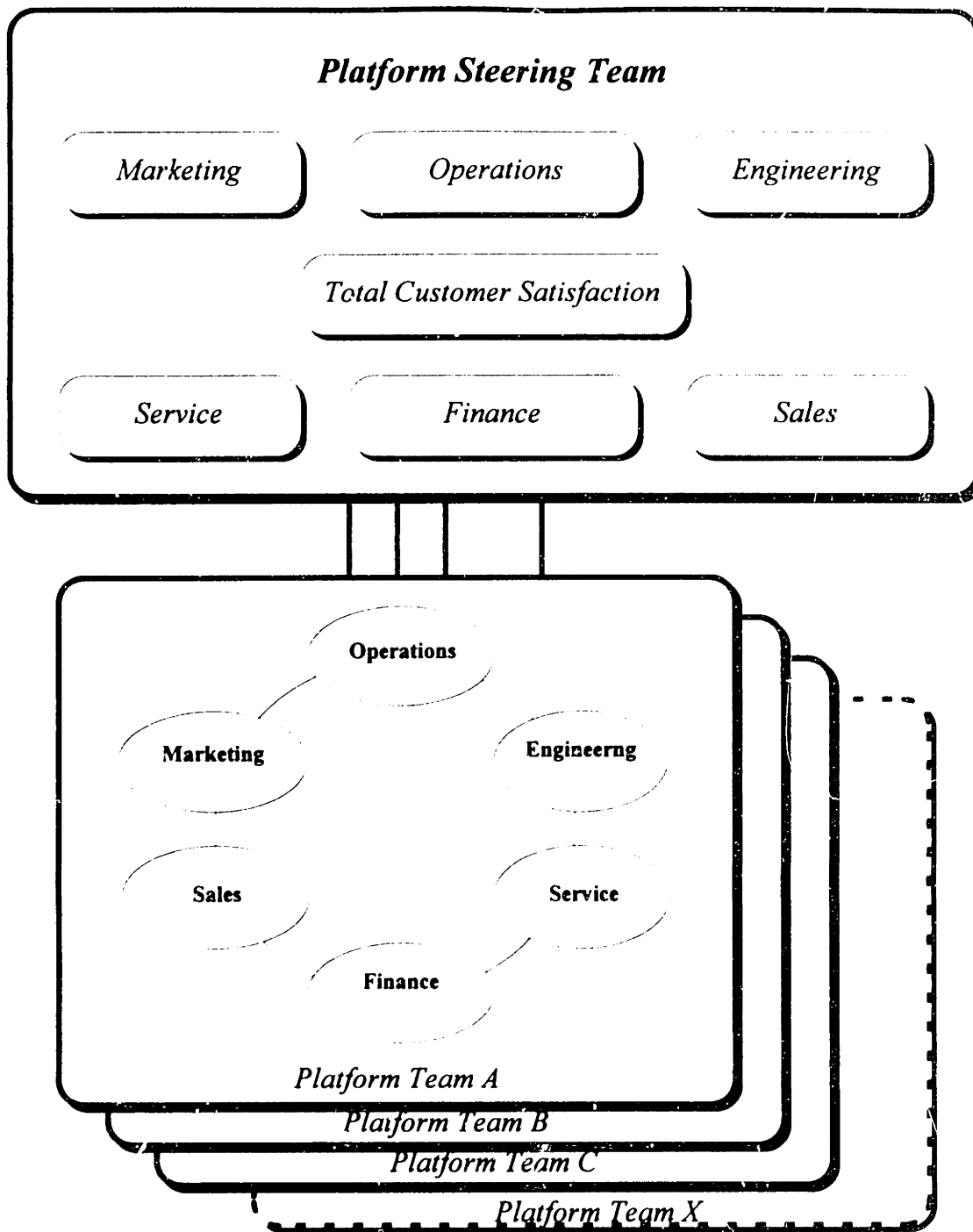


Figure 6-1 Product Team Organization Structure

Product Teams, staffed with the personnel currently having product responsibility in each of the functional departments, are implemented to provide clear accountability and focus at the product line (platform) level. Each Product Team is responsible for operating performance of

the business (order fulfillment, product strategy and the product pipeline, customer satisfaction, etc.) in a major market segment. The team provides a forum for reconciling and implementing functional strategy. As with the Steering Team, we felt that core membership should be limited to Marketing, Engineering, Operations, and possibly Finance. Again, executive management at the firm felt strongly that Sales and Service should participate directly. The teams are currently augmented with support from a representative of Customer Satisfaction (for at least the first 3 months).

6.2.3 Interface Between Product Teams and Functional Groups

In no way do we mean to imply that Product Teams replace or reduce the need for functional departments. Executive managers in each of the departments retain functional responsibilities and control over their resources. Directors in each department are appointed to the Steering team in order to provide functional control. Resource allocation dilemmas between Product Teams or between Product Teams and functional groups are to be handled by the directors at this level.

In fact, for the new structure to work well, the departments must function well. The product team structure provides a mechanism for cascading, reconciling, and implementing functional strategy at the local business level. Emergent opportunities, on the other hand, can now be quickly recognized by representatives on each of the local Product Teams and carried back into their respective functional departments.

Strategy, by its nature, is driven from the top down as well as emergent from the market up. In this structure, the lack of coherent strategies or sufficient processes for maintaining functional strategies will rapidly become evident at the Product Team level. Figure 6-2 more clearly presents this concept, showing the functional/team interface as well as the interface between two of the functional groups.

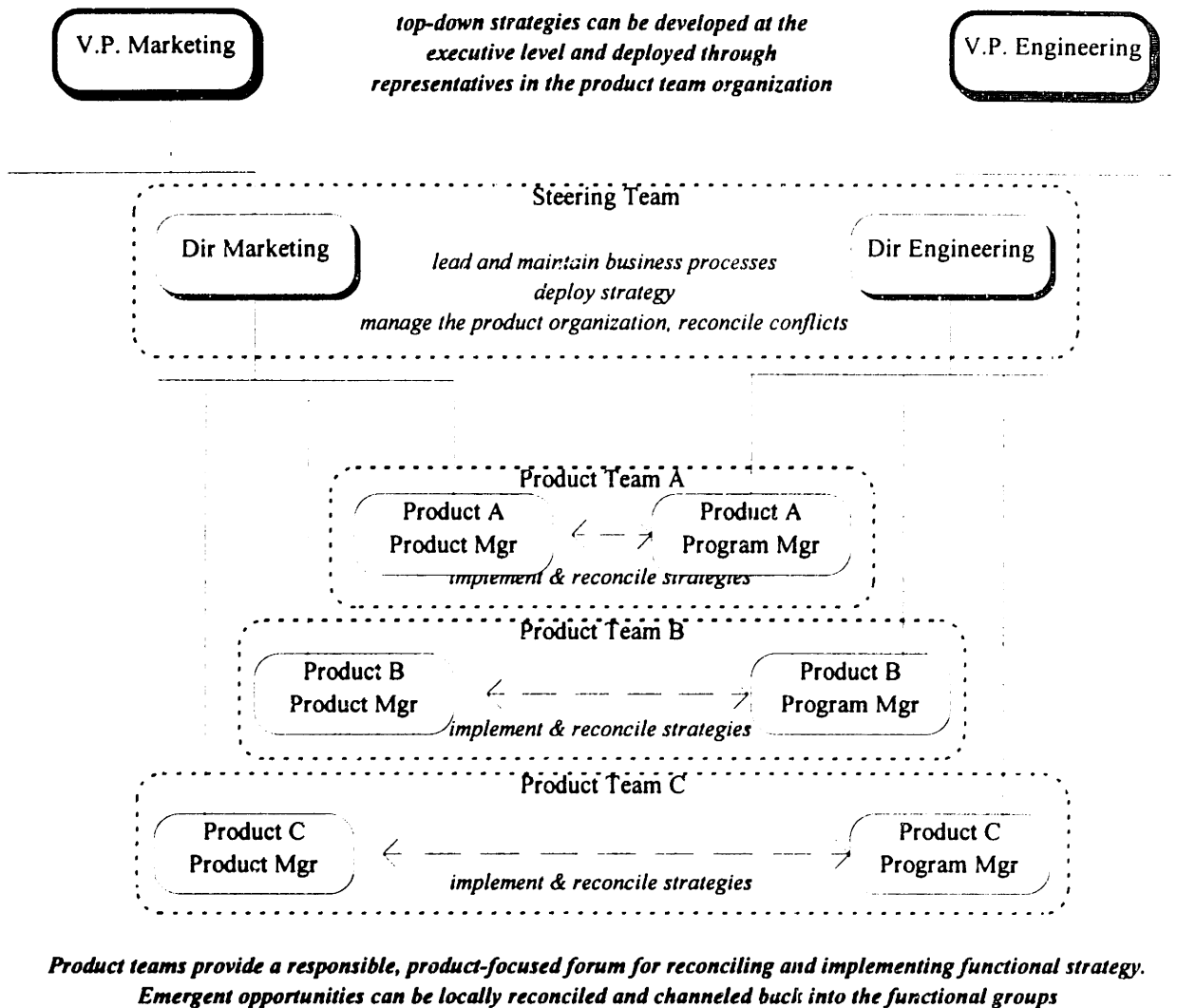


Figure 6-2 Strategy Deployment Model

6.2.4 Organization Charters

Suggestions for tasks, responsibilities, ground rules, and boundaries (authority) for each of the teams were developed and subsequently approved by the executive team at EquipTech. Subsequently, these formed the basis of charters, approved by executive management, for each of the teams. Most of the value in developing the charters came in the form of working relationships and the sharing of perspectives. Figure 6-3 summarizes tasks, responsibilities, and boundaries for each of the teams. Task definitions are subsequently presented in more detail to give a better perspective of the discussions and interests.

| Task | Executive Level | Steering Team | Business Team | Project Team |
|----------------------------------------|-----------------|---------------|---------------|--------------|
| Develop Business Processes | A | M,R | R | R |
| · Forecast (Sales, Builds, Revenue) | | | | |
| · Budget | | | | |
| · Customer Satisfaction | | | | |
| · New Product/Market Strategy | | | | |
| Performance Measures, Steering Team. | A,M,R | M,R | I,R | |
| Performance Measures, Business Teams | | A,M,R | M,R | I,R |
| Initiate New Business Teams | | A | M,R | I,R |
| Business Strategy/Goals 12 - 24 months | A | M,R | R | R |
| Business Strategy/Goals 1 - 12 months | | A | M | I |
| Product Strategy Implementation | | A | M,R | I,R |
| Setting of Pricing/Margins | | A | M,R | I,R |
| Resource Allocations | | A | R | R |
| Annual Budget | A | M,R | I,R | R |
| Overall Forecast (24 months) | | A | M,R | I,R |
| Aggregate Development Schedule | | A,M | M,R | I,R |
| Approval of Contract Books* | | A* | M,R | I,R |
| Product Development Schedules | | A | M,R | I,R |
| Existing Product/Marketing Strategy | | A | M,R | I,R |
| Budget Implementation | | A | M,R | I,R |
| Monthly Revenue Projections | | A | M,R | I,R |

Roles = (A - Approve, R - Recommend, M - Manage Implementation, I - Implement)

* Contract Books also approved by an executive champion (President of the firm)

Figure 6-3 Team Responsibilities, Tasks, and Boundaries

6.2.5 Task Dictionary

This section provides an overview of each of the tasks presented in Figure 6-3.

- *Forecasting Process (Sales, Builds, Revenues):* Articulate and implement a process for forecasting sales revenue by product line, volume by product line, and total revenue.
- *Budget Process:* Articulate and implement a process for developing the annual budget. The Steering Team will coordinate the budget process across product lines and functions. Budgets will be developed in a manner that promotes strategy coordination and planning.
- *Customer Satisfaction Process:* Articulate and implement a process for collecting, tracking, and disseminating customer satisfaction metrics to the company. Metrics will be used as primary measures of success for the steering and Product Teams.

- *New Product/Marketing Strategy Process:* Articulate and implement a process for coordinating and developing market and new product strategy. The process will be inclusive, with input from all key stakeholders. A process for initiating, staffing, and launching development projects will also be defined and implemented.
- *Performance Measures for Steering Team:* Define metrics for Steering Team performance measurement. Negotiate goals with the Steering Team. Track performance relative to metrics. Assess performance of the Steering Team.
- *Performance Measures for Product Teams:* Define metrics for Product Team performance measurement. Negotiate goals with the Product Teams. Track performance relative to metrics. Assess performance of the Product Teams.
- *Initiate New Product Teams:* Allocate resources to and launch Product Teams.
- *Business Strategy/Goals:* Articulate and implement business strategy. Operational strategy and goals will be explicitly developed and shared in order to provide a framework for decision making at all levels of the company. The strategy process will reconcile the vision and guidelines at senior levels of the company with emergent opportunities at the operational level of the company.
- 1-12 months: Product Teams formulate and implement strategy for a particular market segment over a 12 month horizon.
- 12-24 months: The Steering Team formulates and implements operational strategy across all product lines over a 24 month horizon. It is envisioned that 12 month strategy within a market segment will remain the primary responsibility of the Product Teams. The Steering Team is responsible for coordinating strategy across the Product Teams.
- *Product Strategy Implementation:* Develop and maintain an aggregate product strategy for the company.
- *Setting of Pricing/Margins:* Set prices and margins for products.
- *Resource Allocations:* Allocate resources across projects and departments of the company

to ensure that strategic priorities are maintained.

- *Annual Budget:* Coordinate and oversee the annual budgetary planning process.
- *Overall Forecast (24 months):* Develop a rolling 24 month revenue and volume market forecast by product line for all EquipTech products. The forecast will reconcile input from Marketing projections, Engineering schedules, Operations capacity analyses, Finance goals, etc..
- *Aggregate Development Schedule:* Aggregate the plans for all projects and platforms to obtain company-wide manpower and schedule plans. The schedule will be managed to ensure that strategic priorities are maintained.
- *Approval of contract Books:* Approve contract books.
- *Product Development Schedules:* Develop and maintain the manpower and schedule plans for product development projects at the individual and platform levels. Plans will define primary resource requirements across all departments of the company.
- *Existing Product/Marketing Strategy:* Develop and implement market strategy (position, platform/derivative planning, options, etc.) for existing product lines.
- *Budget Implementation:* Allocate resources from the budget.
- *Monthly Revenue Projections:* Develop the detailed monthly revenue and volume forecast.

6.2.6 Team Rules

Ground rules adopted by the Steering Team are presented in Figure 6-4. Product Teams developed their own rules, using these as guidelines.

- All meetings will have an agenda 24 hours ahead of time. Meeting minutes will be taken and distributed to members. Minutes will be copied to the executive level of the company (for at least the first 3 months).
- Team meetings will follow the agenda. Additions or deviations require unanimous consent.
- A weekly meeting will be held every Friday morning from 8-9 with only the steering committee members. Other meetings will be held on an as-needed basis.
- All team members must buy into the team's decisions. At a minimum, this means that a member agrees to support the team (one voice, walk the talk, support the decision) even though that member personally would have preferred an alternative.
 - Decision Process: 5 to 7 and the vote carries. The losing side can ask for a re-vote at the next meeting in which they can present their argument. 5 members need to be present in order to vote.
- Customer satisfaction has a forum in all team meetings.
- Keep the customer in mind during any decisions.
- Can't just say no, must offer an alternative.
- One conversation at a time in team meetings.
- Team has one external voice.
- Walk the talk.
- Attack the problem, not the person.
- Respect where the other person is coming from.
- Where appropriate, confidentiality must be maintained.
- A one page monthly status report will be developed for the Executive level of the company.
- Always keep your sense of humor.
- The Steering Team will be re-charted at 3 and 6 months at an off site meeting.

Figure 6-4 Steering Team Ground Rules

6.2.7 Product Team Objectives

Business objectives were provided to focus the initial efforts in each of the Product Teams. It was anticipated that responsibility for the objective would be shared with the Product Teams as the teams developed more capability and ownership of their product lines.

Typical objectives provided to a team follow.

1. Increase global sales revenue and volume for the platform and related options.
 - Sales revenue should meet or exceed that outlined in your 24 month global forecast.

Your forecast is not currently expected to be different than that already in place.

- Operating capacity should be sufficient to handle forecasted volume.
- Volume should be sufficient to maintain a three week manufacturing backlog.
- Develop enough competency and the analyses required to develop your own forecasts.

2. Increase customer satisfaction for platform related products.

- Address any current problems we are having in the field.
 - Implement a process and capability for tracking and analyzing field data to support decisions for longer term fixes.
 - Develop plans (with functional support) to implement longer term fixes.
 - Strategies and plans need to be consistent with the Field Service strategy for the company. The goal is to strengthen, rather than replicate our existing capability.
- Identify metrics that make sense for tracking customer satisfaction with support from the Customer Satisfaction group. Define your needs so that they may evolve the current process to support your efforts.
- Begin tracking performance relative to the Customer Satisfaction metrics.

3. Finish all related options to support sales launch dates.

- You are expected to compile an 18 month schedule summarizing, among other things, expected project completion dates.

It is your responsibility to develop contract books sufficient to plan and manage major projects. Loose guideline: a major project is any costing more than \$250K or impacting more than \$10M in revenue.

At a minimum, a contract book addresses the following:

- Marketing requirements and plan.
- Financial analysis and targets.
- Engineering plan and schedule.
- Cross-functional resource plan w/ schedule.
- Psychological contract for commitment from supporting functions

6.3 Implementing the New Organization

The plan for implementation at EquipTech was originally based on Jay Galbraith's star model, (Figure 6-5, below). As we discussed in People-centric Designs and Models of Organization on page 27, the model stresses that organizations are built on coherent sets of tasks, capabilities (people), incentives (rewards), processes, and relationships (structure). In Galbraith's model, strategy for the firm defines the tasks that need to be accomplished, then the points of the star are implemented and refined until a coherent system is in place to provide capability.

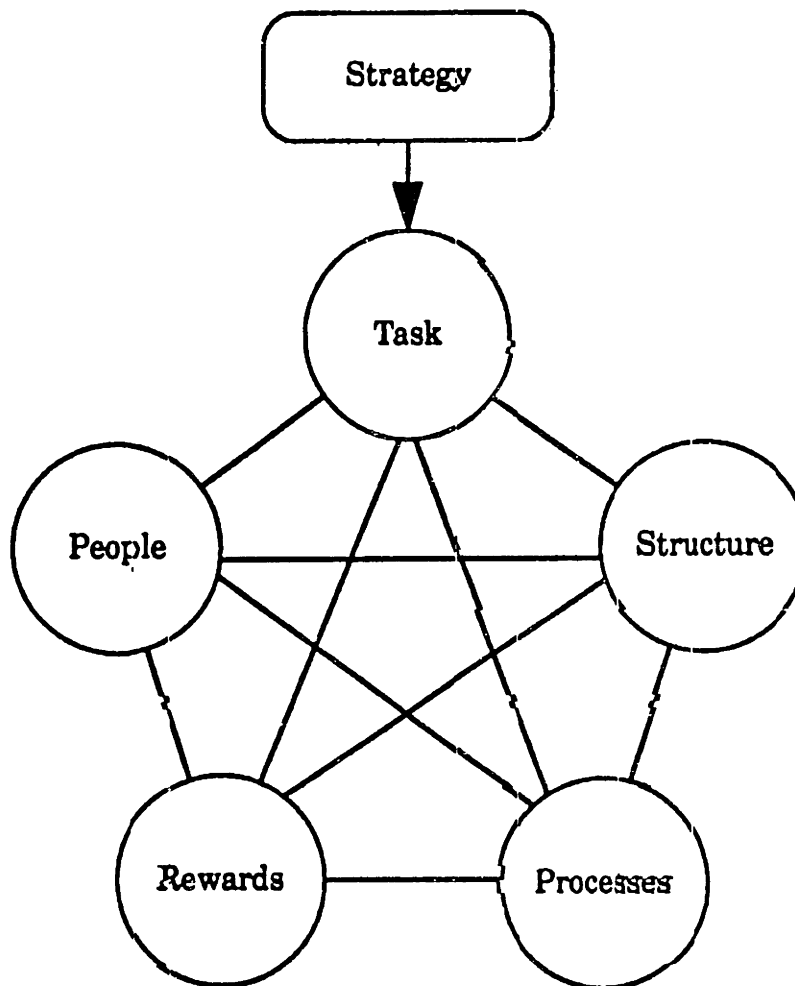


Figure 6-5 Star Model of Organizational Change⁴⁴

⁴⁴ Galbraith, Jay, Competing with Flexible Lateral Organizations, 2nd ed., Addison Wesley, Reading, MA, 1994. ISBN 0-201-50836-2

Recall, as well, that in Hammer and Champy's reengineering model, strategy and values (basic assumptions) define processes, and then, capabilities, measurements, and structure are consistently defined to provide capability.

A common thread from both models is that processes, people, rewards and structure form an interlocking system. Both stress that capability is derived from a working system. One portion of the system cannot be changed in isolation from the others.

6.3.1 The Implementation Plan

Following are steps for the implementation plan for launching the new organization:

1. Executive approval would be obtained for the Product Team concept and the restructuring.
2. The Steering Team objectives and charter would be articulated. Capabilities would be defined and personnel would be identified. Metrics for the Steering Team would be identified.
3. The Steering Team would be convened off-site and a charter would be developed. The experience would be important for two reasons:
 - Participation in the exercise would move the group through the stresses of initial formation and influence testing⁴⁵ that exist in the early stages of team formation. The exercise would stress the group, but certainly would not be insurmountable. Working relationships and responsibilities would be developed.

Influence testing had the potential to be destructive if it surfaced during the follow-on, launch phase of the project.

 - The content of the exercise would be important. Process needs would be identified. Functional perspectives would become more aligned. The team would begin developing the business processes and the infrastructure required for Product Teams.

⁴⁵ Katzenbach and Smith, The Wisdom of Teams: Creating the High Performance Organization, HBS Press, Boston, 1993. ISBN 0-87584-367-0.

4. The Steering Team would charter and launch Product Teams, starting with one and then following with others as the teams gained momentum and processes came on-line.
5. Business process would be developed and implemented. After an iteration or two, they would be articulated. Metrics and Incentives would be put in place to reinforce the processes and the Product Teams.

The team would have to stress “doing” rather than “talking” because the rest of the organization would be watching their actions (rather than listening to their words) closely. Before internalizing new ideas and a structure, the rest of organization would demand assurances that the vision is working and would be successful.

6.3.2 The Implementation Reality

With a tight senior management group and co-sponsorship from the Engineering and Marketing executives of the firm, I believed that we had the coherent focus and strong commitment necessary to support a change process. I focused most of my efforts during the initial part of the project thinking through and developing a coherent set of processes, tasks, responsibilities, and measurements for each of the teams. When the teams were launched, I wanted to be sure that we could move forward without too much confusion.

How did things actually go? Approximately four weeks into the effort, I returned from a two day vacation to find that Product Teams had been launched prematurely. Why? “This is such a great idea -- we’re helping you along. Things are just moving way too slowly and we’ve got these critical issues... get moving! Address the temporary shortfall in sales and product launch issues in the field! Just do it!” The firm was experiencing a shortfall in sales relative to their monthly forecast.

The launch plan had not yet been completed. The Steering Team had not been launched. The needs that a Steering Team would address had not been considered (legitimate cross-functional authority, an interface with the existing functional structure, direction and control, and conflict resolution). Yet, in keeping with the culture of the firm, immediate tasks dominated the launch perspective.

More significantly, and with the benefit of hindsight, the executive team did not share a coherent perspective of or commitment to change. We had not sufficiently communicated with them during the initial stages of the project.

6.3.3 Building a Coherent Organization

The early launch created difficulties. We considered putting the brakes on, but felt that doing so would seriously confuse the rest of the organization as well as undermine executive support for a subsequent effort. We would not be given a second chance. Subsequently, we worked to get a Steering Team up and running to bring the change process back in control.

Currently, the Steering Team is in place and appears to be functioning well. They were able to develop a charter (results of which were partially presented in section 6.2). Business process priorities were identified. Authority and organizational responsibilities were clarified. A copy of the incorporation memo is presented in Figure 6-6.

Product Teams were brought, for the most part, on track. Authority and responsibilities were tested and proven in resolving functional conflicts over priorities and resource allocation. Consistent Sales and Service strategies for addressing the short term concerns at EquipTech were also developed and implemented. More importantly, the Product Teams provided, as designed, a cross-functional forum and focal point for implementing and reconciling functional strategies.

6.4 Creating a Lasting Improvement

Time will eventually tell if we made the right decision in following through on the early launch of the teams. Although processes for forecasting as well as product strategy have been developed, measurements and incentives to support the transition have not yet been identified or put in place.

INTEROFFICE MEMORANDUM

To: All associates
From: [REDACTED]
Date: September 22, 1995
Re: **Steering and Product Teams Announced**

As you are all aware, [REDACTED] continues to grow at a phenomenal rate. The introduction of the [REDACTED] and [REDACTED] products is fueling our expansion with ever increasing intensity. Our first priority at this point in time remains the growth of market share for these products, both domestically and overseas.

Steering Team Appointments

Success as [REDACTED] continues to grow demands that we develop and utilize people at all levels of the organization to their utmost potential. Effective immediately, I am appointing the following people to a steering team with broad responsibility.

- [REDACTED] Total Customer Satisfaction
- [REDACTED] Field Service
- [REDACTED] Sales
- [REDACTED] Marketing
- [REDACTED] Engineering
- [REDACTED] Operations
- [REDACTED] Finance

Steering Team Authority and Accountability

This group is authorized to take the following actions:

- articulate business processes and coordinate planning across functional departments,
- recommend organization changes, including Product Business Teams, to support their actions,
- define and track customer satisfaction metrics,
- make budget, manpower, and development schedule trade-offs, and
- define product strategy and development project priorities

I am going to hold this group accountable for achieving the following results:

- improve our performance and reputation in the marketplace,
- maintain a pipeline of products that support [REDACTED]'s long term strategic goals,
- improve our capability for pro-active planning across department and product lines,
- improve coordination and communication across department and product lines

Functional managers will retain control over their personnel and departments. However, I expect and will ensure that this team receives the support it needs to accomplish its goals. Steering team membership and authority will evolve as [REDACTED] continues to grow and additional organization changes are made.

Immediate Responsibility for Customer Satisfaction

Around the world, [REDACTED] has taken a very aggressive position with respect to product support. This includes new facilities in Scotland, Ireland, France, Singapore, and North America. Our objective in the upcoming months is to staff a comprehensive support organization covering Sales, Applications Engineering, and Customer Service that dwarfs our competitors.

Until we are fully staffed there will continue to be issues with our customers that we have to take a more creative approach to addressing. Almost 60% of [REDACTED] sales are to repeat customers. For that reason, an immediate goal for the Steering and Product Teams has to be to ensure that our customers receive the level of attention they have come to expect from [REDACTED].

We should all be proud of the outstanding success that we have achieved. Continued success depends on our ability to maintain a reputation for customer satisfaction and great products.

Figure 6-6 Steering Team Incorporation Memo

EquipTech is currently straddling a fence, with one foot in process-focused teams and the other stuck in the traditional way of doing business. Without changes to the measurement system, the incentive system, and the human resource system (career pathing and planning), any success in implementing a focus on process and the teaming structure will likely be temporary in nature. Initial problems related to the human resource system are likely to be most evident at the Product Team level, where people have faced the greatest degree of disruption and uncertainty in their environment.

Improving the firm's ability to execute business processes was an initial reason for making this transition. If the steering team can successfully develop and implement the processes on its agenda, the organization may naturally shift more of its weight into process-focused teams. The measurements, incentives, and career paths that define capability may more naturally follow.

The next chapter of this work reviews one of the processes developed and implemented at EquipTech. Specific recommendations for improving the situation are then presented in the final chapter of the thesis.

7. EXERCISING THE NEW ORGANIZATION

“Strategic planning can be thought of as a process by which a broader perspective of the organization is developed and shared by members of the community.

The way in which an organization is structured affects the way this process can occur.”⁴⁶

Improving the firm’s ability to execute business processes is critical to improving performance of the business. Development and implementation of business processes that leverage capabilities created by the new organization will also reinforce the change to Product Teams. Technology and Product Strategy is one of four business processes the Steering Team is responsible for developing and improving.

This chapter reviews the design and implementation of a process for developing and implementing a functionally coherent technology and product strategy. Relevant frameworks and ideas from the literature are first reviewed. An overview of the process developed at EquipTech is then presented. Results from an iteration of the process are then reviewed.

Obviously, information developed as part of this effort are very sensitive to EquipTech. In most cases, it was possible to disguise portions of the analysis. In some areas, it was necessary to eliminate data from the presentation altogether. In areas where it was necessary to omit portions of the analysis, generic examples or ideas will be introduced.

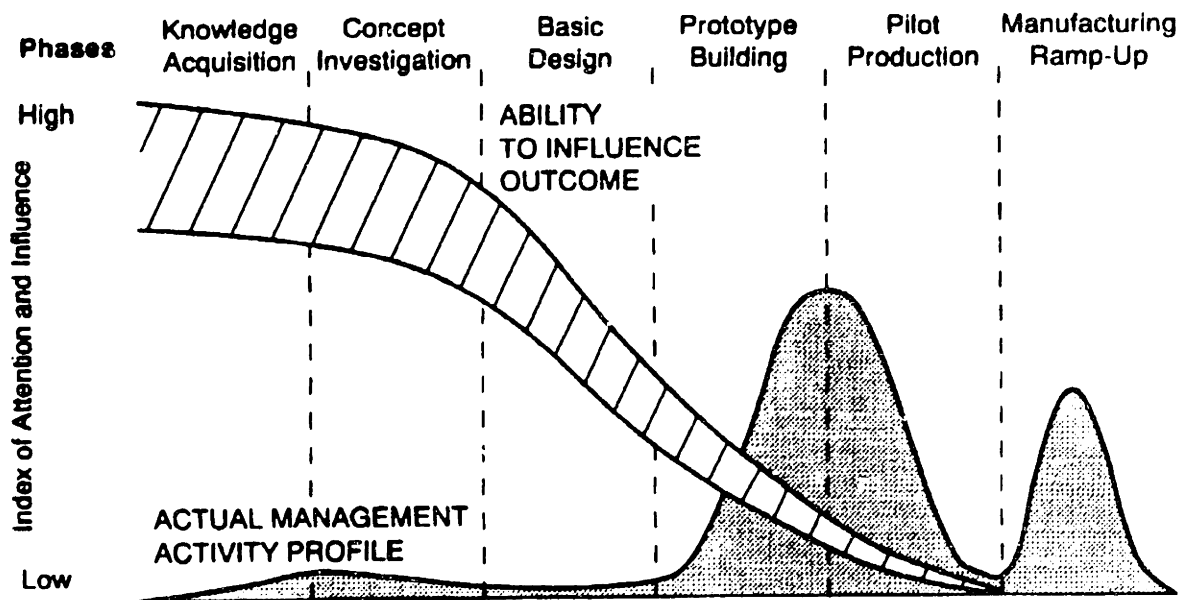
7.1 What Is A Product Strategy Process?

The Technology and Product Strategy process is that of systematically deciding how to best utilize the limited resources of the firm to address future market and business needs. The process should consistently reduce ideas to well understood, well supported, sufficiently staffed, well launched projects.

⁴⁶ Oster, Sharon, Modern Competitive Analysis, 2nd ed. New York: Oxford University Press, 1994. p 179.

The process that has been adopted at EquipTech is based heavily on the ideas of Wheelwright and Clark.⁴⁷ The process is modified to incorporate ideas taught in the Technology Strategy and Product Development courses at MIT, the literature on product development^{48,49}, some of the literature on teams and team work⁵⁰, and the firm's current industrial context and capabilities.

Why so much structure and emphasis in the early phases of development? Management's ability to influence a project's outcome is significant early in the project. Figure 7-1, below, more clearly depicts this concern.



* Management's ability to influence a development project's outcome is high early in development (diagonally shaded area). Yet typically, management's actual activity profile (darkly shaded area) is very limited early on and only becomes significant late in the project, when the effort is in trouble.

Figure 7-1 Timing and Impact of Management Attention⁵¹

⁴⁷ Wheelwright & Clark, *Revolutionizing Product Development*, New York: The Free Press, 1992.

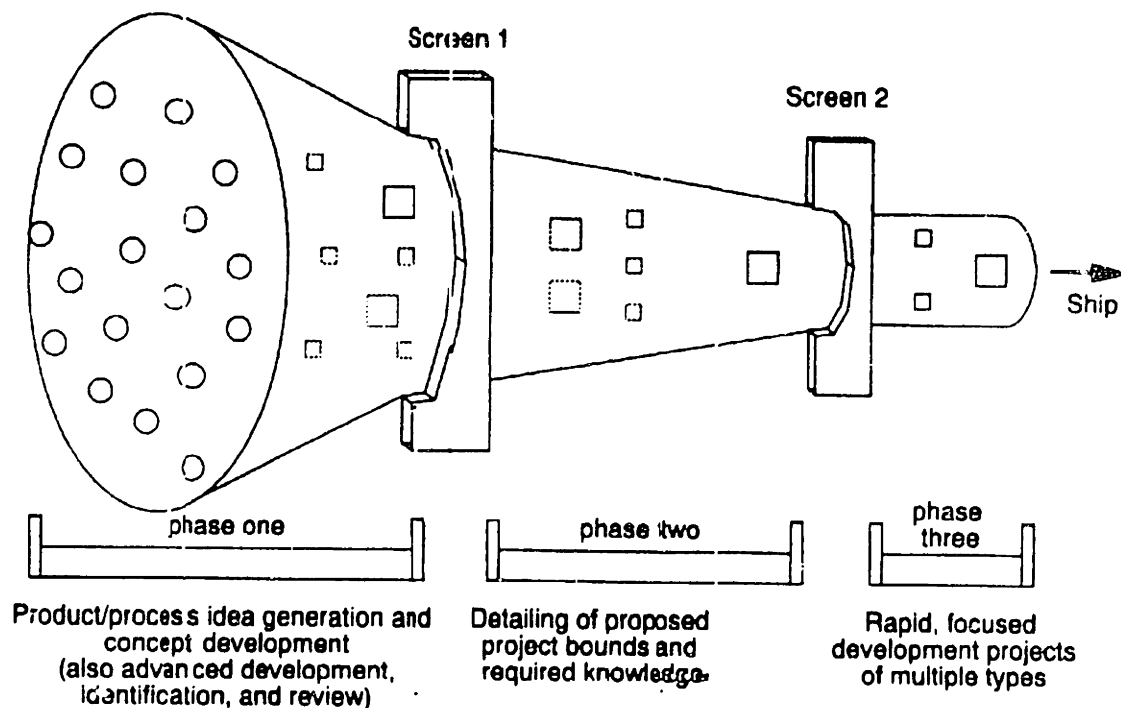
⁴⁸ Preston Smith and Donald Reinertsen, *Developing Products in Half the Time*, New York: Van Nostrand Reinhold, 1991.

⁴⁹ Ulrich and Eppinger, *Product Design and Development*, New York: McGraw Hill, 1995.

⁵⁰ Katzenbach and Smith, *The Wisdom of Teams*, New York: McKinsey & Company, 1993.

⁵¹ Gluck and Foster, "Managing Technological Change: A Box of Cigars for Brad", *Harvard Business Review*, Sep-Oct 1975, p 141. Figure reproduced from Hayes, Wheelwright, and Clark, *Dynamic Manufacturing*, New York: Free Press, 1988, p 279.

Having a technology and product strategy process allows an organization to intelligently select development projects from the wide variety of innovative ideas suggested by customers, suppliers, Marketing, Engineering, Manufacturing, etc. The process also ensures that the level and type of resources at the firm are well matched to project demands. Following a process ensures that projects are initiated and launched consistently in a manner that will promote successful execution. A decent metaphor for thinking about this process is provided in the “development funnel” proposed by Wheelwright and Clark.⁵² The metaphor is presented below in Figure 7-2 and Figure 7-3.

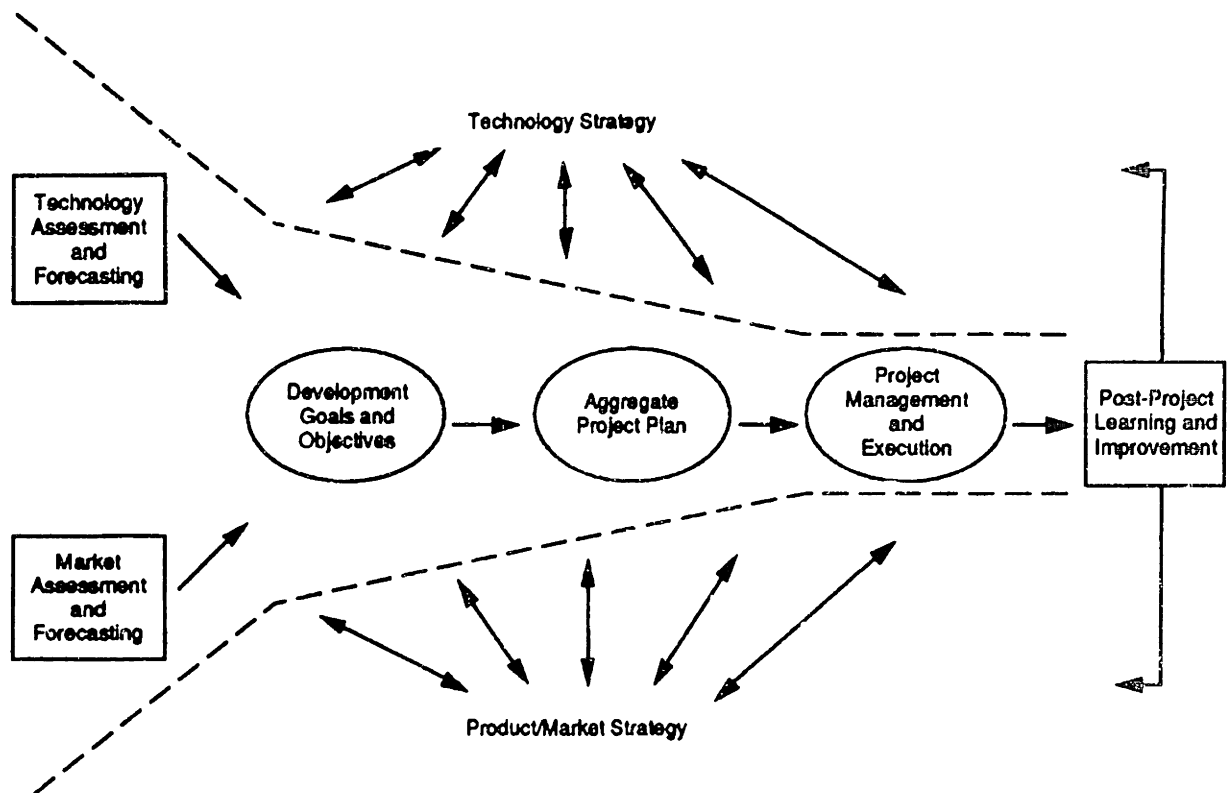


* In Model III of the development funnel, the front end (phase one) is expanded to encourage more and better idea generation. Following an initial screening, the best of those ideas are then detailed and analyzed (phase two), ready for a go/no-go decision. At Screen 2, the approved projects are staffed and moved toward rapid introduction through a focused effort (phase three).

Figure 7-2 Development Funnel as Project Filter⁵³

⁵² Wheelwright and Clark, *Revolutionizing Product Development*, New York: The Free Press, 1992, p 35.

⁵³ Wheelwright and Clark, *Revolutionizing Product Development*, New York: Free Press, 1992, p124.



* Using this proposed framework for development strategy, the technology and product/market strategies play a key role in focusing development efforts on those projects that collectively will accomplish a clear set of development goals and objectives. In addition, individual projects are undertaken as part of a stream of projects that not only accomplish strategic goals and objectives, but lead to systematic learning and improvement.

Figure 7-3 Development Funnel as Strategy Process⁵⁴

7.2 Process Overview

A summary of the process steps adopted at EquipTech is provided in Figure 7-4. In the section following the summary, we review each of the steps in the context of EquipTech's initial iteration of the process.

⁵⁴ Ibid., Wheelwright and Clark, p. 35

| Product Strategy Process Steps at EquipTech | |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>1. Articulate the Product Line Strategies</i> | <ul style="list-style-type: none"> • profile of the target segment • product line positioning relative to competitors • strategy at the product family level • road map for each platform/product line |
| <i>2. Update and Compile Development Information</i> | <ul style="list-style-type: none"> • project scope, resource loading, schedule, status • aggregate by product line and entire product family |
| <i>3. Update the Development Funnel Maps for Each Product Line (project data by development phase)</i> | <ul style="list-style-type: none"> • update the funnel for each platform and at the overall product family level • future the funnels -- develop a solid feel for the product line road map |
| <i>4. Update the Product-Benefit Maps for the Product Family (project data by market impact)</i> | <ul style="list-style-type: none"> • is effort concentrated in new platforms, derivatives, new technologies or breakthroughs? • future the map -- develop a solid feel for the product family road map |
| <i>5. Review the Resource Distribution</i> | <ul style="list-style-type: none"> • allocation versus available resources for each major competency? • allocation versus strategy and initiatives? • developing and renewing capabilities? |
| <i>6. Reconcile Strategies, Resources, and Projects</i> | <ul style="list-style-type: none"> • iterate from the "Development Funnel Maps" step until satisfied |

Figure 7-4 Product Strategy Overview

7.2.1 Marketing Strategies

The first step in the process is that of putting the marketing strategies for each product line (platform) and the overall product family in a form that can be used to effectively steer the broader organization. Strategies must be actionable; they must provide clear and specific guidance for all of the stakeholders in the business. If the strategies cannot be published in a simple format so that everyone involved in the business can understand them, there is little point in having the strategies at all.

7.2.1.2 Competitive Strategy and Positioning

The competitive strategy and positioning analysis identifies how EquipTech's products are positioned relative to competitors in their segments. More specifically, what is EquipTech's value proposition in each segment? How does it compare to each of their competitor's?

Parameters of interest include options and features, price ranges, performance, and the whole product proposition (compatibility with third-party software and equipment, support in the form of training and other services, etc.).

7.2.1.3 Product Line Road Map

A product line road map is developed at the platform (segment) level. The assessment identifies and explains for the rest of the organization the direction and strategic initiatives that EquipTech is undertaking in each segment. Technology related developments or initiatives that impact the segment are also covered.

7.2.1.4 Product Family Strategy Assessment

This assessment is conducted at the product family level. Market segment coverage and price/value points relative to competitors are addressed. Industry-wide and segment-wide trends are identified, digested, and put into perspective. Additionally, the product family road map (plan for evolution) is articulated. New segment or major business opportunities (related to the core business at EquipTech) are identified. The manufacturing product mix is roughly forecasted.

7.2.2 Development Information

In contrast to the marketing, or "what should we be doing" perspective, this analysis presents the "how are we doing" and "what can we do" perspective.

7.2.2.1 Plans and Data

For each project, we compile or update the scope (objectives), resource requirements, schedule, and status. Although these data usually exist, the problem is that they exist in different formats and in different levels of detail across projects. It can be difficult to aggregate the data

across an organization. At EquipTech, data existed in very different levels of detail for many of the projects.

Before the teaming structure had been implemented, nobody at EquipTech had a comprehensive list of all of the projects that were currently being planned or worked within Engineering. When we took it upon ourselves to develop an informal list, in excess of 50 projects were estimated. After capturing the 50+ and routing them for corrections and clarifications, the number was not substantially reduced.

In fact, the definition of what constituted a “project” presented some headaches. For some of the managers, a project was a major undertaking, lasting a year or more with various subprojects and tasks. For others, there appeared to be no overarching plans or schedules. New opportunities were simply added to the list of tasks that were currently underway for the platform. The abilities and preferences that managers exercised in planning and managing their programs varied considerably.

7.2.2.2 Putting EquipTech's Process in Place

The Engineering representative on each Product Team is also the functional Program Manager for that particular platform. For each of the projects currently underway or in the planning stages, this person updated and created a resource-loaded Gantt chart (including support resources from other functional groups). Generic resource tables and guidelines were used. Although the quality of these analyses varied considerably between groups during the initial iteration of the process, all of the resources and projects for their platforms were evaluated.

The Engineering department at EquipTech uses a software tool that, once configured, allows the department to aggregate the data from individual plans. The plans were thus rolled-up for each team and then for the entire firm to provide 18 month aggregate development schedules. Resource requirements can now be broken down by competency to the individual person or department level. The Product Teams make decisions regarding staffing and project load and are thus required to maintain the development schedules on a rolling basis.

Although these analyses could be done for all projects related to a particular platform,

EquipTech is primarily concerned with the new product development projects that are managed within Engineering. Product Teams have been granted discretion over how they would like to manage the other projects.

As previously mentioned, aggregate project data and resource requirements feed into the remaining steps of the process. These subsequent analyses allow the Product Teams to reconcile project data against the marketing product strategy.

7.2.3 Development Funnels

The development funnel analysis employed at EquipTech graphically maps each of the Product Team's projects into a funnel overlaid on the major phases of the development process discussed in Chapter 4. Funnels are created using software that we custom developed for EquipTech.

The data point for each project is sized (by area) in proportion to the number of heads currently allocated to the project. Data are color-keyed to platform. Because stand-alone software developments are often contained as separate projects in order to minimize risk, they are keyed to a separate color. Border color is keyed to strategic initiative for relevant projects. A sample development funnel for one of the Product Teams is provided in Figure 7-5.

An interesting thing happened at EquipTech as we completed and began sharing the first set of development funnels. When Marketing and Engineering team members began to jointly review the funnels, the print outs were rapidly red-lined with changes. Not because the data were bad, but because actual plans began to change. The visible presentation allowed team members to more easily share information, understand the ideas and concerns, and make better decisions. In one of the teams, a manufacturing representative began raising concerns related to the release and launch processes. With a better awareness of the stream of activity that would be hitting his floor, he wanted to ensure that the sales department would not be selling product before he had implemented and ramped manufacturing.

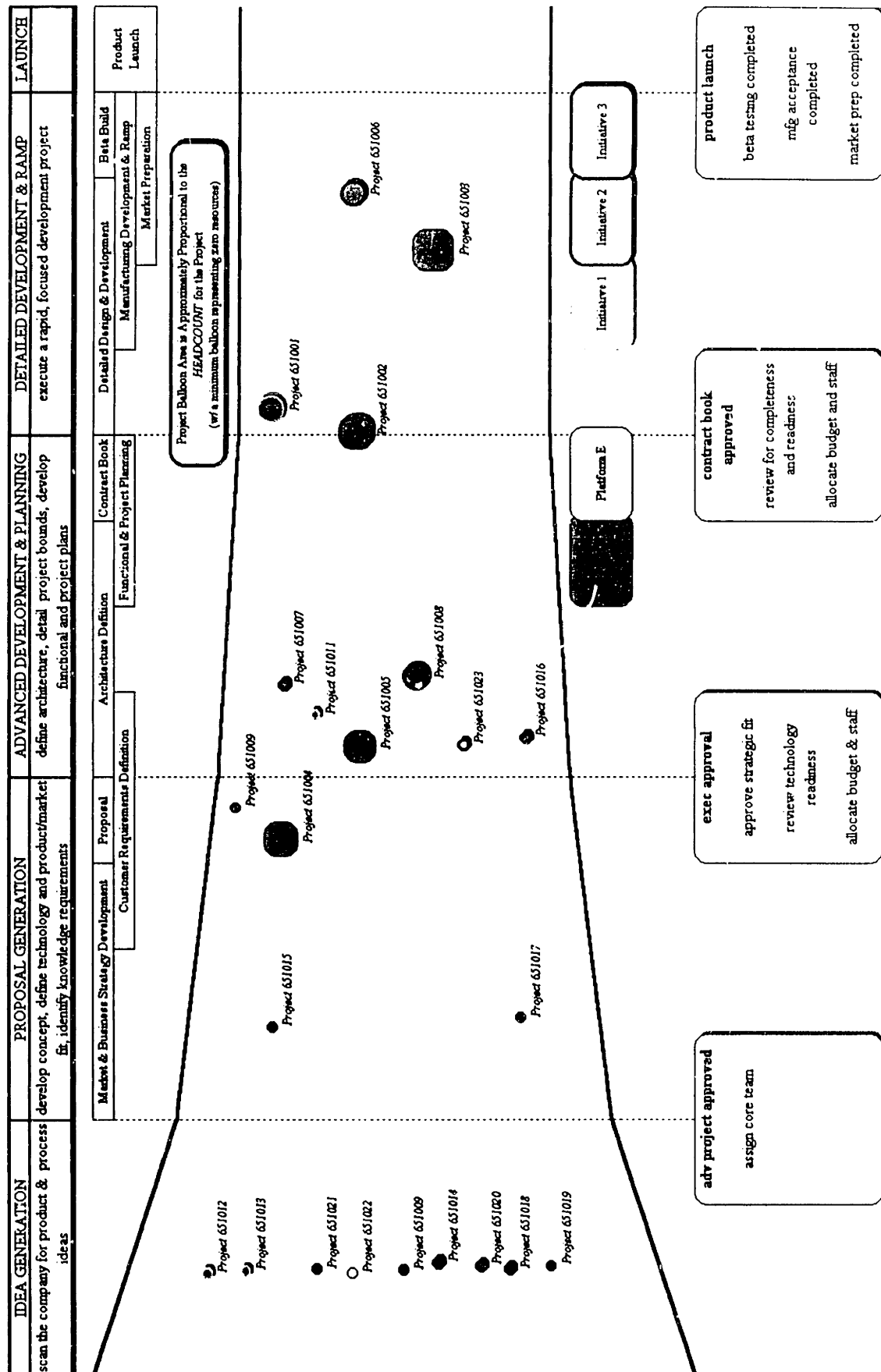


Figure 7-5 EquipTech Development Funnel Example

We present these observations to make a point. The real value in the funnel mapping exercise is not in the maps that are created, but in the process. Standard expectations with increased communication and coordination across functions results in better planning and performance. If the funnels are not red-lined, either incentives are not working or they are probably not well understood.

A thorough analysis at this step should also include futuring the funnels by 3 months, a year, or another appropriate time horizon for the business. The analysis should provide a solid feel for how product line plans will map into the development process over time.

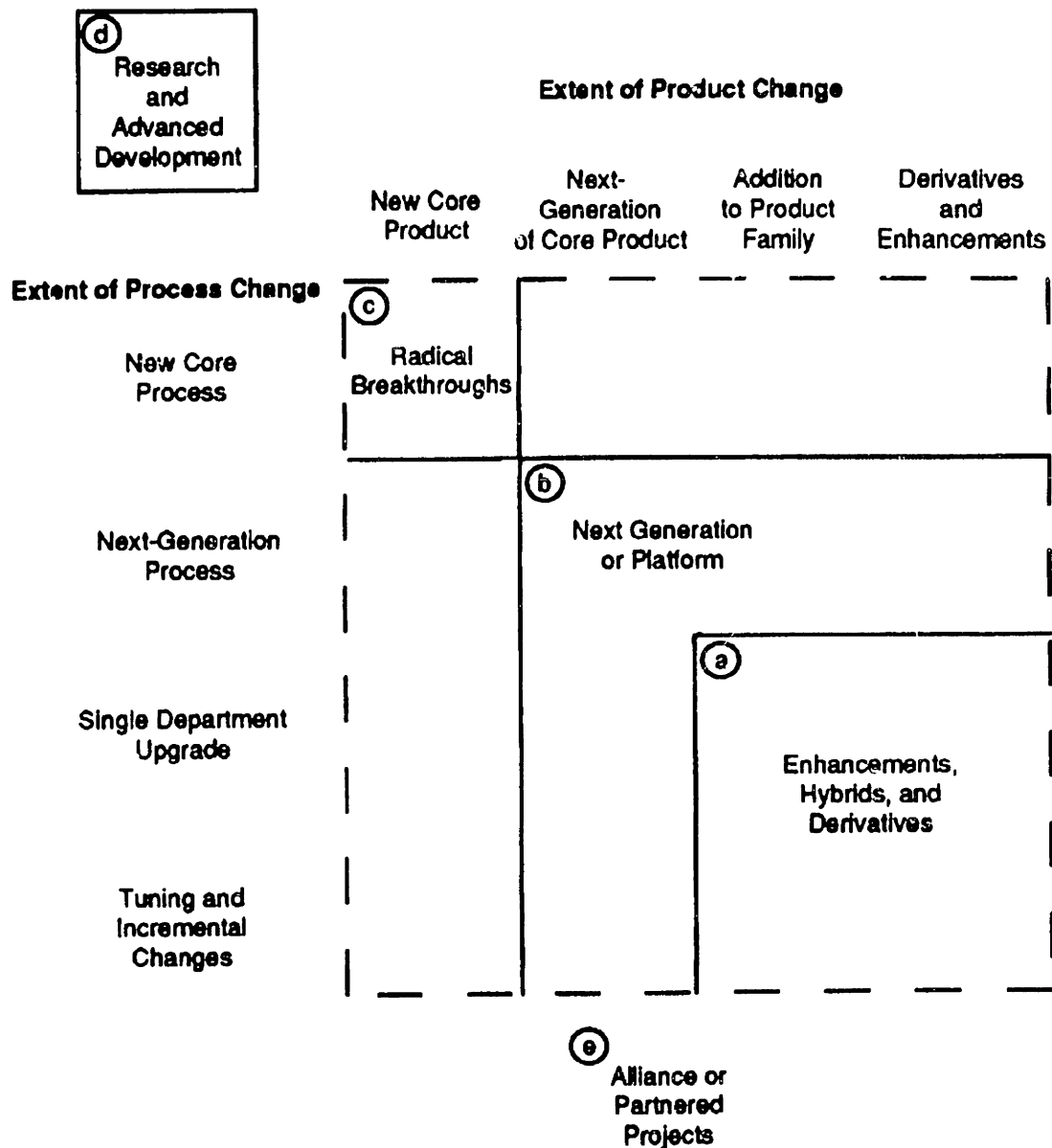
We also experimented with sizing based on estimates for revenue impact or cost. However, this activity was not as value-added because most people already had a feel for the important revenue drivers for the company.

Sizing based on headcount was found to be most useful in analyzing the product strategy. In looking at a headcount funnel, with color-keyed data spatially arranged along the development process, one could quickly get a feel for where the resources were being spent. In fact, one could stand 5 feet away from a map and still get a good perspective on what was happening in development at EquipTech. As we concluded the project at EquipTech, we were in the process of mapping all of the EquipTech projects into a single funnel for this reason.

7.2.4 Product-Benefit Mapping

The product-benefit map is similar to the development funnel in that project and strategy data are color keyed and spatially mapped for ease of interpretation and analysis. An overview of this type of framework, taken from the source for the idea, is presented below in Figure 7-6. Project data, sized by a variable of interest, are spatially mapped into the framework.

The axes adopted for the map at EquipTech are “perceived benefit to customers” and “extent of product/technology change”. A more detailed example, grossly disguised from an actual analysis at EquipTech, is presented in Figure 7-7.



* The four primary types of projects, a through d, differ in the degree of change they require in product and process technology. The fifth type—alliance or partnered—involves joint work with another organization. While any of the four types could be partnered, it occurs most often with those involving substantial change, not with incremental or enhancement projects.

Figure 7-6 Product-Benefit Mapping Concept⁵⁵

⁵⁵ Adopted with modifications from Wheelwright and Clark, *Revolutionizing Product Development*, New York, Free Press, 1992. Axes representing the extent of Product and Technology change were adopted because they are more relevant to EquipTech's business context. Axes in the original, representing the extent of Product and Process change, may be more relevant for process intensive or automated operations.

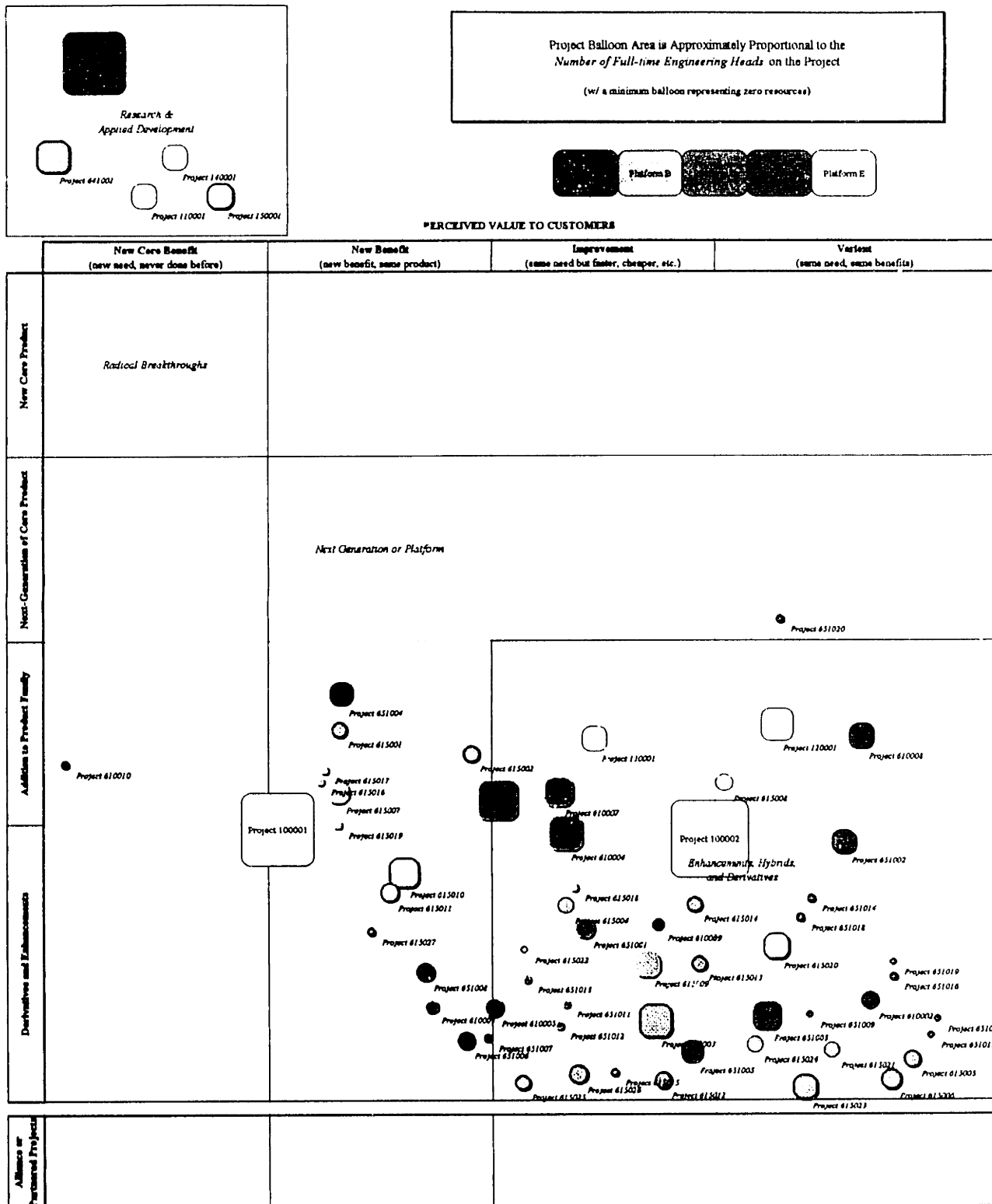


Figure 7-7 EquipTech Product-Benefit Map

In the example, one could interpret that most of EquipTech's resources are being focused on derivative projects and projects offering new benefits that are not significantly based on new technologies. This should be expected in a capital equipment business. Looking again at the map, one might question whether sufficient resources were being committed to new platforms or new technologies. One could also question whether projects were being scoped correctly, given the multitude of projects that were currently not staffed or staffed by only one person. If the presentation were in color, one could review whether resources were supporting strategic initiatives or whether resources were being adequately distributed across the product family.

The purpose of this analysis is to better understand the following.

- What types of projects is one pursuing (breakthroughs, new platforms, next generation products, derivatives, or research)?
- How do these projects map into the product lines?
- How do these projects map into strategic initiatives for the firm?
- How are resources are being concentrated across project types and initiatives?
- How are resources are being concentrated across the product family?

In performing the Product-Benefit Map analysis, we also looked at the how the map would change over time. By creating the map as it will look 3 months or a year into the future, one can develop a solid feel for how the product family will evolve over time.

7.2.5 Resource Allocation

In this analysis, we compare marketing strategy and project plans with available resources for each major competency. Three things we look at in particular are:

- What is the overall loading (% allocated) in each competency? Are we overloading or underutilizing a particular group of people? The utilization target should be, in general, less

than 100% because variation is abundant in product development.⁵⁶

- What is the number of projects per person, especially for critical or key resources?
Everyone wants high performers on their team; these people often get loaded with as many or more projects than they can handle. This is not a productive way to employ people unless they are fulfilling special needs or roles (coordinating, communicating, extremely scarce functional expert, etc.).
- How are we developing and renewing capabilities? Abilities in each of the competency areas should compare favorably with the espoused strategies and the product road maps. If we are weak in a critical area, we may want to consider adding resources or initiating projects that will develop competencies.

7.2.5.1 Fewer Projects Increases Productivity

The lack of product line planning suggested by a continuously regenerating list of tasks indicates that, in some cases, EquipTech is following a reactive strategy. If one does not actively manage the workload in a development organization, it is likely that resources will be under or over utilized. At a minimum, productivity will suffer.

There is good reason to be concerned with the number of projects each person is working on. The evidence at EquipTech suggests a potential for a productivity death spiral. As the load increases with additional projects, development staff productivity declines (see Figure 7-8). Deadlines start to slip. With new projects in addition to old projects that have not yet been completed, the staff becomes even more overwhelmed, leading to lower productivity, and so on. Eventually, the organization reaches a point where people recognize that nothing is being

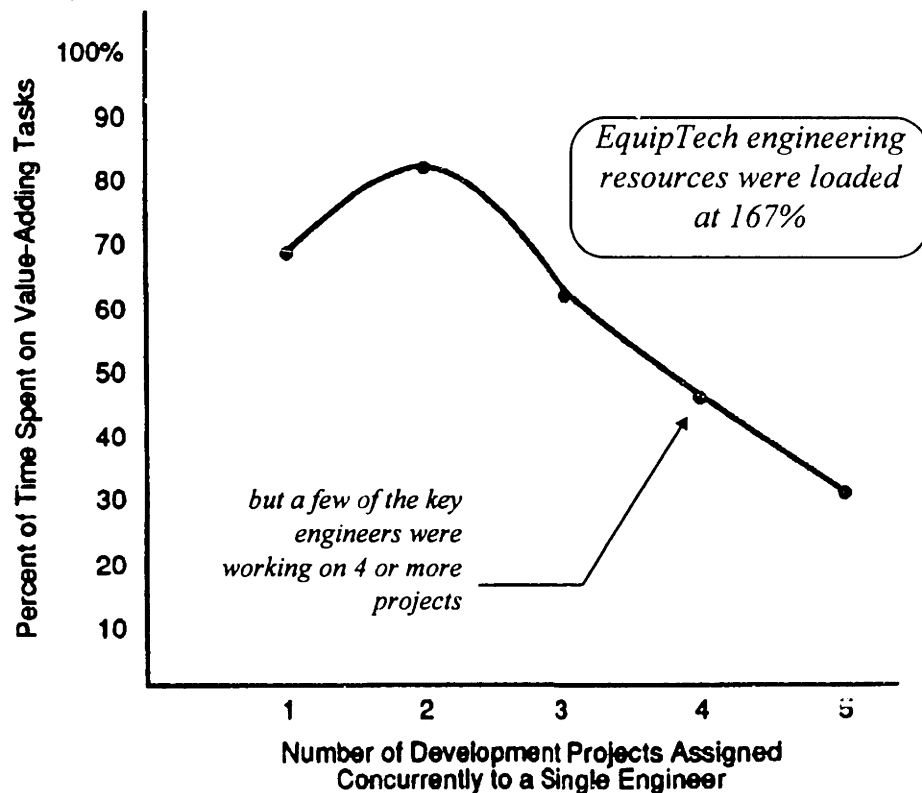
⁵⁶ In keeping with the laws of queuing theory, one cannot run a real operation at 100% utilization rates. As rates approach 100%, the ability to absorb variation is reduced exponentially. An optimal loading will be lower, trading the cost of delays against the cost of slack resources. The only intelligent way to increase utilization is thus to reduce variation in the demand or the process. Demand in EquipTech's product pipeline is likely to remain rather variable. It thus makes sense to focus on implementing a product development process that reduces uncertainty in execution and promotes minimal variation from plans.

For a technical queuing theory example, see Bitran (Gabriel) and Morabito, "An Overview of Tradeoff Curve Analysis in the Design of Manufacturing Systems", Sloan School of Management (draft paper), January 1995.

finished and new project launches slow down. The organization, however, suffers tremendously as it continues to operate at a low productivity level. Often firms adjust to this as a steady state situation until things blow up with unmet business targets or human burnout.

The chart presented in Figure 7-8 implies that often a firm can double its productivity just by reducing the number of projects and better managing the development workload.

Productivity of Development Engineering Time*



* In the studies underlying this graph, the activities engaged in by development engineers were grouped into two categories—those that added value to a development project, and those that did not. This graph shows the percent of an engineer's activities in value-adding tasks.

Figure 7-8 Number of Projects Affects Engineering Productivity⁵⁷

⁵⁷ Wheelwright and Clark, *Revolutionizing Product Development*, New York: Free Press, 1992, p. 90-1. They also recommend Liker and Hancock, "Organization Systems Barriers to Engineering Effectiveness," *IEEE Transactions on Engineering Management*, EM-22(2), 1986, pp. 82-91.

Peak productivity is achieved when most people have approximately two projects to work on and these two projects consume most of their time. A rule of thumb for a loading target might be 80-90%, depending on the amounts of variation in project scope and development process performance one expects. Overutilizing threatens a productivity death spiral. Additionally, with the exponential relationship between delay length and capacity utilization, it is better to technically challenge, but slightly underutilize people. Slack time can be used to accommodate variation, develop or renew capabilities through longer term, less time-sensitive R&D projects, and provide occasional flexibility to take advantage of emergent competitive opportunities.

7.2.6 Reconciliation

Reconciliation, the final step in the process, is hard work. In fact, this is where most of the learning and the development for participants in the process should occur. Essentially, we iterate through previous portions of the process until all stakeholders understand the product, technology, and development strategies. The process is complete when inconsistencies between the marketing strategies, available resource levels, and project plans are considered to be acceptable. In other words, the people involved in the process understand the inconsistencies and agree that the cost of additional planning would most likely outweigh any potential benefits from additional planning.

7.3 Results

EquipTech has completed the initial iteration of this process. Initial signs suggest that the process is working and working well.

The first important result following from the implementation is a marked improvement in the performance of the organization.

- The Product Teams now have an articulated road map for each of the product lines to guide decision making across the business.
- Aggregate plans, incorporating existing and potential projects, are being reconciled with marketing strategies and resource availability. Product Team representatives from

Marketing and Engineering had red-lined the product funnels for various platforms. Actual projects were being eliminated or rescheduled in terms of priority. The Engineering director was working with each of the Product Teams to address a projected shortfall in resource needs.

- The process has also made the number and type of projects needing cross-functional support very visible to personnel in Manufacturing, Sales, Service, and other disciplines that have not traditionally had a strong perspective of the development pipeline. These same people will be directly responsible for preparing and introducing the projects to the market.

A second result is that the organizational change to Product Teams has been reinforced. The product strategy process is inherently dependent on cross-functional commitment and capabilities created by the Product Teams organization. Subsequent to the reorganization, Product Teams own the marketing strategy, the aggregate development schedule, and the development resource loading for each segment. Needs are being reconciled at the local level. The Steering Team is directly involved in coordinating and managing this process across the Product Teams.

The teaming structure will be judged, ultimately, by results in the market. Results in the market follow from well executing business processes.

8. REFLECTING ON THE THEORIES

*Ultimately, what makes it possible for people to function correctly
with each other and to concentrate on their primary task
is a high degree of consensus on the management of the [internal] issues...⁵⁸*

In this chapter we present lessons learned. For the most part, the ideas presented in earlier sections of the thesis were born out in our experience. In some cases, the theories were right on target, clearly defining results that should have been expected or additional actions that could have been taken.

Similarly, our experiences at EquipTech reaffirm the perspective that managing is doing -- what counts is what one can achieve with people and measurable business results.

8.1 Technical Versus Organizational Issues

One lesson we learned, rather clearly, is that the root cause for issues that appear to be technical or specifically functional can often be traced as well to fragmentation of a business process. More specifically, issues can be traced to the lack of specific capabilities being proactively applied at the right point or at the right time. Problems with the bi-metallic part clearly illustrated this learning. Although the solution was technical, much of the effort in resolving the issue was organizational. In the short term, how would we bring technical expertise, from across the organization, to bear in resolving the problem? For the future, how do we bring the right expertise to bear in the design process so that a part that best satisfies customers and stakeholders is designed by engineering and then launched in production?

In the environment at EquipTech, with rapid growth and change, controlling the organization is an issue that cannot be taken lightly. For the sake of control, functional boundaries were

⁵⁸ Schein, Edgar, Organizational Culture and Leadership, 2nd ed. San Francisco: Jossey-Bass Publishers, 1992, p 92-3.

erected. As managers, we often are responsible for fragmenting the processes.

8.2 Executive Commitment to Change

We cannot stress enough the need to reaffirm and test the resolve of executive management in change programs. Executive commitment must be strong, coherent, and sustained when undertaking change in organizations. As we reflect on the project at EquipTech, we believe that we should have spent more time with the executive level of the firm, developing a coherent perspective of the need for change and the resolve necessary to sustain a longer term focus and commitment necessary for change.

Although we believed that the executive team shared a coherent perspective of the need for change and the project, a short term shortfall in sales resulted in the "just-do-it" launch of the program. This clearly did not indicate strong commitment or a similar perspective of the need for change.

One suggestion might be to structure significant participatory experiences to build resolve with the senior management team early in the change program. When the experiences indicate that resolve at the executive level is coherent and strong, the program can be launched for the broader organization.

8.3 Perspectives of Organization

Our experiences at EquipTech also suggest that, as was proposed by Griener, organizations develop in stages that are related to learning. This section reviews the perspectives of organization in light of the experiences at EquipTech.

8.3.1 Mechanistic Organizations

A review of the history at EquipTech suggests, indeed, that functional organizations are often implemented because they are easy to control. The functional, mechanistic organization does provide a scaleable system in times of rapid growth.

As suggested by Lawrence and Lorsch, however, mechanistic organizations work well when

the pace of change in the external environment is slow (mature products, a focused business, little competition). In an environment of rapid change and competition, as was the case with EquipTech, functional organizations often preclude the ability or accountability for local action -- mechanistic organizations can fragment the business processes.

8.3.2 Are Organizations Designed or Do They Evolve?

Experiences at EquipTech suggest that, in the absence of top-down, proactive management and design, environmental factors will dominate the development of an organization. Essentially, the organization grows by reacting to its external environment and the internal stresses of growth. In a rapid growth environment, EquipTech developed basic assumptions and capabilities that were biased towards action and task.

Evolutionary theory suggests that during evolutionary periods of growth, environmental factors strongly influence the development of capability. When crises arise, organizations often experience discontinuous shifts in development -- organizations are designed from the top down.

Considering our experience with EquipTech, we believe that organizations do not just evolve in the reactive sense. Managers can select and create experiences to provide learning or, in moderation, unfreezing stress. In trying to implement a product development process, in working to resolve a bad part design at launch, and in reviewing the performance of previous development efforts, we provided significant learning opportunities for EquipTech. These opportunities sufficiently unfroze the organization, initiating the change to Product Teams. The rate of organizational learning can be proactively managed (albeit to a maximum sustainable threshold, beyond which stress in the organization is likely to be unbearable). Top-down change, when the organization is ready, can be proactively initiated.

The experience at EquipTech further leads us to believe that Griener's characterization of organization development is interesting in the descriptive sense. We do not believe, however, that organizations necessarily follow the same stages of learning or development. For example, Griener's crisis of autonomy may be less a desire for autonomy than a desire to create working

business processes that span the organization. This type of stress might follow naturally from the functional fragmentation that was common at the time he presented his ideas. An organization structured along process or product dimensions might not encounter this type of crisis or stress at all.

8.4 Economics of Organization

Our initial experience suggests that, indeed, the economics of organization should be strongly weighed in the design and management of an organization. The tradeoff between centralization for control and decentralization for local responsiveness was one of the drivers in designing the Product Team organization at EquipTech. Galbraith's two-hat model was selected as the basis for the design. Specific knowledge exists at the functional project and product-line levels -- Product Teams provided fast, local, clearly accountable capability. We addressed the agency problem in the structure of the organization. Because each Product Team member reported functionally to a member of the Steering Team, alignment and control were maintained.

An effective control system, according to this theory, has not yet been implemented at EquipTech. A rational actor in this system has no formal incentive to perform. The control system currently has the following shortcomings:

- cross-functional, business-focused, operating metrics do not exist at the Steering Team level of the organization,
- cross-functional, product-focused metrics have not yet been defined at the Product Team level of the organization,
- individual rewards are not related to performance in the new organization at both levels.

Change is interesting; the novelty as well as informal incentives (personal relationships) may result in performance in the short run. But as people become accustomed to the system and realize that their actions in the system are not tied to incentives or measurements, performance is likely to degrade. We should expect this to happen more rapidly at the Steering Team level. This team is responsible for resolving functional conflict in the organization, trading functional needs against the needs of the broader organization. At their level in the organization, Steering

Team members are also likely to have a better appreciation for the real incentive and measurement system. Recent conversations with some of the team indicate that performance of the team may already be waning.

8.5 Lateral Organizations

A strong voluntary capability existed at EquipTech, providing a solid basis for the development of formal groups in a Product Team organization. With the firm's espoused strategy of providing the most innovative products, Product Teams were a natural dimension for organization. Our experience with EquipTech suggests that this was, indeed, a decent strategy for organization.

Ideas in the development of formal group lateral capability also suggest the following:

- a strategy for developing, managing, and leveraging competencies across functional departments needs to be clearly articulated,
- management has significant responsibilities to articulate the goals that will guide trade-offs within the organization, implement human resources practices that support the organization, and implement an incentive system that is coherent with the new system,
- information flows and systems can be critical to maintaining a constant focus across the business.

None of these have been accomplished yet at EquipTech. Without a working incentive system, the firm will most likely face significant agency problems when trying to align the focus of the teams. The teams themselves may face difficulties in getting work done. This currently is the case with one of the Product Teams.

8.6 Ideas on Culture

The theories of culture also made sense in light of our experience at EquipTech. The strong influence that founders and early leaders have in creating the basic assumptions that guide the development and behavior of organizations was clearly evident. This was most clearly

demonstrated when trying to initiate the development project. The firm, like the founders, exhibited an aggressive, task focused, “just-do-it” behavior. Engineering and innovation were considered, implicitly, to be the dominant forces in the organization.

Again and again during our experiences with the firm, we participated in situations that juxtaposed immediate tasks and an entrepreneurial bias for action against process focus and longer term solutions. This, in itself, should not be unexpected in the context of business. However, EquipTech consistently chose the task-focused path. Even in the process of reorganizing the firm, immediate concerns were addressed in a way that substantially jeopardized longer term gains. This experience highlights the pervasive nature of culture, and the difficulty in changing culture.

As we discussed in Assumptions Derived from Internal Integration Issues on page 14, issues of authority, hierarchy, power distribution, etc. often consume energy in organizations. Everyone, no matter who they are, possesses a limited cognitive capacity for processing information. Schein suggests that unless the issues related to how people work together are consensed (not necessarily correct), people in the organization will spend a good fraction of their capacity dealing with issues of internal integration rather than focusing on issues of external survival for the firm. Individuals strive to define rules that allow them to better understand and cope with what is happening. The “just-do-it” launch of the new organization has called into question many of these issues. EquipTech, having only partially implemented the infrastructure necessary to support Product Teams, is currently exhibiting many of these stresses. Two of the three Product Teams that have been implemented could be viewed as successful. As previously mentioned, the other is suffering tremendously, testing the new structure with every opportunity they have. A significant, but diminishing portion of the Steering Team's focus is spent clarifying roles and relationships for the new organization.

Our experience highlights that organizational change programs must be comprehensive in nature. As presented in the “star model”, tasks, people, incentives, career paths, and clearly defined business processes must all be coherent and aligned with the strategy of the firm.

8.7 Reflecting on the Change Process

The behavioral change analogy also appears to be relevant, given our experience with EquipTech. Unfreezing and organizational learning were successfully accomplished through a series of individual projects. Cognitive redefinition successfully occurred through the teaming proposal and in chartering exercises with the Steering Team.

However, change at EquipTech has been only partially refrozen. Processes for forecasting and product strategy have been implemented. The product development process is currently on the table. But reinforcing mechanisms, in the form of career paths, measurements and incentives, and other business processes, have not yet been established.

The behavioral change analogy suggests that without significant reinforcing mechanisms, the organization will face pressure to return to the previous, task-focused way of conducting business. EquipTech has one foot in Product Teams, but the other is stuck in the traditional, functional way of conducting business. Things will be painful and processes will remain fragmented until the other foot is unstuck and sufficient reinforcing mechanisms are implemented.

8.8 Technology and Product Strategy

The technology and product strategy ideas worked well at EquipTech. Communication between key stakeholders at the Product Team level has improved tremendously. Marketing has been able to share a well-defined strategy for the product line. Engineering has developed better program data and a better understanding of Marketing priorities. Manufacturing, Service, and the other functional specialties now better understand the pipeline and expectations for each product. They are able to participate in and influence planning at the Product Team level. In fact, one of the Manufacturing representatives began raising the need to more critically review the relationship between the marketing and sale of new products and the manufacturing launch process.

Of the specific analyses that were performed, the Product Funnel mapping exercise appeared to provide the greatest benefits to the firm at this point in time. This analysis forced Engineering

and Marketing to better document and share with the rest of the organization their assumptions and plans. Ideas could then be reconciled with key functional stakeholders in a very graphical, easy to understand manner. The Product Funnel analyses have made clearly visible the need to improve the product development and new product introduction processes, as well as to balance functional capacity for supporting development projects.

Product-Benefit Maps appeared to be less useful to the organization at this point in time. The one primary need they did address was that of seeing the data for all of the projects in a single presentation format. We believe that as the organization moves down the learning curve, addressing many of its first-order concerns, Product-Benefit mapping may become more relevant.

8.9 Process Versus Theories

One idea has been reinforced more clearly than any of the others. What needs to be done can be very clear in light of the theories and our experiences with the firm. Yet the process of getting people to do what we believed needed to be done has presented an entirely different, and more difficult challenge.

As we mentioned in the opening chapter of this thesis, the difficult part of management often lies not in understanding what needs to be done, but in process. As a leader and manager, the process is one of controlling the rate of change. One is faced with the challenge of managing the level of stress in an organization: balancing the need for long term learning and improvement with the need for security and action (getting the work done).

The next, and final chapter of this thesis presents, in detail, our closing perspective on the easier part of managing change. We present specific ideas and recommendations for the leaders at EquipTech as well as conclusions for this project.

9. CONCLUSION

... what often goes wrong in change programs is that we manipulate some assumptions while leaving others untouched. We create tasks that are group tasks, but we leave the reward system, the control system, the accounting system, and the career system alone.⁵⁹

In this final section of the thesis, we review major themes that have been presented in the preceding chapters. We identify future work that can be completed to reinforce the changes at EquipTech in order to provide lasting value for the firm. Specific recommendations are delivered. We complete the chapter, and this thesis, with reflections on the project and closing remarks.

9.1 Review of the Thesis

We opened up our presentation with a brief overview of the subject and the goals for this project. The first major section of the thesis provided context and background supporting subsequent work with a review of perspectives in organization design, the economics of organization, models of organizations, and change theory. What culture is and dimensions of culture were briefly covered.

The second major section of this work focused on application of the ideas. We reviewed the context for a project with EquipTech. The firm has experienced tremendous growth as the result of strong entrepreneurial leadership, aggressive product marketing, and innovative design. Management at the firm was interested in “improving the way our products transition into manufacturing.” A characterization of EquipTech along many of the dimensions of culture indicated that the firm is aggressive, reactive, and task focused. We reviewed our experiences with the firm and an initial attempt to improve the product development process. Subsequently,

⁵⁹ Schein, Edgar, Organizational Culture and Leadership, 2nd ed. San Francisco: Jossey-Bass Publishers, 1992, p 141.

a proposal for change, laying the foundation for improvement at many levels of the business, was articulated. We presented the hypothesis that EquipTech would be better served by an organization structure that brought more direct responsibility and focus onto business processes. We discussed the plan for change, as well as the actual change process.

In the third major section of the thesis, we presented early results from the implementation of the organization. We reviewed a process for developing technology and product strategy and discussed results achieved within the new structure. The product strategy process had significantly improved the working relationships between various functional stakeholders. Furthermore, the product development pipeline had significantly evolved -- the firm shelved some projects and raised the priority for others. Finally, in light of our experiences with the firm, we reviewed the theory and ideas presented in the early chapters.

9.2 Recommendations for EquipTech

In many instances, 6 months was not long enough a period of time to complete the work that we have initiated. As we completed the project, the organization had evolved towards a tiered team structure organized around product line. A Steering Team and three Product Teams had been launched. Four key business processes were in various stages of implementation or development.

EquipTech has struggled over time with internal issues of integration as a result of their growth rate. The firm now faces a challenge of unprecedented importance. It is imperative that the transition to Product Teams continues, but that it continues in a manner that minimizes uncertainty in the internal issues. Significant efforts will be required in order to make this happen.

Specifically, I have four recommendations.

1. Reaffirm senior management commitment and support. I believe, in hindsight, that we did not spend an adequate amount of time building the coherent focus and commitment necessary to sustain a program of change. If, in revisit the goals in pursuing this program of

change, strong support and consensus are found, then the goals and vision should be made clear for the organization. If not, then an alternative perspective should be developed. Inaction will not solve the concerns that EquipTech faces. It is a primary responsibility of management to ensure that demands and requirements being placed on the organization are both coherent and explicitly understood.

This project was initiated with commitment from the senior management team, but without a senior operations manager in place. We proceeded anyway with the understanding that such a person would be brought on board in the near future. We believed that our efforts would better prepare the organization for such a person. More importantly, whoever eventually becomes the operations leader at EquipTech must be given the opportunity to shape the organization and make it their own.

The process needs a champion. In the absence of an operations manager, one of the existing senior managers should take formal ownership of the effort. This would go a long way towards reducing uncertainty in the organization. It would also go a long way towards maintaining a proper perspective on important issues at the Steering Team level.

2. Implement a clearly articulated set of measurements and metrics for the organization.

Decide what metrics are necessary and appropriate for managing the operation. Cascade these down, if necessary, so that they are meaningful to the Product Teams. Implement and refine measurement processes to obtain relevant data. Trend the data over time.

I spent the last month of the project trying to bring a focus on measures and metrics that are coherent with the changes we made. Although measurements and metrics were being discussed, I was not successful in bringing the issue to closure.⁶⁰ I believe strongly that

⁶⁰ I was able to bring the issue into focus with the group that will ultimately be responsible for this. Additionally, I was able to develop in the VP Marketing a champion to drive the process forward. However, a phone conversation 8 weeks after my departure suggested that no concrete actions had been taken. The team had overwhelmed itself with immediate tasks.

unless appropriate metrics, incentives, and information flows⁶¹ are implemented, the changes we put into place are in danger of unraveling. In retrospect, I believe that implementing a measurement system earlier in the program would have been more beneficial for the firm.

3. Align the incentive and human resource systems with the new structure. The incentive system sends a clear signal to the organization, telling them what is really important. Career expectations and the human resource system also need to support the new focus. People watch what you do and pay attention to how you measure them. They do not care as much about what you say.

Unless the incentive system is aligned with the new structure, I believe that the organization will be significantly stressed, especially at the Product Team level. Career development and planning systems should also be carefully reconsidered in light of the changes that have been introduced. Incentives and expectations must be clearly articulated if the stresses of internal integration are to be minimized.

4. Focus on business processes. Continue implementing and improving the "nuts and bolts" of the business. Processes are where the value is added for customers.

Business processes are the reason we recommended and began implementing this change in the first place. Improving and implementing new processes can solidify the new structure as well as the future for EquipTech. Significant efforts to clearly establish the new processes should continue.

9.3 Opportunities for Future Work

This thesis has been, above all, an exploration of the transition that firms make as they grow from entrepreneurial origins into larger, more organizationally focused, process-competent

⁶¹ I do not mean information technology. I refer to the information itself and information flows. In the short run, technology is one possible (but sometimes rigid, expensive, and time consuming) way to address this need. IT should be carefully considered as a source of leverage once the needs are better understood.

businesses.

It would be interesting to review the histories of other firms more systematically. This experience provides one data point in a potentially larger study. What are the types of stresses or experiences that, in the aggregate, have shaped the development of maturing entrepreneurial firms? Are there even conclusions that hold in the aggregate? Are there common pitfalls that can be avoided or, as Griener suggested, stages of development that should be expected?

Additionally, this study provides a window into the development of a particular firm. The firm manufactures capital equipment for the electronics industry, serves one major niche, and sells to a world market. After 5 years of very rapid growth, the firm is beginning to mature. It would be useful to be able to peer through windows into other entrepreneurial firms, in different stages of development or in different industries.

9.4 Final Thoughts

I enjoyed working with the people at EquipTech. They stand apart as bright, fresh, and aggressive in comparison with many of the other organizations I have experienced. I am proud of what we have accomplished in the short period of time I spent with the firm.

This internship provided the opportunity and the context to practice many of the ideas I have been taught at MIT. Ultimately, this project helped the leaders at EquipTech begin organizing their company for the future, transferring responsibility to less senior managers and leveraging the abilities of a broader cross-section of the firm. I know we have started down a path that will improve their ability to compete over the long run. I hope more than anything that we have helped them develop a managerial focus on process. Time will ultimately tell.

10. APPENDIX A: DIMENSIONS OF CULTURE

10.1 Assumptions Derived from Internal Integration Issues

10.1.1.1 *Internal Integration (Becoming a Group)*

- definition of a common language and conceptual categories, ability to communicate
- group boundaries and criteria for inclusion and exclusion: who is in or out, criteria for membership
- distribution of power and status: pecking order + criteria and rules for getting, maintaining and losing power
- norms of intimacy, friendship, and love
- defining appropriate behaviors, rewards and punishments
- explaining the unexplainable -- beliefs that have developed to avoid the anxiety of dealing with the unexplainable or uncontrollable

10.1.1.2 *Consensus Within the Group*

- preoccupation w/ position and identity
- insecurity
- unknown rules of the game = cannot predict or understand what is going on

10.2 Assumptions Derived from Issues of External Survival

10.2.1.1 *Mission and Strategy: the shared understanding of core mission, the primary task and the purpose for the organization*

- balance of stakeholder needs
- beliefs about core competencies
- beliefs about basic functions in society

10.2.1.2 *Goals: derived from the core mission, goals are concrete and facilitate decision making regarding the means used to achieve the goals*

- consensus on meaning and purpose of key functions
- different levels of abstraction
- different time horizons

10.2.1.3 Means: the appropriate day to day behavior to achieve goals, internal issues of status and identity

- what appropriate skills, technology, and knowledge are, how they are developed, how they are employed
- basic design of tasks
- division of labor -- consensus on who owns what: how important is territory, property and turf, what are appropriate limits, how is it divided
- organization structure -- which groups dominate (strongly related to the founder's beliefs and influence)
- reward and incentive systems
- control and authority system
- information systems

10.2.1.4 Measurement: the criteria and information systems for measuring fulfillment of goals

- Who decides truth or acceptability?... self, boss, market data, staff expert(s)
- What are the appropriate criteria for deciding?... financial, customer satisfaction, market share, employee morale
- What is the appropriate time horizon for making evaluations?... daily, monthly, quarterly, annually

10.2.1.5 Correction: the appropriate diagnosis and remedy processes for when goals aren't being met

- will reveal other assumptions about mission and identity, close connection to assumptions about internal functioning
- local processes: focus on the individual, focus on strategy for particular problem
- global processes: reassess quality of information and processes (R&D, etc.), convene a diagnostic team for cross-functional learning... can result in widespread open debate leading to self corrective action
- other processes: brush the problem under the rug, move people into different jobs

10.3 Assumptions Derived From Leadership Perspectives

10.3.1.1 Nature Of Reality And Truth

- what is real, what is not?
- is truth revealed or discovered?
- how is truth ultimately determined

- pure dogma, tradition or religion (always done this way)
- revealed dogma or wisdom, from the authority of wise men or formal leaders... "president wants it this way" or "consultants recommend"
- derived by "rational-legal" processes... socially determined, given by an "appropriate" person or committee, the result of voting, etc.
- survives conflict and debate
- pure pragmatism, that which works
- established by research or science... becomes dogma-like

10.3.1.2 Nature Of Time (Observed Artifacts?)

- orientation and appropriate context in which to think and act, the appropriate concept and perspective in time
 - how things used to be, immediate tasks, quarterly results, distant future (long term R&D, etc.)
- how is time defined and measured (strong cultural attribution)?
 - monochronic time: medium is defined by a linear ribbon, infinitely divisible, one thing at a time, punctuality and efficiency are valued, suited to situations requiring coordinated action
 - polychronic time: medium is defined by what is accomplished instead of the clock, several things at a time w/ each in suspension until it is finished, relationships are valued, good for solving complex problems w/ scattered and interactive information
- discretionary horizons (context sensitive)
 - appropriate definitions of "soon", "on time", accuracy in time measurements, or "far off" depend on function, occupation, and rank
 - temporal symmetry and pacing: how are activities paced relative to each other (monochronic vs. polychronic)... "Time imposes a social order: How things are handled in time can convey status and intention"

10.3.1.3 Nature Of Space (Observed Artifacts?)

- how is space allocated and owned?
- symbolic meaning of space around a person
 - status relationship to amount of space?
 - who gets the good space? conference rooms vs. senior offices
- role of space in defining personal relationships
 - appropriate norms for intimacy distance, personal distance, social distance, and public distance

10.3.1.4 Nature Of Human Nature

- attributes that are considered intrinsic or extrinsic... how are people motivated, workers and managers viewed?

- humans are rational-economic actors
- humans are social animals with social needs (Maslow's hierarchy)
- humans are problem solvers and self-actualizers with the need to be challenged and use their talents
- no universal theory... human nature is complex and malleable, variable
- human nature is good, evil, or neutral? (McGregor's Theory X vs. Theory Y)
- are humans perfectible or not?
- importance of individual people relative to the organization

10.3.1.5 Nature Of Human Activity -- Right Things To Do Given The Previous Assumptions

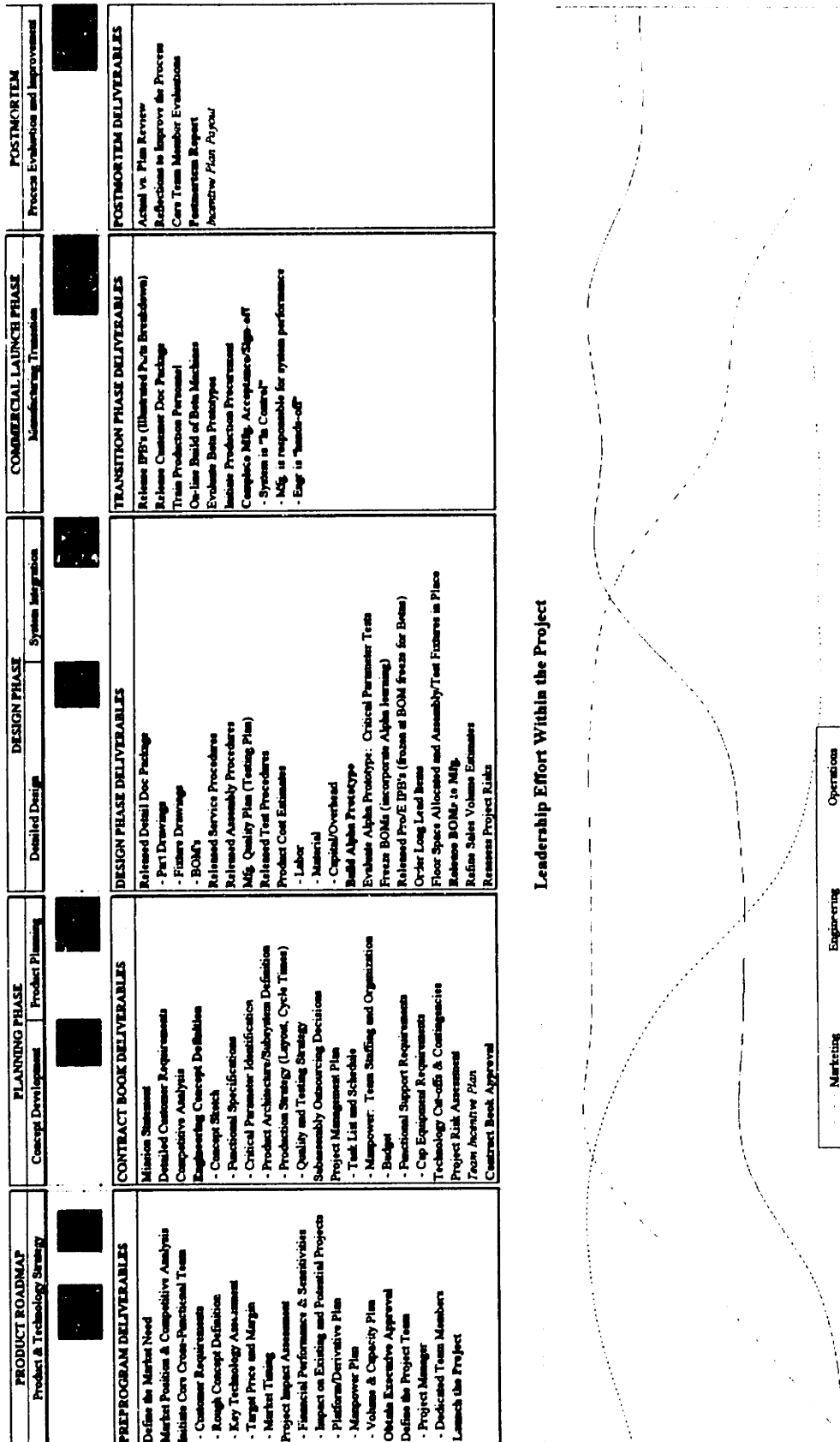
- appropriate level of activity or passivity
 - Doing Orientation: "proper to take charge and actively control your environment"... focus on task, efficiency, and discovery following from assumptions that humans are perfectible and that nature is pragmatic - it can be controlled and manipulated
 - Being Orientation: nature is powerful, humanity is subservient to it... think of adapting to realities rather than creating markets or dominating some portion of the environment. One cannot influence nature -- one must accept and enjoy what one has.
 - Being in Becoming Orientation: individual must develop personal capacities and achieve perfect union with the environment... emphasize rules, hierarchy, clearly defined roles to curb impulses and achieve developmental perfection. Assumes that impulses are dangerous and must be controlled, expressions of emotion are good or bad. Focus on what the person is rather than what the person can accomplish.
- relationship of the organization to its environment (dominate and change it, react to it, co-exist with it)
- what is work, what is play?
 - work, family, or self interest is primary?
 - separation of self from aspects of society?

10.3.1.6 Nature Of Human Relationships -- The Right Way For People To Relate To Each Other

- norms for interpersonal relations
 - power, influence, hierarchy
 - intimacy, love, peer relationships
- individualistic, group collaborative, or communal?
 - who is source of good ideas
 - value of hierarchy, formality, protocol
 - life is cooperative or competitive?

- appropriate basis and exercise of authority
 - how is authority derived: lineal tradition, moral consensus, law, charisma
 - assumptions on how authority to be exercised?
 - appropriate level of participation and involvement
- role relationships
 - emotionally charged or neutral? what degree of emotion is appropriate?
 - diffuse or specific (expect family and social relationship or expect simply a business relationship)
 - universal (for a given position) or individualistic criteria
 - ascription (birthright) or achievement-based social rewards
 - actions are self vs. collectively oriented?
- psychological contract between employer and employees?
- how should conflict be resolved?
- how should decisions be made?

11. APPENDIX B: STRUCTURED DEVELOPMENT PROCESS



| |
|-------------------------------|
| PRODUCT ROADMAP |
| Product & Technology Strategy |

Exec
Approval

Launch
Team

| |
|--------------------------------|
| PREPROGRAM DELIVERABLES |
|--------------------------------|

Define the Market Need

Market Position & Competitive Analysis

Initiate Core Cross-Functional Team

- Customer Requirements
- Rough Concept Definition
- Key Technology Assessment
- Target Price and Margin
- Market Timing

Project Impact Assessment

- Financial Performance & Sensitivities
- Impact on Existing and Potential Projects
- Platform/Derivative Plan
- Manpower Plan
- Volume & Capacity Plan

Obtain Executive Approval

Define the Project Team

- Project Manager
- Dedicated Team Members

Launch the Project

| PLANNING PHASE | |
|---------------------|------------------|
| Concept Development | Product Planning |

Concept
Defined

Contract
Book
Approved

CONTRACT BOOK DELIVERABLES

Mission Statement

Detailed Customer Requirements

Competitive Analysis

Engineering Concept Definition

- Concept Sketch
- Functional Specifications
- Critical Parameter Identification
- Product Architecture/Subsystem Definition
- Production Strategy (Layout, Cycle Times)
- Quality and Testing Strategy

Subassembly Outsourcing Decisions

Project Management Plan

- Task List and Schedule
- Manpower: Team Staffing and Organization
- Budget
- Functional Support Requirements
- Cap Equipment Requirements

Technology Cut-offs & Contingencies

Project Risk Assessment

Team Incentive Plan

Contract Book Approval

| DESIGN PHASE | |
|-----------------|--------------------|
| Detailed Design | System Integration |

Alpha
Built

BOMs
Released

DESIGN PHASE DELIVERABLES

Released Detail Doc Package

- Part Drawings
- Fixture Drawings
- BOM's

Released Service Procedures

Released Assembly Procedures

Mfg. Quality Plan (Testing Plan)

Released Test Procedures

Product Cost Estimates

- Labor
- Material
- Capital/Overhead

Build Alpha Prototype

Evaluate Alpha Prototype: Critical Parameter Tests

Freeze BOMs (incorporate Alpha learning)

Released Pro/E IPB's (frozen at BOM freeze for Betas)

Order Long Lead Items

Floor Space Allocated and Assembly/Test Fixtures in Place

Release BOMs to Mfg.

Refine Sales Volume Estimates

Reassess Project Risks

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| COMMERCIAL LAUNCH PHASE |
| Manufacturing Transition |

Manufacturing
Acceptance

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| TRANSITION PHASE DELIVERABLES |
| Release IPB's (Illustrated Parts Breakdown) Release Customer Doc Package Train Production Personnel On-line Build of Beta Machines Evaluate Beta Prototypes Initiate Production Procurement Complete Mfg. Acceptance/Sign-off <ul style="list-style-type: none">- System is "In Control"- Mfg. is responsible for system performance- Engr is "hands-off" |

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| POSTMORTEM |
| Process Evaluation and Improvement |

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| Postmortem Report |
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| POSTMORTEM DELIVERABLES |
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| Actual vs. Plan Review Reflections to Improve the Process Core Team Member Evaluations Postmortem Report <i>Incentive Plan Payout</i> |
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12. REFERENCES

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