THE MIT LEADERS FOR MANUFACTURING PROGRAM:

A CASE STUDY OF IMPLEMENTING CHANGE

by

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ABSTRACT

Beginning in the summer of 1988, MIT enrolled the first class of the Leaders for Manufacturing program, a program offered jointly between the School of Engineering and the Sloan School of Management. The program proposes significantly new ways of educating future manufacturing managers and of researching the problems of the manufacturing environment. It calls for departures from familiar intellectual frameworks and from how MIT and the involved schools normally operate. As such, the Leaders program is an attempt at significant change.

This paper examines this change effort, in progress at the time of writing. The analysis presented describes the MIT environment, the context within which the change is occuring, with the aid of several models of how universities function as organizations. It explores the nature of intellectual frameworks, or "paradigms", and how those paradigms can be shifted. It describes a model for organizational change which is later applied to the case under study.

The context and the models are then used to explain the position of the Leaders program within MIT and analyze its prospects for effecting the changes it proposes. The analysis draws upon extensive personal interviews conducted with senior and junior faculty involved with the Leaders program, as well as observations of Leaders meetings and study of Leaders planning documents.

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A NOTE OF THANKS

Any organization that opens itself up to scrutiny deserves the appreciation of the case writer. I want to thank Kent Bowen and Tom Magnanti for their interest in this project and their efforts in opening doors for me. I also want to thank the many faculty, administrators, and students who gave their time to talk with me about the program. The Leaders program and the people driving it forward gained my admiration. I believe the program holds out tremendous promise to the fellows, faculty, and corporations who become involved with it. I also believe that MIT, as an organization, could be positively influenced by the changes the Leaders program seeks.

Bob Thomas deserves special thanks. He was flexible and helpful throughout an extended period of time when we tried to make arrangements with a few different organizations to work with them on a case study of implementing change. He gave his intellectual support and criticism, met tight time schedules, doubled as a reference librarian, yet maintained an ethical distance from confidential information concerning a program of which he is an integral part. He was a supervisor in the best sense of the word.

Finally, I want to thank my wife Julie. She supported me through the trials and successes of this work, as she has supported me throughout my Sloan experience. She was a sounding board for ideas, and a great production help at the end.

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CHAPTER 1

INTRODUCTION

The Leaders for Manufacturing - Creating Change

Beginning in the summer of 1988, MIT enrolled the first class of the Leaders for Manufacturing program, a program offered jointly between the School of Engineering and the Sloan School of Management. The two year program offers study in management and in one of any of five engineering disciplines. Study culminates in a single thesis leading to two Master of Science degrees, one from Sloan and the other from the engineering discipline chosen. The program is funded by a select group of eleven leading manufactuinrg companies. The curriculum, according to the program brochure, "is designed to educate a new generation of manufacturing leader by bringing together managememt and engineering."

To many, within MIT, and within academia and industry at large, the program's approach to manufacturing education is seen as innovative and appropriately integrative. An article in the October 1988 issue of Manufacturing Review reviewed it as follows:

> Because the practice of manufacturing is essentially interdisciplinary, graduate programs should be structured so as to instill significant breadth, along with deep knowledge in some particular area of practice. This is a difficult balancing assignment, and means that effective graduate programs in manufacturing engineering can not be cut from the same cloth as those of disciplinary-oriented traditional engineering programs. One new and novel program which exemplifies

this point of view is the "Leaders for Manufacturing" program started in June of 1988 at MIT.[1]

As the review above suggests, conceiving, initiating, and sustaining such a program is a "difficult balancing assignment." It is a difficult assignment intellectually and organizationally. It involves the integration of two (or more) intellectual traditions, each of which maintains distinct approaches to research and teaching. This assignment involves the commitment and coordination of loosely linked groups (sponsors, students, senior and junior faculty, administrators, and so on). Significant departures from familiar intellectual frameworks, and from how MIT and the involved schools normally operate are implied. As such, the Leaders for Manufacturing program is an attempt at significant change.

Managing Intellectual and Organizational Change

This thesis will focus on two key problems that confront efforts -- like the Leaders program -- to establish a new agenda for research and teaching. The first problem (or challenge) involves accomplishing a paradigm shift, i.e., the reconstruction or "reframing" (Kuhn, 1962; Bartunek, 1988) of the intellectual models of research. The specific objective is a new and distinct intellectual basis for manufacturing education and research.

The second problem involves the process of organizational change which is likely to

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[1] Philip Francis, et. al., "The Academic Preparation of Manufacturing Engineers: A Blueprint for Change," Manufacturing Review, vol. 1, no. 3, October 1988, p. 162

accompany a paradigm shift. Universities such as MIT owe their structure and process to hundreds of years of organizational evolution. By contrast to most forms of private enterprises, the university is typically less structured, is virtually dependent upon the autonomous, voluntary actions of its members, and generates sub-groups that often share more in common with their peer sub-groups at other universities than with another sub-group located in the next building. Thus, efforts to change a university's organization requires an approach cognizant of and tailored to the particular norms and habits of these groups. This analysis will attempt to characterize MIT's organization and examine the efforts of the Leaders program to effect an organizational change at MIT.

The Importance of Understanding the Context for Change

All change occurs within a context. The context helps to define the range of actions considered in any change effort. It suggests paths of least and greatest resistance. Understanding the context for any change effort is essential for effective implementation. The analysis in Chapter Two focusses on two key aspects of the context: the intellectual and the organizational. The nature of paradigms is explored and close attention is given to how they change. The intellectual context is then matched with its organizational context. From a preliminary discussion of universities as organizations, I focus on the structures and processes which support paradigms and, following from the dynamics of a paradigm shift, I draw attention to the organizational changes which may have to be made in order to cement the Leaders program. Because universities are exceptionally complex organizations, the discussion is selective, highlighting issues of particular importance to the Leaders program.

Analyzing Change as it Happens

Chapter Two will employ a widely-used model of organizational change as a framework for understanding what the Leaders program has accomplished to date and what future actions it could pursue in its efforts to create change. The model, developed by Richard Beckhard and Reuben Harris (1977, 1987), stresses consensus-based decision making, an approach appropriate for university settings. It is thorough, and touches upon all elements of change: from creating a vision, to clarifying the motives for change, to identifying the obstacles to change. It offers an applied approach, naming and describing concrete steps a change manager can take throughout the process. Because the Leaders program is in the midst of its change effort, such an approach could be useful to those currently guiding the program.

Chapters Three through Eight build from the intellectual and organizational contexts, and the Beckhard/Harris change model, to take stock of the efforts being made by the Leaders program. The program is viewed as a change effort, attempting to achieve a vision, as well as to manage itself, its resistance and its base of support. One simple analytical tool, the Force Field Analysis (Lewin, 1947), is especially useful in organizing the diverse factors that affect the program's progress. The Force Field Analysis is a visual way to array the forces which support or resist a desired change. By building two comumns and putting opposing forces on right and left hand columns, the relative balances between supporting and resisting forces can more easily be assessed. Certain forces will carry more weight than others, so the analysis needs to take into account the intensity of each force as well as the number of forces on each

side.

After creating such an array of forces, the tool then allows dynamic thinking about the balance portrayed: What happens to the balance if another supporting force is added? What happens if a resisting force is neutralized? Is the battle won, or do more need to be neutralized? What is the relative strength of each force? Can supporting forces be further enhanced? How many forces can effectively be addressed at once?

The final chapter, Chapter Nine, summarizes the application of the Beckhard/Harris model to the Leaders' change effort, and speculates about how successful the program will be. This speculation draws heavily upon the preceding analysis, but does not filter out the author's less tangible impressions and feelings.

Research Methodology

The analysis in the thesis is based upon interviews with faculty and students, attendance at Operating Committee and Research Committee meetings, primary and secondary documents, and literature ranging from theories of change and scientific revolutions, to the organization of universities, to the education of engineers and business managers.

Over the months of March and April, 1989 I interviewed 9 senior faculty (4 Sloan, 5 Engineering), the Deans of both the School of Engineering and the Sloan School, 7 junior faculty (5 Sloan, 2 Engineering), and members of the Leaders program administrative staff. I also held several informal discussions with a small sample (2) of Leaders fellows. All were willing to speak with me in confidence. To protect this confidence, no quotations in my analysis are directly attributed to specific individuals.

This sample of interviewees was selected to give a broad sample of people involved in the program, from the Leaders program directors to junior faculty who are marginally involved with the program. Only faculty who had some contact with the program were selected, primarily because they were presumed to be more amenable to talking and would have more developed opinions about the program.

Each interview lasted between a half hour and an hour and a half. Most interviewees addressed questions from an interview guide, circulated to them in advance of the interview. Additional questions were addressed depending upon the interviewee's interest and my own specific information needs at the time. See Appendix A for a copy of the interview guide used. Notes from the interviews were typed up and the content indexed. Indexing allowed the identification of the dominant dimensions of the program's vision, as seen through the eyes of involved faculty. It also enabled sorting by junior or senior faculty, and engineering or management faculty.

CHAPTER 2

INTELLECTUAL AND ORGANIZATIONAL FRAMEWORKS

To understand the intellectual and organizational changes that the Leaders for Manufacturing program is attempting, it is useful to come a broader understanding about: the intellectual frameworks of the people who populate universities, universities as organizations, and about how organizational and intellectual change occurs. These broader understandings will provide a context for analyzing the Leaders program within the MIT environment.

The Importance of Paradigms

The word "paradigm" refers to the models used by a scientific community form the basis of its traditions of scientific research. These models are often the result of ground-breaking research and theory. A paradigm provides the fundamental principles upon which a discipline is based. It attracts adherents who will perform further research based on its models. Thomas Kuhn describes a paradigm as an, "object for further articulation and specification under new or more stringent conditions." [2] Historical examples of paradigms include familiar movements such as Newtonian dynamics and Ptolemaic astronomy.

Paradigms are essential for the practice of what Kuhn calls, "normal science." Normal science is the rigorous further articulation and specification of a paradigm. It is

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[2] Thomas S. Kuhn, The Structure of Scientific Revolutions, (Chicago, Illinois: The University of Chicago Press, 1962), p. 23

the typical activity engaged in by scientists. The results gained in normal research, "are significant because they add to the scope and precisions with which the paradigm can be applied." [3] Normal research is devoted to solving problems whose solutions can virtually be predicted by the paradigm. Yet the ways to achieve those solutions are in doubt, so therein lies the interest in normal research. Normal research is much like solving a puzzle, according to Kuhn. A solution exists, but it is up to the ingenuity and skill of the problem solver to achieve it. Given an understanding of the models of the paradigm, a researcher constructs a hypothesis of what the solution should be, then engages in research to test the hypothesis.

Paradigms not only have a life in the world of ideas, they produce observable symbols in the real world as well. Specialized journals and societies, curricula, and even whole academic departments support the normal science of individual paradigms. Scientific communities educate their new members through the study of their relevant paradigms. Scientific communities depend on paradigms to guide the activities that are their reason for being. Paradigms are part of what make those activities scientific.

A scientific community's adherence to a paradigm typically places bounds on the problems its members will pursue. Kuhn writes:

> ... one of the things a scientific community acquires with a paradigm is a criterion for choosing problems that, while the paradigm is taken for granted, can be assumed to have solutions. To a great extent these are the only problems that the community

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[3] Ibid., p. 36

will admit as scientific or encourage its members to undertake. ... One of the reasons why normal science seems to progress so rapidly is that its practitioners concentrate on problems that only their own lack of ingenuity should keep them from solving.[4]

Paradigms have the advantage of advancing normal science and the consequence of limiting the choice of problems to be solved. By limiting the choice of problems, a scientific community makes it more difficult to pursue inter-disciplinary work. Without a shared paradigm, non-paradigmatic research appears to be non-scientific.

Universities as Organizations

The origins of the organizational form of the university date back to 12th and 13th century Europe. It has evolved in complicated ways yet it has not come to mirror either the bureaucratic structure of governmental institutions or the hierarchical structure of the business enterprise. While a complete analysis of university organization could fill volumes, for the purposes of understanding the organizational context of the Leaders for Manufacturing, only the aspects of the literature that relate most specifically to the challenges of the Leaders program have been included.

The discussion begins with the articulation of a mission for a university. Historically, a university's primary mission was teaching, the transmission of knowledge. In the past century, however, the importance of a second function, that of creating

[4] Ibid., p. 37

knowledge, has competed with teaching for primacy. The choice a particular university makes between these two has significant implications for its organization. James Perkins elaborates:

> Today teaching and research are missions with distinctive styles and different, often contradictory, requirements for organizational structure. ... In research, ideas become more important than people, the laboratory and the library more important than the faculty meeting, and external funding more important than the internal budget allocation. The judgment of peers in one's field of specialization, rather than the progress of the student, becomes the critical measure of performance.[5]

The analysis that follows focusses on larger universities where the research mission holds greater sway than the teaching mission. One useful indicator of such an institution is one in which the publishing record of junior faculty is the dominant criteria for the award of tenure.

Given that the two schools involved in the Leaders program could be considered "professional" schools, the uninitiated might wonder how the use of a research university model could be illuminating. After all, professional schools produce practitioners, and in such environments teaching might be thought to have priority. However, professional schools usually operate on one of two models, the academic

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[5] James A. Perkins, "Organization and Functions of the University," in The University as an Organization, ed. J.A. Perkins, New York: McGraw Hill, 1973, p. 7

model or the professional model (Cheit, 1985).[6] Schools that follow the professional model tend to emphasize functional fields and apply techniques to them. Teaching stresses the development of judgement for use in dealing with complex, unstructured problems. Publishing research is an element in faculty promotion, but not the dominant one.

The academic model treats the profession as a science. The approach is discipline-driven. Cheit details this model:

> Instruction emphasizes the disciplines that underlie issues and the analytical techniques that can be used in studying them. ... In pedagogical style and in outlook, a school that closely follows the academic model is similar to a university department. It seeks similar faculty recruits. It values the pursuit of knowledge for its own sake. ... Faculty members are rewarded for publication, especially for creative work that demonstrates theoretical treatment of issues. The faculty is productive, and its published scholarship has academic standing and commands respect.[7]

Thus, for purposes of this analysis, frameworks used for understanding research

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[6] Cheit's models describe U.S. business schools. The analogy is here extended to include engineering schools as a matter of convenience. However, Schon (The Reflective Practioner, 1983) describes a similar distinction between approaches to the professional development of engineers.

[7] Earl F. Cheit, "Business Schools and Their Critics," California Management Review, Vol. XXVII, No. 3, Spring 1985, pp. 53-54

universities can be useful in analyzing business and engineering programs which appear to fit the academic model described above.

If research is a key mission of a university, it follows that the primacy of this activity will induce an organizational form which supports research. As described earlier, paradigms coalesce a critical mass of researchers. Often these groups of researchers will become a formal research group or even academic department. They specialize in research which builds on their paradigm. The academic department then, is the organizational vehicle for specialized research that is founded on a particular paradigm(s). The advance of specialization has helped to establish the academic department as the dominant organizational unit in universities (Duryea, 1973, Weick 1983).

Weick develops this connection between the research activity of departments, and the way in which departments are "loosely coupled" to each other and to their schools and university:

> Just as the department is the dominant unit within a university and gives shape to the university, research (rather than service or teaching) is the dominant activity within a department that shapes the structure of that department. The technology of research, consisting mostly of individualized, isolated work, tends to dominate the departmental form directly and the university form indirectly.[8]

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[8] Karl E. Weick, "Contradictions in a Community of Scholars: The Cohesion-Accuracy Tradeoff," The Review of Higher Education, Summer 1983, Volume 6, No. 4, p. 257

Within each department there may be several "tightly coupled" groups of faculty/researchers. They are tightly coupled in that they share a paradigm for research and, to an extent, coordinate their research efforts. The "groups" are frequently as small a one person. These groups are somewhat more loosely coupled at the department level since research efforts are less likely to be coordinated across the department and less interaction takes place between groups than within groups. Viewed at the next level up, groups within an academic Area are even more loosely coupled. In universities the tightest connections are not between departments, but rather between groups within a department.

By this analysis it appears university organizations are highly decentralized, with few mechanisms for coordination or control. The research mission, with its paradigms and research norms, guide the actions of the autonomous sub-units, the academic departments. The autonomy accorded individual faculty members is considerable in such an environment. Faculty members have discretion over what to research, how to teach, and even the hours they work. Thus, the university is in a position to place few demands on the faculty member, leaving the provision of direction to the faculty member's department.

The prevalence of lifetime employment contracts, otherwise known as tenure, also contributes to the autonomy of senior faculty members. Vroom describes tenure as, "a factor that makes it possible for [faculty] to attempt 'upward' influence with relative impunity while requiring persuasive rather than coercive influence in a 'downward'

direction." [9]

Faculty and departments are subject to controls, however, albeit not directly from university administration. Because of their specialized, academic mission, faculty subscribe to the standards of their specialty, as embodied in the journals of their specialty and the opinions of their counterparts at other universities. They seek approval within a community of scholars who are sufficiently specialized to be competent to evaluate their work. These scholars are usually affiliated with a variety of universities. Hardy, et al explain: "Pushed to the limit, then, individual autonomy can look like professional control - it may be explicit freedom from administrators, even from peers in other disciplines, but is is not implicit freedom from colleagues in other universities." [10]

The dominance of specialization and organizational forms that support it cast a shadow on the prospects for inter-disciplinary work. How is it, in this loosely-coupled organization where individuals respond to standards set by a variety of outside sources, that inter-disciplinary work can be initiated and sustained? This is especially problematic because the inter-disciplinary work seldom rests on a paradigm of its own, borrowing instead from related paradigms. The current assessment is gloomy:

... given competition for scarce resources (faculty positions, curriculum space,

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[9] Victor H. Vroom, "Leaders and Leadership in Academe," The Review of Higher Education, Summer 1983, Volume 6, No. 4, p. 369

[10] Cynthia Hardy, et al, "Strategy Formation in the University Setting," The Review of Higher Education, Summer 1983, Volume 6, No. 4, p. 413

funding, etc.) specific discipline areas tend to win out over multidiscipline or interdiscipline areas. In the past, this has led to such external-environment-focused areas being accorded "second-class-citizen" status in many schools, ... by the frequent use of part-time faculty to teach courses in these subject matter areas and the generally greater difficulty of full-time faculty members in these areas obtaining tenure.[11]

Hazard Adams, in his irreverent memoirs of his days in academia, put the matter even more starkly when he encouraged intellectual leaders on a faculty not to destroy their disciplines, "in the vague, sentimental murk that tends so often to pass for 'interdisciplinary' and 'innovative' curricula."[12]

A final matter of interest in this discussion of the university as an organization is the matter of how faculty are rewarded. In a fashion not too different from most professionals, faculty are influenced by both intrinsic and extrinsic rewards. The intrinsic rewards of the job are the level of autonomy it provides, the opportunity to work on intellectually challenging problems, the chance to have an impact on students and the research in a chosen specialty, and so on. The extrinsic rewards include tenure, research grants, salary, status within peer group, and so on. What is most interesting about the power of this reward scheme is the relative importance of the intrinsic rewards. The intrinsic rewards of the work of faculty are thought to be quite influential

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[11] Lyman W. Porter and Lawrence E. McKibbin, Management Education and Development: Drift or Thrust into the 21st Century, New York: McGraw Hill, 1988, p. 318

[12] Hazard Adams, The Academic Tribes, New York: Liveright, 1976, p. 142

(Staw, 1983).

The preceding two sections of this chapter have attempted to describe the intellectual and organizational status quo in universities. The next two sections speculate as to how significant change can occur - a paradigm shift, organizational change, or both.

A Model for Organizational Change

The Leaders for Manufacturing program has described a program of teaching and research that requires organizational changes within a subset of MIT's many academic departments. There are undoubtedly several ways of achieving such change, several possible models. This section will describe one such model as a way of providing a framework for understanding what the Leaders program has accomplished to date, and the future actions it could pursue in its efforts to create change.

Richard Beckhard and Reuben Harris developed a model for managing complex organizational change which grew out of their own consulting work with a variety of organizations, including professional schools. The model is reproduced below and subsequently described.[13] It is useful not only for description but as a tool for planning action. Given that the Leaders program is still evolving, such an application bias should be helpful.

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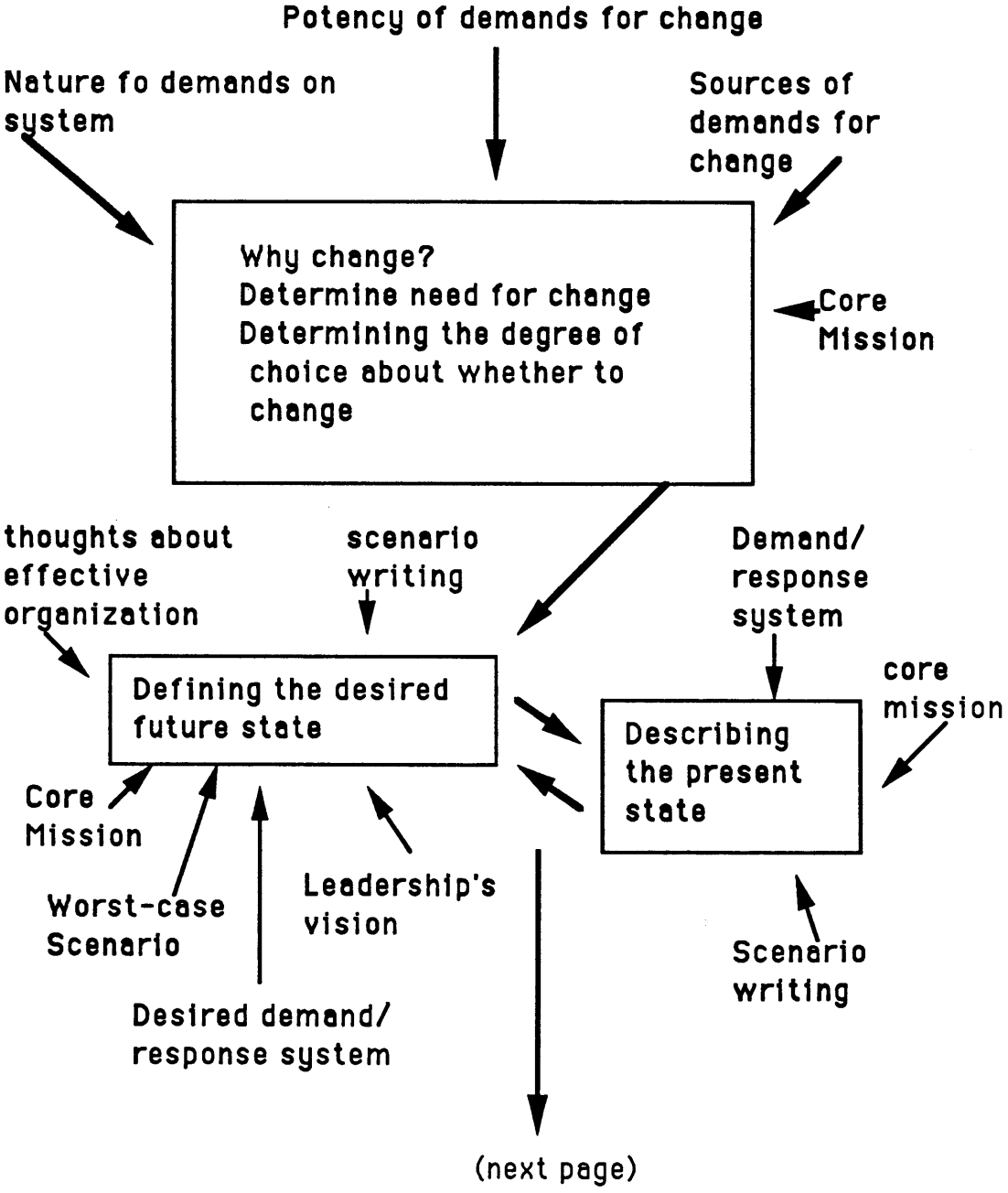
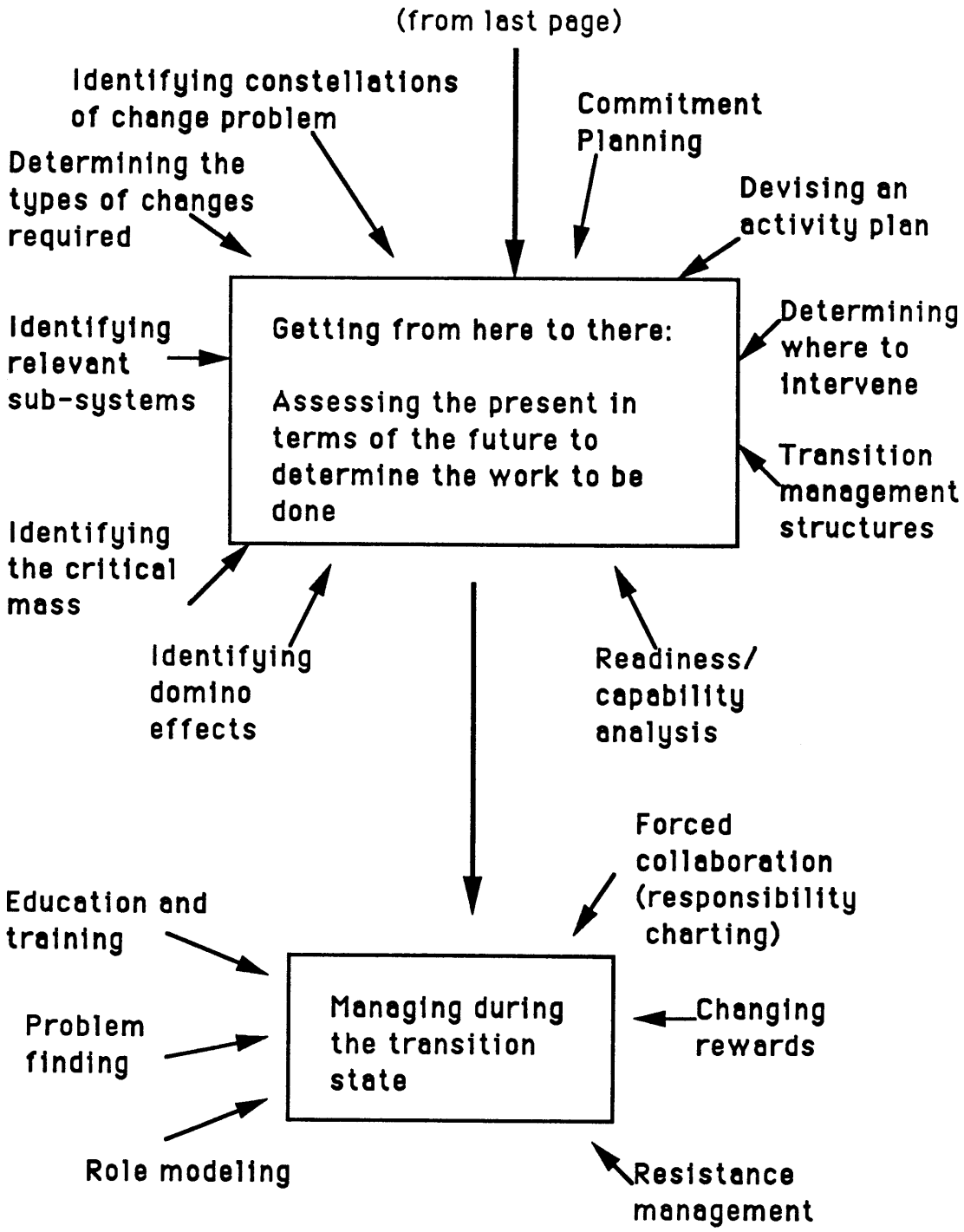
[13] Richard Beckhard and Reuben T. Harris, Organizational Transitions - Managing Complex Change, second edition, Reading, MA: Addison-Wesley, 1987

THE CHANGE MANAGEMENT PROCESS

Beckhard and Harris model (1987) Part I



THE CHANGE MANAGEMENT PROCESS - PART 2



Why Change - Organizations are open systems, constantly subject to the demands of the external environment. For universities this environment includes prospective students, potential employers of students, sources of research funding, alumni, peer groups of the various disciplines at other universities, the national and local media, and so on. Demands that relate to the core mission (research, teaching) of the university usually get the most response from the university. The first element of the change process is to establish why the change is important. When the demands change, the university has to decide if it needs to change in order to effectively respond; more importantly, it needs to decide whether or not it needs to respond at all. This is an important element of any change project: Does the university have a choice about whether to change or not? If it has no choice but to change, the motivation of change participants will be a lot easier to stimulate. Because universities are so decentralized and their faculty so autonomous, faculty usually perceive that there is a choice, that life could go on as it always has if no changes are made. This is an important issue for the Leaders program.

Define the Future State - Once the need to change has been established, the organization should define what the change looks like. That is, what is the "vision" for the future state, when the organization is successfully meeting the new demands. The vision should attempt to describe results to aspire to (e.g., " 75% of all fellows take their first job in manufacturing").

A vision is important for both organizational alignment and for motivating those in the organization. A well articulated vision provides "a unifying theme and a vital challenge to all organizational units, communicates a sense of achievable ideals, serves

as a source of inspiration for confronting the daily activities, and becomes a contagious, motivating, and guiding force congruent with the corporate ethic and values." [14] Writing a vision statement is often the first thing attended to in the strategic planning process.

The vision, while extremely important, is not enough. Certain mid-point goals should be described, goals that are more specific:

> This description of the interim future state for the organization should specify the expected organizatonnal structure, reward system, personnel policies, authority and task-responsibility distributions, managerial values and practices, performance-review systems, relationships with external groups, and expected organizational performance outcomes.[15]

Once the future and interim future states have been articulated, a change manager now has a "lens" through which to assess the present state of the organization. This lens is important because it helps the manager focus on aspects of the present system that are likely to have the greatest impact on the change desired. It helps to determine what to change and what not to change.

One operationalization of this lens forms the core of Chapters 3 through 8 of this thesis. It provides one means for identifying elements of the present intellectual and

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[14] Arnoldo C. Hax and Nicolas S. Majluf, Strategic Management: An Integrative Perspective, Englewood Cliffs, New Jersey: Prentice-Hall, 1984, p. 45

[15] Ibid., p. 46

organization structure that will be the most affected by the Leaders program.

Assess the Present State - Assessment of the present state is a diagnostic process. First, data must be collected about the present state through interviews, documents, observation, and so on. An inventory of the characteristics of the present state and sorting these characteristics into clusters (or "constellations") will provide a description which, according to Beckhard and Harris should:

> ... should specify the who (individuals and groups), what (organizational processes), and how (consequences) of the problem and its effects. Then examine all of the constellations together for any domino effects. Is there a certain key problem that must be dealt with before anything else can happen?[16]

Next, identify the relevant "people systems" which will be significantly involved in the change, and think about the degree to which people in these systems will have to change their current behavior, attitudes, or work to reach the change goal. An example of an important people system at MIT would be the senior faculty members who might be interested in the Leaders program. This analysis should uncover likely sources of resistance and support. Part of this analysis should include an assessment of the readiness and capability of the needed participants for the desired change. For example, do faculty have the willingness and motives for change? If they have these, do they also have the power/influence/authority, information, and skills necessary to make the

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[16] Ibid., p. 59

change happen? Finally, identify the minimum number of people needed from each people system to make the change possible. Beckhard and Harris call this latter group the "critical mass".

Getting from Here to There - All this analysis should lead to action. The next step is to develop an activity plan that is relevant, specific, details chronology, and is adaptable, and integrated. Make choices about where to intervene first. Go to "top management" or create new teams and systems? Use a temporary ad hoc project group or work through administrators? There are plenty of choices for the right organizational vehicle for initiating the change effort. Then decide on an intervention "technology" or mix of technologies. Is the change better off being tried out in a pilot project or should it be carried out across-the-board? A good rule of thumb to use in selecting intervention points and technologies is to remember that it is very difficult for a stable organization to change itself.[17] More often than not a temporary system (e.g. ad hoc team, pilot projects, etc.) is more effective in accomplishing the change.

Successful change not only depends on effective process mechanics, it usually requires exceptional personal attributes and skills from the people leading the change. Specifically, a successful change leader has:

- The clout to mobilize the resources necessary to keep the change moving; ...
- The respect of the existing operating leadership and the change advocates; ...
- Effective interpersonal skills; a large part of leadership at these times requires

[17] Ibid., p. 74

persuasion rather than force or formal power[18]

Resistance Management - The primary obstacle to working through the process described in this model is resistance to change. Resistance can happen at almost any point in the process. Getting consensus on a shared vision may be the most difficult obstacle, or collecting a critical mass to execute some part of the change could be the problem. Analysis at each phase in the model should include an assessment of the forces of resistance. Beckhard and Harris present a symbolic "formula" that can help in discovering the balances of forces for and against change:

C = [ABD] > X

C= Change

A= Level of dissatisfaction with the status quo

B= Desirability of the proposed change or end state

D= Practicality of the change (minimal risk and disruption)

X= "Cost" of changing

For change to be possible, A,B,D must outweigh what people think are the costs, X, of changing.

In Chapters 3 through 8 a tool similar in intent to the above equation, the Force Field Analysis, is used to describe the forces for and against important elements of the

[18] Ibid., p. 76

change that the Leaders program is attempting. The analysis in those chapters is further influenced by the Beckhard/Harris model for change. The analysis works to uncover the role of critical masses, the demands of the external environment, and the capability of key people systems for change. The material in those chapters is not structured to strictly follow this model for such a strict fitting would be cumbersome, but depends upon it for the content choices made and the themes highlighted.

However, as a prelude to those chapters, let me begin by tying the preceding discussion of paradigms and university organization to the problem of organizational change posed by the Leaders for Manufacturing program.

Paradigm Shifts and Organizational Change

Paradigm shifts involve the recognition of the inadequacy of one or more paradigms in solving a certain set of problems. These existing paradigms become less important as a new paradigm emerges which is much better at solving these problems. In the modern era, paradigms have usually manifested themselves organizationally in universities; thus, paradigm shifts can produce organizational change as well. Kuhn's analysis of paradigm shift is explored below, corraborated by Bartunek's description of the dynamics of "reframing" [19], and loosely matched to the organizational change

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[19] Jean M. Bartunek, "The Dynamics of Personal and Organizational Reframing," in Paradox and Transformation: Towards a Theory of Change in Organization and Management, Robert E. Quinn and Kim S. Cameron, Cambridge, MA: Ballinger, 1988. Bartunek's article describes a "frame" as a "generalized cognitive structure, framework, or template people use to impose structure on, and impart meaning to, some particular domain." (p. 138) "Reframing" requires a "new framework or template on some particular domain, a new 'lens' for seeing and understanding it." Strictly speaking a frame is not a paradigm, but Bartunek's analysis does give another perspective for viewing a similar intellectual change process.

process of Beckhard and Harris. It is interesting to note how intellectual shifts can occur in much the same process as organizational shifts.

Crisis is the most common prelude to paradigm shift. Such a crisis answers the Beckhard/Harris question, "why change?". A paradigm crisis can occur in several ways, but most frequently such is crisis is ignited by the generation of research or experimental results which cannot be explained within the confines of the existing paradigm. Quite often, there will be great resistance among thos pursuing "normal science" to accept inconsistent results as anything more than faulty measurements or experimental errors (e.g., the current "cold fusion" controversy). When, as is often the case, challenges to an existing paradigm originate in a locale or a group physically or intellecutally "distant" from those who have staked a claim to normal science, the resistance will take the form of disbelief shrouded in charges of ignorance, fraud, and deceit. However, to the extent that results inconsistent with the existing paradigm cannot be explained away and, most importantly, the challenging results begin to attract theoretical explanation and scientific adherents, the process shifts from simple controversy to overt paradigm crisis.

Bartunek describes a similar crisis necessary for the initiation of reframing. "... reframing commences with an event that signals that the present framework for understanding no longer works." [20] Lewin might say that such events "unfreeze" the present ways of understanding and make them available for change (Lewin, 1947).

If change requires some vision of a future state, herein may lie a reason why

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[20] Ibid., p. 145

paradigm shift can be so difficult to predict or control. Paradigm shift seems to be initiated in response to events, but without the benefit of a clear idea of what the alternative paradigm will be. Academics do not completely abandon the shores of their own paradigms until they can clearly see the shores of the new one. Yet the creation of a new paradigm demands experimentation before that vision of a new paradigm is clear. Kuhn finds no convincing solution for this dilemna other than that the gap can be bridged by risk takers who have faith that they will find the other shore.

> The man who embraces a new paradigm at an early stage must often do so in defiance of the evidence provided by problem-solving. He must, that is, have faith that the new paradigm will succeed with the many large problems that confront it, knowing only that the older paradigm has failed with a few. A decision of that kind can only be made on faith.[21]

While the vision of the future paradigm may not be articulable at the outset, the process of assessing the present state can lead to the articulation of trial paradigms. As inexplicable data are more closely studied, their nature is slowly revealed.[22] Bartunek's reframing process also involves the collection and examination of discrepant information

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[21] Thomas S. Kuhn, The Structure of Scientific Revolutions, Chicago, Illinois: The University of Chicago Press, 1962, p. 157

[22] Kuhn was unable to give clear reasons why researchers would be attracted to such closer study of anomalies, but the argument of "faith" given above might suffice. This is a nontrivial point and one that may be better addressed in an assessment of the intrinsic and extrinsic reward system for faculty.

and attempts to understand it by generating new frames. An iterative process ensues: the new frame is used to try to make sense of discrepancies, and if it is not satisfactory the information is reviewed again and a new frame is generated.

The transition state of a paradigm shift is characterized by a time when the old paradigm(s) are blurred, when there is a loosening of the rules of normal research. However, the old paradigm(s) do not smoothly evolve into the new. Rather there is a period of time in which the paradigms, old and new, are in simultaneous use. Kuhn elaborates:

> During the transition period there will be a large but never complete overlap between the problems that can be solved by the old and by the new paradigm. But there will also be a decisive difference in the modes of solution. When the transition is complete, the profession will have changed its view of the field, it methods, and its goals.[23]

In getting from "here to there" the new paradigm emerges, a new frame is created.

The juxtaposition of the Beckhard/Harris change model with the process of paradigm shift suggests that a paradigm shift can occur concurrent with organizational change. In fact, it can be one of the drivers of the organizational change process. As organizational changes go, paradigm shift and "reframing" are quite difficult. Any change that proposes to challenge core beliefs is bound to draw resistance. Kuhn

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[23] Ibid., pp. 84-85

suggests that, "novelty emerges only with difficulty, manifested by resistance," [24] and that, "road to a firm research consensus is extraordinarily arduous." [25] Bartunek describes the affective apsects of the reframing process, characterizing the process as, "often paralyzing and disorienting." [26]

Possibly the most unsettling part of this analysis, however, is the lack of sound theory to explain fully why researchers will undertake the early work of the paradigm shifting process. It would seem that such early work is critical to the implementation of a paradigm "shift" plan. This terminology may seem a bit too structured to use in describing something as organic as a paradigm shift, yet in many ways the Leaders program is attempting to organizationally catalyze the shift. The organizational change terminology has relevance. The discussions of Chapters 3 through 8 will explore this point more deeply.

The MIT Environment

The Leaders program should be understood within its organizational environment, MIT. The models of paradigms and universities as organizations discussed earlier, are illustrated in the following review of especially relevant aspects of the MIT environment. This review is the first block in building an understanding of the "present

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[24] Ibid., p. 64

[25] Ibid., p. 15

[26] Jean M.Bartunek, "The Dynamics of Personal and Organizational Reframing," in Paradox and Transformation: Towards a Theory of Change in Organization and Management, Robert E. Quinn and Kim S. Cameron, Cambridge, MA: Ballinger, 1988, p. 153

state" of the system and in understanding why organizational change is important to the Leaders' success.

MIT can easily be characterized as a research university. It is one of the nation's leading research universities with a reputation for producing cutting edge research, and for being a magnet for research dollars. Its professional schools (management and engineering among them) have national standing, and are structured on an academic model. Tenure decisions place heavy emphasis on the volume and quality of research publications and activity. Specialization of departments and sub-groups within departments is the norm. Cross disciplinary efforts are infrequent and often met with skepticism.

The primacy of research makes paradigms an issue of consequence. Normal science depends on paradigms, and MIT is a place of scientists. MIT probably has the best defenders of existing paradigms, as well as the best originators of new paradigms. What makes this possible is an environment which puts faculty loose on their own, giving them maximum autonomy to pursue their own work. Funding mechanisms reinforce this individuality, as few central research dollars are collected and disseminated internally. Most faculty find their own external sources of funds for research.

Without a high degree of autonomy, it could be argued that paradigm defenders might be more able to squelch the efforts of paradigm originators. If normal science is enforced through organizational control mechanisms, then it would be even more difficult for new paradigms to be discovered. The only conditions under which a coordinated group of researchers could hope to originate paradigms is if it comes together with the express purpose of supporting the origination of a paradigm.

While MIT researchers subscribe to the constraints and direction of the peers of their specialties across the academic landscape, MIT also plays an important role in leading the consensus in various specialties. So while the disciplining influence of journals, conferences, and so on are significant, MIT researchers are in a better position than most to stretch the limits of the consensus.

Senior faculty and the academic departments they belong to, are extremely influential in most of the internal decisions of the Institute, and can dramatically affect (or even neutralize) the power of a Dean, the Provost, or the President. Yet because they are "loosely coupled" it is difficult for faculty to originate and execute cross-departmental initiatives without the assistance of Deans and other administrators. Junior (i.e. untenured) faculty play a lesser role, more insecure without a lifetime contract and the official seal of approval from their academic specialty. They have little organizational power and are quite often silent on matters which do not affect them directly.

The Leaders Program: Paradigm Shift and Organizational Change

The goals of the Leaders program (the vision for it) imply the need for organizational change and paradigm shift. The program is addressing the needs of an external environment which is asking for managers with a different mix of technical and management skills, and is looking for breakthroughs in the way that they think about their enterprises. It is also addressing the growing evidence that no single paradigm appears to be sufficient for solving the intellectual problems posed by the manufacturing environment. The program seeks to take a leadership role in the

academic community by creating new paradigms and producing a cadre of people who can disseminate the new knowledge. The program should produce revolutionary changes in business, similar to or surpassing the kinds of changes precipitated by the fundamental shift in thinking that Just-in-Time inventory concepts produced.

The research that grows out of such a fundamental shift is bound to be of a more applied nature than scientists traditionally pursue. The sponsors who fund Leaders research will undoubtedly place a higher premium on a more applied type of research. The extrinsic rewards of research funding will help to create change.

The emphasis on paradigm shift is intellectually important and organizationally expedient. It appeals to the intrinsic rewards of researching, for those who have faith that a new paradigm exists, or at least that the old paradigms are inadequate. If the program is founded on a new paradigm it overcomes much of the usual resistance to cross-disciplinary efforts. A new paradigm seems to attract more durable organizational support.

The Leaders program has adopted an organizational form which has a higher probability of dealing with and avoiding resistance than other alternatives that might have been considered. Beckhard/Harris would assert that had the program been attempted within the organizational framework of an existing single department (a stable organization), it would have been much more difficult to create the new kind of research and teaching it seeks. New organizational groups are freer to create new norms, yet because the Leaders program is a composition of two established organization it faces a tenuous balancing act, incorporating the norms of each organization equitably, while retaining the independence it needs.

Given its goals, the challenges posed by the environment are considerable. The program has adopted a near optimal organizational form for attempting the changes its vision requires. But organizational form is only a part of implementing change. The remainder of this thesis addresses the implementation challenges the Leaders program faces in creating a paradigm shift and concurrent organizational change. Certain aspects of the change have been selected for analysis, partly because the models developed point to their importance, and partly because the aggregate opinion of faculty interviewed identified these aspects as being the most critical. The analysis is a survey of the present state viewed through the lens of the changes desired.

Paradigm Shift (Chapter 3). At least since March of 1988, faculty have been dwelling on the need to make this happen. The March 1988 draft of the Vision Statement from the founding faculty members argues that, "a set of paradigms exists on which manufacturing science can be based." [27] This was the most common theme expressed by faculty in interviews. The resistance of normal science will have to be managed.

External Acceptance (Chapter 4). Faculty envisioned that success for the program would include acceptance of their ideas and approach by colleagues at MIT and in other institutions. Acceptance would include publication of Leaders research in important journals and the replication of the program at other institutions.

Equitable Relationship between Schools (Chapter 5). Faculty from both the School of Engineering and the Sloan School felt strongly that the program should remain an

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[27] Source document secured from Kent Bowen (Vision Statement, draft, March 1988).

equitable partnership, in which neither school took a dominant role. Meshing the traditions and methods of two schools and several departments will be a challenge in such a loosely coupled environment.

Senior and Junior Faculty Participation (Chapters 6 and 7). Faculty participation is seen as essential to the growth plans of the program. Yet because participation is essentially voluntary there are concerns about how the demands will be met. While several issues are shared between junior and senior faculty, there are enough distinct differences to merit treatment in different chapters. Junior faculty participation is vital both to both filling out staffing requirements and to generating new ideas and the "trial paradigms" that the paradigm shifts require. Significant resistance is posed by the reward/tenure structure.

Attractiveness of the Program to Prospective Fellows (Chapter 8). Faculty saw the program attracting increasingly more qualified and committed applicants. A related outcome they envisioned is that graduating fellows would take good jobs in manufacturing. While the environment (sponsors and other manufacturing firms in this case) are calling for such employees, it is unclear that they are ready to compete for them with salary and rewarding career paths.

CHAPTER 3

PARADIGM SHIFT

Participants in the Leaders program, faculty, sponsors, and students alike, anticipate that the projects and research of the program could lead to the creation of one or several new ways of thinking about manufacturing. These "new ways" are difficult to put a finger on. Different faculty have different words for them. Some call it a paradigm shift. Others refer to it as a set of new principles, or a new set of core understandings. Some look for the change to be revolutionary, not simply a blending of existing ideas.

This analysis will use the term "paradigm" and refer to paradigm shifts, to characterize the changes described above. Faculty look to a new paradigm (or paradigms) to be distinct from the paradigms commonly adhered to by related disciplines such as mechanical engineering or operations management. A new paradigm will serve as a base for further research, for textbooks, and for solving manufacturing problems across industries.

Falling short of this vision will mean that research was attempted yet it never broke out beyond the boundaries of the existing disciplines. It will mean that manufacturing problems were solved within existing paradigms: that faculty, as one member put it, "did more of the same." It was business as usual applied to the Sponsors' problems.

The Force Field Analysis below summarizes the forces which support the creation of new paradigms (on the right), and the forces which work against the creation of new paradigms (on the left).

"More of the Same"

- Some faculty are skeptical. Setting out to create a new paradigm is a very different research proposition than they are accustomed to. To pursue this kind of research is to attempt to solve a puzzle for which there may be no solution. If there is nothing to find, even the brightest minds will not find it.

- Some faculty perceive that Leaders research will take longer and be slower in yielding results. The program works against a 5 year funding clock, and faculty would like to have something to show for their efforts before time runs out. And hopefully get funding renewed. Long lead times and uncertain results could keep research agenda more conservative.

New Paradigms

- Some faculty are energized by their belief that new paradigms are emerging. Present anomolies in research support their faith.

- For those willing to take this risk, the expectations of sponsors and interested peers will motivate them.

- The emergence of new principles suggests that there are more to find. Principles such as Just-in-Time inventory management failed to grow out of existing paradigms. Such anomalies suggest that new paradigms are possible.

Discussion

It is quite possible that the manufacturing problems facing industry today will be best solved using techniques that are based upon a new, and yet undefined, paradigm. If the development of the techniques are dependent upon the development of the paradigm, it makes sense that the development of paradigms is of such great interest to Leaders faculty. More than being simply the mark of a discipline with real intellectual content, the paradigms can be seen as being essential to the solving of practical problems.

Discovering new paradigms is probably more difficult and uncertain than most academic research. A revolution in manufacturing is sought, yet existing patterns of research make it difficult to imagine how this revolution can be achieved. Kuhn believes that most scientists stay within the bounds of their paradigm and attempt to solve puzzles. They attempt to demonstrate and explain phenomena in ways that are consistent with the principles of their discipline.

It is quite possible that the research work of the Leaders program is not yet "normal science." It poses puzzles that may have no solution. It can be seen by one discipline (department, or school) as the "concern of another discipline (department or school)." [28] Kuhn's analysis helps to explain why some faculty are skeptical and why others are energized. For some the research offers opportunities to "precipitate magic," or to be truly "cutting edge." For others, the research could be a black hole for their valuable time, time that could be better spent on problems with knowable solutions.

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[28] Thomas S. Kuhn, The Structure of Scientific Revolutions, Chicago, Illinois: The University of Chicago Press, 1962, p. 37, parenthetical addition by author.

Recommendations

Certainly, there are organizational issues that affect how free faculty members are to pursue new principles. I will discuss those further in a review of the mechanics of how new ideas gain acceptance. However, the above analysis is pointed more to the internal thought processes of the engineering and management scientists involved with the Leaders program. It is meant to encourage testing of Kuhn's assertions and whether or not they have something to say about how Leaders faculty will create new paradigms. To my mind the analysis suggests several actions, some of which are already being pursued.

Professors with unconventional educational backgrounds, or mixed discipline backgrounds, should be included in program teaching and research. An article on the education of manufacturing engineers in Manufacturing Review supports this approach.

> "Every effort possible ought to be made to attract well qualified and experienced professionals onto faculties ... the lack of a doctoral degree, by itself, should not be an impediment to bringing such people into the academic fold ...'nontraditional' faculty must be accorded the opportunity to be regarded as equals among the traditional faculty, and not as second-class citizens." [29]

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[29] Philip Francis, Winfred Phillips, et al, "The Academic Preparation of Manufacturing Engineers: A Blueprint for Change," Manufacturing Review, vol. 1, no. 3, October 1988, p. 160

The expectations of the public and the program sponsors need to be managed so that they look for long-term results and unconventional thinking.

Several other program goals seem to depend on establishing paradigms. Textbooks and new courses depend upon it. Future puzzle solving and applied techniques depend on it. Although these relationships may not be as linear or dependent as presented here, they might be. This would suggest that the urgency to embark on unconventional, non- or inter-disciplinary research is high.

CHAPTER 4

EXTERNAL ACCEPTANCE

Research from the Leaders program may well lead to the creation of new paradigms for manufacturing. The involved faculty may be convinced of the "newness" of them. However, it is one thing to create, and another to gain acceptance of what has been created. Most faculty envision that the work of the Leaders program will have wide ranging influence, in how companies organize manufacturing, in how other universities structure their manufacturing education, and in what the most interesting research problems of the day are. To accomplish these goals the work of the Leaders program has to be seen as being intellectually credible and capable of solving significant industry problems. The analysis in this section will focus on how research from the Leaders program will be accepted by the academic community.

This analysis will assume that research that functions mostly as consulting will not reveal new insights about general principles, and, thus, will not enhance academic stature. This kind of research is more in the domain of the practitioner, not the scholar/scientist. To influence other universities and to shape the research problems of the future, Leaders research will have to go beyond this level. The research will have demonstrate the creation of new knowledge.

Dismissed as Consulting

- Interdisciplinary work is seen to be at a disadvantage in the competition for publication in important refereed journals. To the extent that Leaders research is seen to be inter-disciplinary or even extra-disciplinary, it is likely to be slow in gaining access to the journals that are accepted as the arbiters of new knowledge.

- Certain research breakthroughs could be withheld from dissemination if sponsor companies become concerned about the leaking of industrial secrets.

- Sponsors could become impatient for applied solutions. So far little pressure of this sort has been applied. Such pressure could force research that does look like

Accepted as New Knowledge

- The creation of new journals focussed on manufacturing problems is currently being discussed within MIT and with peers in other universities. If new refereed journals appear, more articles are likely to be published. Quantity of publication will help acceptance.

- MIT has a prominent place within the scientific/academic community. (10% of all U.S. engineering faculty hold a degree from MIT.) Thus, the Leaders program has the persuasive power of the MIT name behind it.

- Many MIT faculty hold positions on the boards of refereed journals and could be in a position to influence journal standards.

consulting in order to keep the

support of sponsors.

Discussion

The primary point of interest in this analysis is the positive "feedback loop" that can be created through academic journals. For a variety of compelling reasons faculty seek to have their work published in refereed journals. They usually draw their cues about what defines publishable work by noticing the nature of the problems and analyses that are currently published in the journals that matter. Faculty use these cues to help them choose the problems they will seek to publish on. The more articles published on a certain set of problems, the more interest those problems will attract from researching faculty. The more articles published, the greater the academic legitimacy. The fewer articles published, the less interest, the less legitimacy. This proliferation of articles focussed on the new ideas of the program, reflects Kuhn's and Bartunek's belief that new paradigms or new frames grow out of the consideration of many trials. The number of trials attempted and discussed is important.

The Leaders program seems to pose research problems that are "messy". Issues such as simultaneous or concurrent engineering require the analysis of both technical and human systems. The problems of simultaneous engineering probably cannot be solved without both. Yet such interdisciplinary work is difficult to publish in many of the journals that matter to the scholars involved in the research. Engineers might look at an such a cross-discipline analysis and say, "there seems to be real insight into management issues here, but the technical work is ordinary." A Human Resources

professor might look at the same analysis and say, "the work on management issues is rather ordinary, but it sure seems as if the technical work has real value." Such analysis can look more like the work of an accomplished practitioner, and not enough like the work of an intra-discipline scholar. While this may be a desirable outcome for some sponsors, it will not help propel the journal feedback loop in the right direction.

Recommendations

To be accepted, scholars must first have something to offer. The quality of Leaders research will depend to some extent on the quantity of research activity focussed on manufacturing problems. To stimulate that quantity of research, Leaders research has to be accepted in the journals that matter. The process is iterative and self-reinforcing. One faculty member suggested that making the choice to do Leaders-type research will be a whole lot easier as soon as, "10 to 15 papers get published in the right journals." The problem is getting the process started.

The Leaders program should probably not depend on existing refereed journals. Although MIT faculty who sit on the boards of journals can help, getting research accepted and published by these journals is likely to be a slow, low volume process. Research that lives at the fringes of a discipline must truly be of a breakthrough nature to get much attention. A critical mass of more ordinary research from the fringe is not likely to amass in the printed word. The program needs less intellectually constrained outlets, although the new outlets have to have a stature similar to existing ones. The Leaders faculty should not wait for existing journals to come around. They should aggressively build new journals "that matter."

CHAPTER 5

EQUITABLE RELATIONSHIP BETWEEN SCHOOLS

Although it has its roots in the efforts of a few key engineering faculty, the Leaders program has developed into an partnership between the School of Engineering and the Sloan School. Almost to a person, faculty with whom I talked stressed the importance of maintaining a balance of effort and rewards between the two schools. Without this balance, many felt that the Leaders program would fail. Faculty expect each school to contribute to the intellectual content, curriculum development, planning, and administration. Just as the work is to be shared, it is expected that rewards -- in the form of money, prestige, and publicity -- should be shared equitably, both financial rewards as well as prestige, publicity, and so on. Yet, each school has distinct intellectual traditions, teaching styles, and "cultures" that could make collaboration difficult and the perception of equitable treatment less tractable. The analysis presented in this chapter looks at the forces that can lead to a less equitable relationship between the two schools and the forces that make it more equitable.

It should be noted before beginning that relative to other universities, MIT has made significant strides simply by establishing this partnership. Other universities have attempted such collaboration with less success. Stanford's engineering school's efforts with the business school have ended in frustration. Other "technology institutes" have moved ahead on manufacturing programs without the benefit of management faculty collaboration (e.g. RPI). Several symposia have recommended that a manufacturing engineer's education should take advantage of this kind of collaboration, yet few

universities have a program with such a balance of commitment between engineering and management schools.[30]

Less Equality	More Equality
• Leaders research grants have a lesser impact on engineering faculty given their much larger research expenses.	• The fact that research grant money is available for interdisciplinary "manufacturing" work has pushed faculty to think about ways to make their research more integrative.
• Methodologies for research vary widely between the two schools so joint research is difficult to conceive and plan.	• Requiring fellows to have two thesis advisors, one from each school, has encouraged equal efforts from faculty members at both schools
• The Fellows curriculum seems weighted towards the Sloan core. Engineering faculty are concerned that the thesis will not be technical enough to provide adequate	• More faculty are being hired who are "cross-educated" - Sloan faculty with engineering degrees and

[30]. An article in Manufacturing Review, "The Academic Preparation of Manufacturing Engineers: A Blueprint for Change" (October, 1988) supports this view. Several articles in a collection called Education for the Manufacturing World of the Future (1985) advocate this interdisciplinary approach. One author states, " ... preparation of engineers must be broadened to include topics in management, economics, and interpersonal skills. In many cases, knowledge in these areas is weak or absent in engineering graduates. The inverse is true in schools of business and management, where training in technology is generally deficient." p. 46

engineering training.

- Organizational and size differences between the schools work against integration: strong departmental structures and large department size at the School of Engineering encourage discipline specific research and teaching.

- Differences in the perceived rating of the two schools relative to the peer institutions may create fears of dilution of prestige for one as a result of collaboration with the other.

Engineering school faculty with corporate experience.

- The governance structure of the Leaders program maintains a balance between schools at each level of authority - the Deans on the Governing Board, the Co-Directors,and senior faculty involved in the program's committees.

- Weak departmental walls and Sloan's unusually close connection to the Institute make cooperation and teamwork more likely.

- Exceptional leadership from several individuals has helped to show a commitment to working in partnership.

- Both schools enjoy national reputations. Their degree programs

are comparably attractive.

Discussion

The Engineering School faculty and The Sloan School faculty have traditionally taught their students and conducted research in different ways and at different funding levels. In the Engineering School most graduate students are nearly fully supported by research grant money and fellowships. Most Sloan master's students pay their own way, through loans and savings. The majority of Engineering School research is funded through the U.S. Government, the majority of Sloan research is funded by private industry. Faculty members in both schools raise the majority of their research funds through their own individual efforts. However, the scale of funding needed by engineering faculty is much greater than that required by Sloan faculty.

In one engineering department there are 6-7 graduate students per faculty member. A research budget of about $350,000 per year is required to support those students and their research. Sloan faculty generally support fewer research assistants, fewer of those assistants are supported full-time, and lab and equipment costs are much lower.

The Leaders program has made some efforts to acknowledge these differences in funding needs. In the initial round of research funding, Sloan faculty were awarded more grants (10) at a lower funding level ($11,000/grant). Engineering faculty received five grants, funded at $25,000/grant.[31] Salary support for designated senior faculty is a consistent percentage of total salary, for both engineering and management faculty.

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[31] A trickle of new awards have also been made, following a similar weighting.

While the grants made to engineering faculty have been relatively generous, it is not clear that they have much persuasive power when compared to an average $350,000 per year research budget. Engineering faculty have suggested that it is unlikely that a professor would reconfigure his or her portfolio of research projects to make room for a $25,000 grant, unless the money could legitimately be applied to ongoing topics of interest. These faculty feel that the current level of funding only attracts faculty who already have this ongoing interest in manufacturing. In order to pull in less committed faculty, the magnitude of the funding will have to increase significantly. One professor even suggested that it would have to increase by an order of five or more to make the Leaders program self-sustaining at the Engineering school.

I should not leave the impression that Leaders research grants have been ineffective, however. Junior faculty in both the Engineering School and Sloan have mentioned that the grants have been influential in getting them to stretch their research ideas beyond the usual bounds of their discipline. And while grant recipients, as well as faculty who receive salary support, can not always say that they are actively engaged in new manufacturing research, they admit that they feel guilty about not doing more.[32]

While some faculty believe that Sloan's curriculum is more like an engineering curriculum than most business schools, the differences between the activities of an engineering master's student and a management master's student are still pronounced. An engineer's master's program has been described to me as, "a smattering of courses and then the thesis." The first year of courses is something of a sampling of courses

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[32] If guilt is a leading indicator for action, then the activity level should soon be picking up.

that do not necessarily comprise a "core". The student's greatest learning comes during the thesis work in the second year. The management master's program has almost an inverse emphasis. The first year consists of an intensive core that most students share in common. The thesis is not regarded as the vital learning experience and could diminish in importance over the next few years.

Several engineering faculty showed concern that the Leaders Fellows' theses will not have sufficient technical content to provide a legitimate engineering learning experience. The concern is that if the theses do not have a strong engineering component engineering faculty thesis advisors who are not already strong Leaders participants will stop participating in the program. The concern over a heavier emphasis on management content may simply be a function of this being the first year, when more courses do seem to be management-related. Thesis projects are just getting underway, and to several engineering faculty the Fellows look more like Sloan students than they are comfortable with. Ideally, the second year of the program should be the time when the Engineering School's strength with thesis work provides leadership. However, given the need to make the thesis work interdisciplinary, an imbalance in the program between the two schools may be perceptible.

The perception of equity between the two schools will probably be enhanced by more joint activity. While joint supervision of theses has encouraged activity, joint research has been harder to conceptualize and initiate. Part of the problem lies in the wide differences some faculty see between the research problems and methods they work with and the problems and methods used by faculty from the other school. Whereas a management professor might seek to observe an aspect of management in

different companies and settings, an engineering professor is more likely to look at a particular mechanism or phenomenon and solve a particular problem related to it. Developing a better sense of what joint research looks like will take some time.

The MIT culture is obviously an amalgam of the cultures of the various schools and departments. However, the members of each of these schools and departments seem to share some basic assumptions about how the Institute "works". In none of my interviews did anyone describe MIT as a highly bureaucratic place, where little empires are built and separate rules apply. Rather, it is described as an institution with weak departmental walls, where most schools and departments play by the rules of the Institute. Faculty understand that they are usually expected to be on their own to secure research funding. Every faculty member goes through the same tenure screening process and submits to similar standards. Weak departmental walls permit communication but do not necessarily enforce it. Departments are loosely coupled. Bonds are created mostly through individual effort.

Several faculty with whom I spoke believed that it is this shared culture that enables collaboration like the Leaders program to happen. In other words, the striking similarities between the cultures of the Engineering School and the Sloan School will enable a balance of ownership and participation to occur. Other universities that have attempted such collaboration have failed in part because the management school and the engineering school failed to understand how the other school "worked".

Recommendations

To meet the program's goal of having sufficient staffing for double its current

number of fellows, engineering faculty will have to be persuaded to make room for Leaders activities. An obvious yet problematic recommendation is to increase the size of Leaders research grants awarded to engineering faculty. The concern is that an imbalance of funding toward the Engineering School will make Sloan faculty feel significantly less important. This concern seems logical, yet it is possible that Sloan faculty appreciate the dilemma and are willing to live with it. At least one Sloan faculty I talked to believed that the program can succeed only if the research dollars are sufficient to hold the attention of the engineering faculty. Barry Staw, a professor at UC Berkeley's business school, concurs that consent for differential rewards is important:

> When an important organizational goal is to achieve cooperation among members of an institution, differential rewards can often constitute a source of friction. ... If cooperation is paramount, then only those contingent rewards that can be justified or accepted by the membership should be considered.[33]

The Leaders program curriculum seems to be too dependent on the thesis to provide the bulk of the engineering education. If an engineering education does not provide a core course learning opportunity, perhaps new Leaders courses should address this problem. Without new courses or a greater perceived balance of engineering and management courses in the first year, the thesis could become a source of contention

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[33] Barry M. Staw, "Motivation Research Versus the Art of Faculty Management," The Review of Higher Education, Summer 1983, Volume 6, No. 4, p. 310.

rather than open minded collaboration.

Most faculty look for the Leaders program to become a model for other universities to follow. One measure of success offered by faculty is whether or not the program has a multiplier effect, generating a critical mass of technically competent managers because so many other schools adopted a similar program. Yet faculty frequently point to the unique relationship of the two schools and MIT's special culture as important factors that made Leaders possible. As the story of the Leaders program is told to potential exporters of the concept, spokespersons should try to identify aspects of the program that will not be easy to replicate.

Senior faculty involved with the Leaders program should try to develop some guidelines and models for how joint research can proceed. Granted, this could develop naturally over time given the incentives of research dollars. Once a few successes are being reported, the program's communications channels should circulate the details about how the research was initiated and carried forward.

CHAPTER 6

SENIOR FACULTY PARTICIPATION

The Leaders program needs to continue to attract senior faculty, especially those who have not traditionally focussed on manufacturing yet have valuable knowledge and abilities to offer. This chapter looks at how the Leaders program can attract and keep the interest of senior faculty.

Several faculty spoke of the need to make the program more "self-sustaining." This phrase suggests that the program could reach some sort of steady state, where the incentives and structures attracted faculty and students at an appropriate rate. This might imply that the program's research and graduates would speak for themselves, success breeding success. It also suggests that faculty, especially senior faculty, feel that they are currently providing too much of the sustaining, at a level that they are not comfortable continuing.

At the same time, several faculty members project that the participation of the faculty will have to grow. One estimate is that at least 10% of all Engineering School faculty is needed. Another view is that the program will need 50% more faculty next year, with each faculty member picking up a little bit more of a load than they currently carry for the Leaders program.

Less Attractive	More Attractive
• The administrative commitment required by the program is becoming	• Faculty involvement with committee work has created a more diffuse

burdensome. There seems to be less payoff for time spent in meetings than there used to be.

- As interesting as the Leaders program is, it competes with many other interesting projects and Institute and departmental administrative duties faculty are already engaged in.

- Expanded learning opportunities have been less than satisfying. Pro-Seminar does not quite fill the need.

- Salary support and research dollars are not yet at a "persuasive" level for the needed additional faculty.

ownership of the program.

- An air of excitement still surrounds the program. Reasons for excitement range from the opportunity to have impact on a national problem, to the intellectual challenge of achieving a paradigm shift.

- The program gives access to companies and people that are hard to come by.

- The designation of Leaders faculty and the 25% salary support that goes with it.

- The Institution's "endorsement" of the Leaders program helps make work done through Leaders more visible.

- Opportunities for social interaction

build bonds and are valued (e.g. lunches after Pro-Seminar last fall)

- The program gives access to bright students and research assistants who are committed to manufacturing.

Discussion

Most of the forces that make participation in the Leaders program less attractive speak to the competition for senior faculty time. Most activities that senior faculty engage in are discretionary, and programs and individuals who want senior faculty involved with them have to compete with each other for faculty interest. If faculty time is the commodity being pursued, it is certainly a seller's market. The potential "buyers" of faculty time are plentiful and diverse. The Leaders program competes with: research efforts the faculty have already initiated and staffed, other sources of research funding (NSF and others), administrative commitments, and a steady crop of new research centers and labs being established, especially at Sloan. The Leaders program needs to be comparatively attractive in this environment. Senior faculty have so many choices that the Leaders program has to have a competitive strategy for getting and keeping faculty involvement.

Of all the many facets of the Leaders program strategy, this facet lends itself best to classic strategic models. First, the faculty of Sloan and the Engineering School can be segmented into several "markets". The Leaders program already enjoys the interest

and support of its most natural market, the Operations Management groups at Sloan, and several Engineering faculty whose research in Mechanical Engineering and Materials Science (among others) have already brought them close to the shop floor. The program's real challenge is to reach beyond this segment. And it is entirely possible that other segments will require a different set of incentives and have different needs for interacting with the program. The Leaders program is a differentiated "product". The question is, does it need to be repositioned to reach a new customer segment?

The analogy may seem a little trite, but it does give some interesting benchmarks with which to evaluate current and potential tactics for attracting other faculty. Below is a review of the important current tactics:

* Building excitement
* Providing intellectual challenge
* Providing financial incentives
* Providing desirable access to people and companies

Building excitement. It is very difficult to put a tangible measure on this factor, yet it could well be the most effective tool the Leaders program has available. Most of the faculty with whom I talked described some way in which the program was exciting to them. There is the sense that the Leaders program is important, at MIT and even on the national stage. It is addressing a problem that has received national attention, i.e., a problem whose solutions could affect the quality of life of the nation. It provides the opportunity to have tangible impact. It is a program with the Institute's "endorsement". It is visible, at the level of a Project Athena or a VLSI Lab. It can provide contacts

with other faculty within the Institute which might never have been cultivated otherwise. It is new, an opportunity to personally effect change. One senior faculty gave this description of what he would say in five years looking back at the program's success: "We did great things, and people knew it."

The need to use excitement as a persuasive lever is recognized in most organizational literature. Apparently it is recognized by engineering faculty at other universities as well. Robert Cannon, Chair of Stanford's Institute for Manufacturing and Automation, wrote in a 1985 essay on building a university manufacturing program, "Students, faculty, and professionals will be attracted to university research and to careers where there is the excitement of newness and of doing something for the first time, ... To excite students about manufacturing, one must first excite the faculty about the prospects in manufacturing." [34]

The sense of excitement among a small core of faculty close to the Leaders program is quite tangible. The intensity of that excitement diminishes as you move further away from this core. The excitement factor loses its clout against opposing factors the more you come up against competing interests and the nagging sense that the organizational demands of the program are starting to lose their value (e.g. unfocussed or too frequent Leaders committee meetings for example).

Faculty involved in the program are still somewhat bouyed by the zeal that accompanies the first year of most start-up organizations. While signs of a diminution of that zeal are not readily apparent yet, several faculty were concerned that the

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[34]. Robert H. Cannon, Jr., "A Response from Academia", in Education for the Manufacturing World of the Future, p. 56

program could not depend on that same zeal in the second year of the program. Another set of motivations would have to take the lead in driving the program forward.

Providing intellectual challenge. This is an important subset of building excitement. This tactic speaks directly to one of the primary reasons people pursue academic careers. If the program can provide better challenges, it should have an edge. The challenges of the Leaders program are "better" for most faculty currently involved, although the attraction is strongest for those closest to the program's genesis. The challenges the Leaders provides are better likened to the challenges of an explorer than a technician. The intellectual challenges of the leaders program are still unnamed and undefined. It involves the difficult, uncertain process of paradigm shift. For some faculty this uncertainty is part of the excitement. For others, it is too much excitement. Or, they are concerned that compelling projects may never fully emerge. As one senior faculty put it, "right now [the program] doesn't really hold priority yet."

The literature on faculty motivation in voluntary organizations such as universities describes the importance of motivating through intrinsic rewards (Staw, 1983). The intrinsic satisfactions of researching and solving interesting intellectual problems, or of supervising a bright graduate student's work, are very real.

Financial incentives. The program provides salary support and some research grants. The financial incentive seems to have varying success. Where it fails, it does so because it is insufficient, not because faculty are not interested in what money can do or buy. As one senior faculty member succinctly put it, "no dollars, no research." One senior faculty member speculated that the financial support currently offered would be insufficient to persuade marginally interested faculty to substitute Leaders work for what

they are currently working on.

There is an apparent tension here between the intrinsic attractions of the intellectual challenge and the extrinsic rewards for taking on those challenges. It is possible that a faculty member may ignore more interesting work because the financial incentives do not override competing financial incentives (Staw, 1983). However, Leaders is not in a position to change the rules of this competitive environment. It can probably only hope to compete with an attractive combination of financial incentives and intellectual challenge.

Providing desirable access to people and companies. This tactic is an unqualified success, although it is difficult to assess the relative strength of its persuasive power. Faculty have all valued the opportunities the program has afforded for meeting and conferring with new peers. The lunches following last fall's Pro-seminar, the Japan trip last summer, and the steady, meaty newsletters and communications were mentioned regularly. Favored access to sponsor companies that the program provides was often praised. The access to senior company personnel and the trust engendered by the program has been appreciated.

Recommendations

The primary thrust of the following recommendations is to find ways to attract more faculty into the Leaders program. If the program remains people constrained it will have difficulty growing and maintaining the quality of its efforts. While this chapter has been focussed on senior faculty, much of the analysis and the following recommendations can apply to junior faculty as well. (Junior faculty respond to many

of the same forces, however, the tenure decision often overrides these other concerns.)

Consider making larger research grants to engineering faculty. This may mean fewer grants, but it seems as if the program has to take a larger percentage of a faculty member's research budget to really get their attention. The program could discriminate with these larger awards, offering them to faculty who are "hold-outs" from the program, whose research interests would be helpful but have not been applied to manufacturing yet. Such price discrimination holds obvious equity problems. However, these problems could be overcome if the core of Leaders professors could reach a consensus on how the plan worked.

Now that the program vision and some of the important administrative patterns are virtually in place, the program needs to generate excitement around the intellectual substance of the program. If activity breeds interest, the program could use a few research "jack rabbits" to step out with some unconventional research initiatives. Someone needs to set an early role model that people can follow and critique. The jack rabbit role is a high risk role to take and should probably be taken by senior faculty members who are close the Leaders program.

Use the present Leaders communication channels, and think of new ones, to give recognition to faculty who are "doing great things" with the Leaders program. MIT does not seem to be a place where much public recognition is given to faculty, although recognition can be a powerful motivator for the recipient and others who are listening or reading. Giving Leaders achievers a high profile could help to draw more faculty into the program.

To hold on to the substantial current faculty interest in the program, find ways to

reduce administrative/committee commitments. Many faculty have complained that the committees they are on are meeting too often and not getting enough done. It gives them the sense of the program losing steam and that their committee time is wasted time. A recommendation would be to cut back on all committee time, except where urgent issues need to be addressed. In these cases the commitment should be stepped up, with a real sense of urgency implied. Committees that are under the gun should try to draw in faculty from inactive committees when necessary. Junior faculty could be brought onto committees on an ad hoc basis to help get decisions made that directly affect them (e.g. research, Pro-seminar, etc.) Create action and change with more ad hoc, temporary committees designed to tackle specific issues, and disband when they are resolved. The purpose of reworking committee time is first to try to free up faculty time so that more Leaders research work can be done. Second, it is to try to squelch the source of any faculty resentment toward the program.

Additionally, the administrative function of the Leaders program could be staffed more deeply with full-time people. If some committee work is to be delegated to full time staff, those staffers should have a fairly high degree of comfort with the technical/intellectual content of the program. Understandably, these people may be hard to find. One solution might be to make the program's project manager position a rotating full-time 1-2 year assignment for a senior faculty member or visiting faculty member.

Develop a Pro-seminar specifically for faculty, in which the academic content was given more depth and challenge. Faculty Pro-seminar attendance has been down significantly this term. The seminar does not compete effectively for faculty time

because of a perception that the academic content has been a little light, more suited to the students' learning needs than to the faculty's learning needs. The most valuable part of the last fall's seminar was the lunch meeting that followed. The seminar could be used especially for cross-school learning, bringing up management faculty's engineering literacy and visa versa, or as a forum for continuing on-going Leaders research and developing trial paradigms.

CHAPTER 7

JUNIOR FACULTY PARTICIPATION

Most faculty members I interviewed conceded that junior faculty who commit their time and energy to the Leaders program face greater risks than tenured faculty. One senior faculty member with a stake in the program confided that junior faculty risk their careers and their reputation, and that he is glad that he is not in that position. Another senior participant believed that if the Leaders program failed, one reason would be that, "we didn't promote the junior faculty who got involved in the program."

This chapter will take a look at the forces acting upon junior faculty members who choose to commit to being involved with the Leaders program. Specifically, I will look at those forces as they relate to the tenure decision.

Denied Tenure

- Many faculty perceive that the Leaders program can't protect them in making their tenure case. The standards applied really come from their peers in their discipline, within and from outside MIT.

- The tenure clock keeps ticking. Leaders projects look like they will

Granted Tenure

- The Deans of both schools are on the Leaders' Governing Board, and senior faculty from several departments are in involved with Leaders. This means that the Leaders program should have some important representation in tenure cases.

take longer to yield results. This means fewer articles within the five and one half years.

- Leaders' research is seen to be at greater risk of not being publishable.

- Doing teaching and providing thesis advice can steal away from research time if the work is not directly related to current research.

- The Leaders program has encouraged joint research. Unfortunately, jointly authored papers make it difficult to judge the individual achievement of either author. Thus joint papers have less weight in tenure decisions.

- The Leaders program gives junior faculty greater access to senior faculty. This access can give them better advice about how best to spend their time and how to work within the MIT political environment.

- MIT seems to "endorse" the Leaders program. This is seen as a signal to faculty that if they work with the program they are not completely on their own, that all thing being equal they will be better supported if they work on Leaders.

- Faculty whose work is either aligned with Leaders projects or whose work already faces the same challenges in getting published see greater risks in working with Leaders.

- Leaders provides access to

companies, grant money, and research ideas that would otherwise have to be secured through individual efforts. This access cuts down on the "overhead" of doing research, thus allowing faculty more time to do the research.

- Leaders is attracting new faculty to MIT who are interested in succeeding with the program. A few new faculty said that Leaders was one of the big reasons they chose MIT.

Discussion

Even if the Leaders program is wildly successful in providing practical solutions to sponsor companies' manufacturing problems, it will have failed junior faculty if the research that comes from this work does not meet the standards of the various academic disciplines. Junior faculty answer to the academic standards of their peers at MIT and their peers who practice within their discipline at other universities. According to the lore of the academy, the most important measurement of scholarly achievement used in tenure decisions is the number of publications a faculty member has placed in

the journals refereed by his/her peers. As long as this measure holds the most weight, the Leaders program will depend on scholars outside of MIT to make favorable choices.

The literature on universities confirms the importance of peer groups outside of a faculty member's university in bestowing approval. "As a professional, the appropriate peer group for praise and symbolic reward is usually the faculty member's profession rather than the employing institution." [35] Because of the level of specialization achieved in universities, departmental peers are often not in a position to adequately judge each other's scholarly work. The scholar is not, "dependent on the judgements of his institutional colleagues concerning his research. ... Rather, he presents his work to those in his field who can pass competent judgement, and these specialists are for the most part scattered over the academic landscape." [36]

Tenure decisions also involve the judgments of senior faculty and Deans. While these people look carefully at evidence such as journal publications, they take into consideration other less objective data. The Leaders program has been fortunate to involve two school Deans and many senior faculty. The hope here is that these people will take a more personal interest in faculty who have made a commitment to the Leaders program. The question remains, however, as to whether the Leaders program effectively "go to bat" for junior faculty in making their tenure cases. It could be argued that Deans and senior faculty can only help you after you have made it through

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[35] Barry M. Staw, "Motivation Research Versus the Art of Faculty Management," The Review of Higher Education, Summer 1983, Vol. 6, No. 4, p. 312.

[36] James A. Perkins, "Organization and Functions of the University," in The University as an Organization, James A. Perkins ed., New York: McGraw Hill, 1973, p. 7.

your own department's appraisal. Unless your department or area has senior faculty who are involved in the Leaders program, your commitment to Leaders work may not have value unless it has also passed the approval of peers within your discipline.

Given this analysis, it would seem that the Leaders program has little direct influence in the tenure decisions of the junior faculty who work in the program. If junior faculty are at all risk averse, it is understandable that they are reluctant to abandon "safe" routes to tenure and take on the challenges that the Leaders program provides. However, it was clear that several forces provide rewards that are only available if the risks are accepted.

One striking impression from the interviews was that every moment of a junior faculty member's time bears an opportunity cost. An hour spent with an advisee is an hour that could have been spent conducting telephone interviews, working in a lab, or preparing a grant proposal. While this opportunity cost argument could be made for most people, it seems especially true for people who have five and one half years to do the "right things," and have almost complete freedom to decide what those "right things" are and how to get them done. Very little is absolutely required of them (only teaching 1-2 classes per semester), and their promotion and career depend little on those required activities. Therefore, making good decisions about what to spend time on concerns junior faculty, as does how to accomplish a great deal in little time.

The Leaders program can greatly aid a junior faculty's choice and time management concerns. The program has offered research money, money made available through much less time consuming and restrictive channels than is the norm. It has provided access to high level company contacts, something that often takes time and is not

always successful. It has provided regular contact with senior faculty who not only provide insights for research, but who also help junior faculty negotiate the MIT political landscape. In short, the Leaders program can provide high quality research sites and contacts, research dollars, and senior faculty exposure, with less time investment. These factors could lead to more research of a higher quality.

It should be noted that a few junior faculty felt that participation in the Leaders program offered substantially greater risks than the ones they already faced. This was true either because they are already pursuing research areas that conveniently fit what could be viewed as Leaders research, or because their research has always been interdisciplinary and is a challenge to publish.

The Leaders also is the beneficiary of what could be called the Institute's "endorsement." This endorsement is entirely unofficial yet functions to give the Leaders program a status above other collaborative efforts at the Institute. MIT is a place where faculty do their own thing, commonly as individuals, and answer primarily to the standards of their own academic circle and the sponsors who fund their research. However, projects of the Leaders' scope require a great deal of collaboration and more money than an individual acting alone could hope to raise. Collective action is needed, and if the program gains the support of Deans, the Provost, and the President of the Institute, that action can be called forth. Through the efforts of these people, the Leaders program gained funds and publicity that could be considered the equivalent of endorsement. Given the prevailing decentralization of MIT, garnering such an endorsement is extraordinary. This endorsement has given several junior faculty the impression that research done through the Leaders will be looked upon favorably. As

one junior faculty member put it, "I have to be concerned about how others perceive that I spend my time. I stay involved with the Leaders program because I know it has the approval of my Dean and the Institute. If it were more of a "grassroots" effort I probably wouldn't be involved." It is important to be clear here, however. The endorsement is a perception that encourages more junior faculty participation. Whether the endorsement is truly a force that can deliver in tenure decisions is less clear.

Recommendations

The Leaders program needs to find ways to have greater influence in tenure decisions. This influence could come through pressing for changes in tenure criteria at the Institute, through its influence over the scholars who set publication standards in the various related disciplines, or by finding ways to stop the tenure "clock" for periods of time during a junior faculty member's tenure evaluation period. The two schools should consider joint Leaders appointments of senior faculty who could have a voice in tenure decisions at each school where Leaders faculty are involved. The real purpose of having greater influence is to reduce the risks that junior faculty take in participating in the Leaders program. Without reducing risks, the number of junior faculty available to the Leaders program will probably not grow.

While the program can augment the rewards available to those who take the risk and get involved (e.g. larger grants, closer senior faculty mentoring, and so on), these rewards do not change the rules of the tenure decision. For junior faculty decided upon making a career in academia, the destination, tenure, counts more than the quality of life along the journey. Efforts to influence junior faculty are probably best spent on

affecting the tenure decision.

CHAPTER 8

ATTRACTIVENESS OF THE PROGRAM TO PROSPECTIVE FELLOWS

The vision articulated by faculty members interviewed included the placement of a high percentage of Leaders fellows in manufacturing jobs. It also spoke of the desire to raise the average quality and experience level of candidates accepted to the program. Several faculty saw a connection between these two elements of the vision: if graduating fellows get good manufacturing jobs then the program will become more attractive to people, even experienced people, who want to advance in the manufacturing environment.

Some faculty gave numerical standards for these elements of the vision. One said he would feel the program is succeeding if 85-90% of the graduating Fellows take manufacturing or manufacturing related jobs, and if 60% or more take a job at one of the sponsor companies. Another number to watch is the applicant to fellowship available ratio. Currently there are 100 applications for 30 fellowships. Another faculty member said he would like to see that number go up to 240 or 300 for 30 spots.

In this chapter I will analyze the forces that make the Leaders program more or less attractive to potential applicants. The analysis will include the issue of the jobs Fellows take after the program, for this track record has a direct affect on the applicant pool. Some forces discussed are not yet fully operational and may never become so. They are included because the prevalent perception that they may be a problem or an aid has an impact on what prospective students believe about the program.

Less Attractive

- It is widely speculated that manufacturing firms will not be able to pay "MIT wages" (or MBA salaries) and attract the graduating Fellows. A high percentage of Fellows many be wooed away by higher-paying opportunities at investment banks and consulting companies. If this happens, prospective Fellows would then not be clear about the distinctive value of the program over an MBA.

- Fellows may have over-inflated expectations of what the program can do for their career prospects. If the first few classes are dissatisfied, word will get out.

- The career guidance function appears to be informal, limited to sponsor companies.

More Attractive

- Full tuition support and a generous stipend are provided for all Fellows for both years.

- The program is virtually unique. Few programs of national stature offer the future plant manager such a combination of management and engineering courses at such an early point in their careers.

- If early graduates take manufacturing jobs, are successful, and the news of their success gets out, such role models will attract interest.

- Degrees from two "top-ten" graduate schools can be achieved in only two years.

- The program is on the vanguard of what seems to be a national

- Practicing engineers (with a few years of experience) are not convinced of the engineering master's and choose the MBA route.

- The program is still somewhat controversial at MIT and still at a formative stage. Prospective students may not want to step into the middle of unresolved issues.

"mission" to become more competitive. It has patriotic as well as professional allure. It sets students apart.

- The program offers a meaningful six-month internship with a sponsor company.

Discussion

A concern shared by faculty, students, and sponsors alike, is that neither sponsors nor other manufacturing companies will be able to offer an attractive enough pay and location package to attract graduating Fellows.

Two factors (possibly more) inform this concern. The first is that sponsor companies acknowledge that it will be difficult to restructure their company's pay system in order to be able to pay consultant's salaries to twenty-four year old graduates of the Leaders program. This factor alone was enough to scare off some prospective sponsor companies. Caterpillar Tractor supported the concept of the program but felt that they would not see the payoff because they would not be able to attract students to their plant locations at the salaries that they could offer.

The second is that Leaders Fellows are immersed in the Sloan environment and hear the discussions and feel the pressure to land a high paying job. One faculty member believed that there are universities better suited to running a Leaders-type program because the average salaries offered to their business school graduates are more on a par with engineering offers than MIT's are.

The financial support offered by the program provides varying degrees of attractiveness to potential students when viewed in relation to the students' alternatives. Prospective fellows who apply through the Sloan School are often considering other MBA programs as well. Most business students finance themselves through loans and savings, so that the lure a free ride is probably strong. Prospective Fellows who apply through the Engineering School may also be considering other graduate engineering programs. Those programs often provide financial support, so the difference between the Leaders program and their alternatives is not as wide. This diversity of alternatives may have the affect of making the Sloan applicant pool for the Leaders program a more deeper, more experienced, and competitive pool. One indicator of this may be that the average age and work experience of current fellows who were accepted through Sloan were more than two years greater than their peers accepted through the Engineering School.

The career guidance function of the Leaders program has been informal to date, and is in some sense constrained by the program's relationship to its sponsors. While sponsors have no obligation to hire graduating fellows and Fellows have no obligation to prospect exclusively at sponsor companies, it would be awkward for the program to actively support the interest and recruiting efforts of non-sponsor companies.

Undoubtedly, an important reason sponsor companies have invested in the program is the access it give them to promising manufacturing talent. Yet no exclusive access was ever agreed to. However, if the program encouraged non-sponsor companies it would, in a sense, be encouraging a "free rider" problem. Non-sponsor companies, without investing in the students, could invest instead in their recruiting efforts. To some extent companies such as Stanley Works has been able to do this through their own initiative.

The career guidance offices of the Sloan School and the Engineering School have been marginally involved to date. They have no formal responsibility to the Fellows, but are beginning to provide some advice. While the program has no official career guidance function, it has assured Fellows that sponsor companies will have opportunities. The sponsor companies have not actively recruited yet because of their agreement with the program to let the Fellows concentrate on their studies and internship during their first year and a half. While this makes sense, some Fellows have become concerned and have pressed the issue.

Several people involved with the Leaders program felt that the expectations of the Fellows, sponsors, and even the public need to be managed. The feeling is that the program has overpromised, that 30 people per year are not going to revolutionize American manufacturing, that two degrees in two years is not equivalent to two degrees in three or four years. These people are concerned that the program will not be able to deliver up to the expectations of its "clients".

A related concern is that the program has been too public. With the program positioned at the vanguard, the public will be expecting a great deal, possibly more than the program can realistically deliver. Some are concerned that the expectations of

the Fellows themselves are inflated by such coverage. Their sense of the impact they can have probably exceeds what they will actually be able to accomplish in their first few years on the job. To the extent they are frustrated because of this, word would probably get out to prospective Fellows.

A word should be said in support of building expectations, however. As suggested with regard to faculty, creating a sense of purpose and excitement is vital to the program. With few irresistible incentives to offer and no established structures or traditions, the program depends on aspiration and excitement. I would argue that high expectations and a grand sense of purpose were essential to the program ever getting off the ground. It had to risk creating this problem of unmet expectations if it was ever to exist in the first place.

A final force to be discussed is the powerful affect that a national crisis can have in boosting the attractiveness of a program such as this. As one faculty put it, "without Japan, there would be a lot less interest all around." The Leaders program benefits from the flurry of press interest in the manufacturing competitiveness of the U.S. Not unlike Sputnik's effect on science and math education, the manufacturing competitiveness crisis has begun to raise the prominence of manufacturing as an important career.

Recommendations

The career guidance function needs to be better defined. A definite set of recruiting ground rules should be established in collaboration with sponsor companies. If priority is to be given to sponsors (without obligations or guarantees), it should be made explicit. A recruiting calendar of events should be established. A program of relations

with interested non-sponsor companies should be articulated and pursued. These efforts are important not only for helping to manage sponsor relations and to ease the minds of concerned Fellows, but also because the program will have to actively help Fellows uncover high paying opportunities. Several Fellows (this year especially) have little job search experience and are unlikely to know much about how to find those few, sought after high paying manufacturing jobs.

A career guidance function can also help to manage Fellows expectations about their careers. By being proactive it could help them become more realistic about starting salary without feeling cheated somehow. It could offer to be a resource and job clearing house for Fellows throughout the first 3-5 years of their manufacturing career, helping them find the right position even if the first one doesn't meet their expectations. By following the initial careers of Fellows the program could also stay close to the real success stories, involving those people in recruiting prospective Fellows.

The program should actively pursue ways to expand the applicant pool. The full tuition and stipend feature of the program could be promoted more widely. This feature should be especially attractive to prospective MBAs who would otherwise expect to finance themselves. The program should try to list itself in information clearinghouses that provide information about scholarships and Fellowships.

The curriculum needs to continue its evolution. The program has to reconcile the desire to give two degrees, with its interest in limiting the program to two years and providing a more focussed education than a simple mix of engineering and management courses could provide.

CHAPTER 9

SUMMARY AND OPINIONS

In many respects, the Leaders for Manufacturing program is involved in all stages of the change process, still refining its vision at the same time it is delivering classes and funding research projects. Because change is an iterative process, it is not necessarily inappropriate for the program to be operating at various stages simultaneously. If the leaders of the program can manage frustrations bred by a "ready, fire, aim" approach, their reward will be quicker feedback and adjustment of the change process. This chapter summarizes the Leaders program's efforts in each stage of the Beckhard and Harris change model, and makes some final assessments of how the program can succeed.

Why Change? - After accepting the generous sponsorship of eleven companies, MIT lost a degree of choice about whether or not to change. As an organization, MIT has an obligation to try to meet the goals set forth for the Leaders program. It can opt out only if sponsors fail to support the program as they have promised. The organization depends on the voluntary efforts of individuals, each of whom does have the choice about whether or not to change. There is no pressing crisis for these individuals that insists upon their involvement with the Leaders program. Only the persuasive power of intriguing intellectual content, the opportunity to affect industry, research funds, or the Institute's endorsement, address the "why change" question.

The Future State - The Operating Committee of the Leaders program has given much consideration to the formulation of a mission statement for the program. This

Committee has also attempted to describe a vision of what the future state of the program would look like. The research for this thesis attempted to do much the same thing with the faculty interviewed. Given the decentralized, autonomous environment the program functions within, it is encouraging to see that a single vision of the program is fairly widely shared.

However, this vision runs into problems as it is used as a basis for developing more specific visions for program areas such as research or curriculum. Some members of committees responsible for creating these more specific visions feel that the program's vision is too general to be useful. Others are frustrated with all of the "soft" up-front work that creating a specific vision requires. They are anxious to get on with tangible actions even when there is not yet the clear vision that is so critical to the selection of the actions to be taken. In such an environment there is a risk that the overall program vision will not get "hard-wired" into all aspects of the program.

Present State (described more fully in Chapters Two through Eight) - In the absence of crisis and/or direct authority, the Leaders program has used positive incentives to attract faculty, students, and sponsors. The incentives are designed to help overcome the various sources of resistance to the changes the program is interested in achieving. Several sources of resistance still loom large. Tenure criteria and the weighting of those criteria constrain junior faculty participation. The historic low pay and low prestige of manufacturing careers threaten to keep applicant pools on the small side. The mechanics of paradigm shift are either not widely understood among the faculty, or are too unattractive. Ground breaking research will find few adherents in these circumstances. Even when new research is discussed, some faculty suggest that, "the ideas be focussed

on researchable topics or problems." "Researchable" problems are the staple of normal science. They will attract researchers, but will probably not yield a paradigm shift.

While the faculty's readiness to change is a volatile variable, its capability for change is less of a problem. Senior faculty have the power and influence to change curriculum, choose their own research topics, make tenure recommendations, and pressure journal boards to publish Leaders articles. There are very few obstacles to change that faculty have no control over.

Getting from Here to There (described more fully in Chapters Three through Eight) - The Leaders program has implemented several structures which assist change efforts. As a separate entity, existing under the tutelage of no one department, area, or school, the program can create its own rules and its own history. While it must work with the cultures of each school, it is in a much better position to attempt to adopt new ways of operating. The creation of committees allowed consensus decisions to be made in the decentralized, individualistic environment. Most likely, a more autocratic decision-making apparutus would not have been acceptable. The committees also had the advantage of being new, and almost ad hoc. Groups with a short term objective are often more effective in making change happen, and these Leaders committees operated with much the same vigor. Now, however, the committees are becoming more institutionalized and less outcome or objective oriented.

For all of its Institute "endorsement" and visibility in the press, the Leaders program is still a very small part of MIT. It is seen by some faculty outside of the program as simply an unwelcome competitor for faculty time, students, space, and funding. As such, it is not in a position to force radical institution-wide change. For example,

attempting to change the Institute's guidelines on tenure evaluation would probably be less fruitful than developing means of meeting the Institute's guidelines while still meeting the program's objectives (e.g. creating new publishing outlets and stacking tenure review boards with professors from several Leaders departments.)

The program has benefitted significantly by having the right people driving the change effort. Both co-directors are senior faculty members with experience in department leadership. They are respected as researchers in their own field of specialty. They are regarded for their effective interpersonal skills. According to Beckhard and Harris these are qualities important for effective change leadership.

Final Impressions - Much of the planned activities of the Leaders program seems to hinge on the development of a new paradigm for manufacturing. Until it emerges, many faculty will not be drawn to concentrate on "Leaders" research, textbooks will not be written without a coherent set of principles to rest upon, new curriculum will not be developed without a new intellectual basis. MIT is a research institution, and without this fundamental building block of research, the program will have difficulty reaching its goals. Paradigm shift is the first "domino" that can influence many others.

The rewards that come from involvement with the Leaders program are not completely aligned with the goals the program desires. Tenure criteria and weighting of criteria make junior faculty reluctant. The relative size of research grants for engineering faculty are not competitive enough to draw significant attention to the program. The intellectual satisfactions are unclear to some. Those who are not particularly interested in finding new paradigms may be frustrated working on puzzles that may have no answers. The starting salaries and career prospects in manufacturing

for graduating Fellows are currently not as competitive as several non-manufacturing options.

The Leaders program's primary strengths are its organizational structure and its leadership. The program has, to date, achieved an admirable degree of balance between the two schools. The explicit support it enjoys from the two schools' Deans and MIT officers has given it funds and goodwill well beyond programs of similar size. Its "administration by committee" operation has helped gain broad commitment from faculty.

The role of leadership can not be underestimated. A research culture does not tend to support collective research activities, research without a paradigm, or cross-disciplinary work. The culture is defined by the autonomous actions of each faculty member and the departments to which they are attached. Yet the Leaders program has at least started to create something different. The "something different" requires change for most people involved. Getting people involved when the rewards are unclear requires that the leaders of such an effort be trusted, that they engender a faith that the program will have an impact. Apparently they do engender faith and are trusted. One faculty member said that the program co-directors could be trusted to "take care" of faculty who got involved. Another cited the openness and welcoming way of key Leaders insiders.

The Leaders for Manufacturing is an ambitious program which bucks cultural norms and strives for lofty goals. It may have over-reached. Yet it has survived significant resistance already, often through the strength of such intangible factors as excitement, interest, and leadership. Its future success will continue to depend on these factors.

Several faculty believe that, "if we can't do it, nobody else can either." That is, they believe that MIT is uniquely qualified to be a pioneer of such a manufacturing program. The program needs the confidence implied by this statement, but must be wary of the hint of complacence. The sense of world monopoly American manufacturers felt during the post-War period blinded them to Japanese advances. It may be that MIT is best qualified. But, without sufficient effort it may not emerge as the market leader.

APPENDIX A

A copy of the following interview guide was sent to most of the faculty interviewed prior to the scheduled interview. Virtually all of the interviews conducted touched upon these four question sets, allowing a quantitative as well as qualitative content analysis of interview results for these questions.

QUESTIONS TO CONSIDER

Below are a few questions to consider before our interview. As you can see, I hope to address both where you think the program is headed and how you think it will get there. I look forward to our meeting.

- Envision that it is the year 1995. The Program has been extremely successful in your view. What three things would you hold up as evidence of its success? What is it about the nature of the Program that has caused these successes? What is the program's stature within the MIT community?

- Envision that it is the year 1995. The program has been cancelled. It greatly failed to meet your expectations. What three things would you hold up as evidence of its failures? What is it about the nature of the program that has caused these failures?

- For you, what is the riskiest part about committing time and energy to LFM research, administration, or teaching? What is the greatest payoff of such commitment that you could imagine for yourself?

- What structures are currently in place as part of the LFM program that encourage and support your involvement? What structures should be developed or enhanced?

APPENDIX B

NAMES AND AFFILIATIONS OF THOSE WITH WHOM INTERVIEWS WERE CONDUCTED

NAME	AFFILIATION
Rosalie Allen Administrative Assistant	Leaders for Manufacturing program office
Gabriel Bitran Professor	Management Science Sloan School
Kent Bowen Co-Director, Leaders for Manufacturing	Materials Science and Engineering School of Engineering
Marie Cedrone Administrative Officer	Leaders for Manufacturing program office
Thomas Eagar Professor	Materials Science and Engineering School of Engineering
Charles Fine Assistant Professor	Management Science Sloan School
Kevin Freund Fellow	Leaders for Manufacturing
Michael Graves Assistant Professor	Aeronautics and Astronautics School of Engineering
David Hardt Professor	Mechanical Engineering School of Engineering
Rebecca Henderson Assistant Professor	Management Sloan School
Charles Holloway Visiting Professor	Management Science Sloan School
Thomas Kochan Professor	Industrial Relations Sloan School

NAME	AFFILIATION
Thomas Magnanti Co-Director, Leaders for Manufacturing	Management Science Sloan School
Donald Rosenfield Project Manager, Senior Lecturer	Leaders for Manufacturing
Emmanuel Sachs Assistant Professor	Mechanical Engineering School of Engineering
David Staelin Professor	Electrical Engineering and Computer Science School of Engineering
Lester Thurow Dean	Sloan School
Marcie Tyre Assistant Professor	Management Sloan School
Gerald Wilson Dean	School of Engineering

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