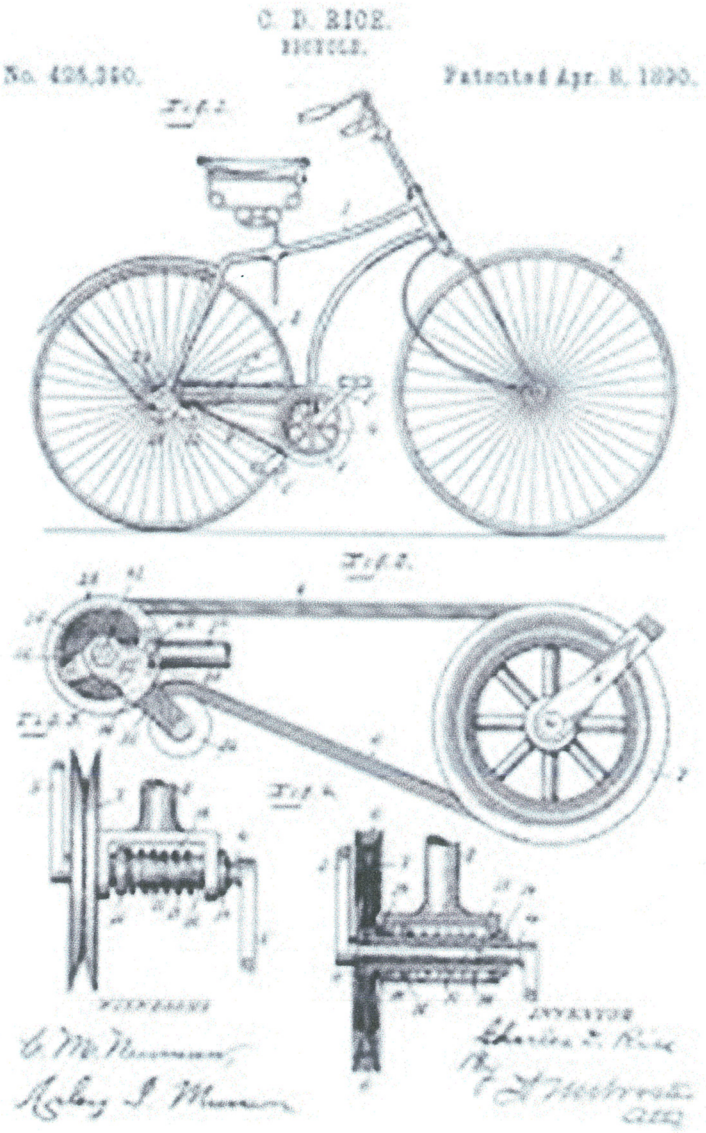
Maine Entrepreneurial Institute:

W.K. Kellogg Foundation

1975: $1,000,000



Challenge

"If anything imaginable is possible, if there are no constraints whatever, what would be the nature of a trustworthy organization to…

effectively facilitate the fair exchange of intellectual property

including trade secrets in a virtual world."

Dee Hock, VISA founder

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PROJECT
NEW ENTERPRISE

A Proposal* for an Experiment
in
Innovation and New Enterprise Formation

Submitted to the
Office of Experimental R&D Incentives
National Science Foundation

By the Project Team

Center for Research and Advanced Study
University of Maine at Portland-Gorham

M.I.T. Development Foundation

Principal Investigator

Halsey Smith, Director

Co-Principal Investigator

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November 30, 1973

*Incorporating the results of the Phase I Planning and Background Study conducted by the Project Team under Grant DI-3950.

PART I
PROJECT PLAN

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ACKNOWLEDGMENTS

This document has been prepared in a joint effort by the M.I.T. Development Foundation and the University of Maine Center for Research and Advanced Study, under the general guidance of Messrs. Halsey Smith, R. S. Morse, and John O. Flender. Mr. H. Nelson Upthegrove, MITDF, was project director in this Phase I planning effort. At M.I.T., Mr. Arnold J. Herzog and Professor Arthur Gerstenfeld (Boston University) made major contributions. In Maine, Mr. Harry J. Waters directed the work. He was supported by Messrs. Donald A. Annett, John G. Campbell, F. J. Crozier, Gregory A. Deprez, Robert E. Doucette, Albert A. Fitzpatrick, John F. Mariner, Richard L. McKeil, Robert C. McMahon, E. Grosvenor Plowman, Alvin O. Rogers, and Ms. Patricia Solotaire.

ABSTRACT

National Science Foundation Grant No. DI-39501 to the M.I.T. Development Foundation, Inc. (MITDF) provided funds for a three to six months collaborative effort of the MITDF and the University of Maine Center for Research and Advanced Study at Portland-Gorham (CRAS) to plan a Maine experiment to test a potential national policy for the stimulation of innovation and new enterprise. The operational objective of the proposed experiment is to alter inhibiting factors and influences and activate the innovation and entrepreneurial processes.

M.I.T.'s Sloan School of Management has long been engaged in studies of innovation, technology transfer, and new enterprise formation, using much data from the Boston 128 area, where these processes have been intensely active since World War II. The results of these studies are the basis for the planned experiment.

Maine is 49th among the states in economic growth rate. It suffers an outflow of its educated youth, and it is handicapped by its geographical isolation A few large, out-of-state based paper companies dominate the industrial scene, and the state has traditionally depended upon the seasonal and exploitive tourist and resort business. There is widespread concern within the state and evidence of a vigorous determination to reverse the trend in the state's circumstances.

Maine lacks the active, complex networks of people and institutions required to generate and sustain innovation and new enterprise processes. It has no venture capital organization. The experiment plan calls for the creation within the CRAS, of a Maine Institute for (1) Innovative Enterprise (IIE) and for the establishment of a Maine venture (2) capital group.

The Wood Turners and Shapers are a Maine industry of about 60 firms. Mainly supplying piece parts to out-of-state manufacturers, they are mostly old, family owned businesses. This industry, relatively isolated and almost exclusively dependent upon their existing customers, will be an initial test for stimulation of innovation in an existing business.

The experiment will be measured with techniques developed and demonstrated for the assessment of technological communication and innovation activity in an isolated underdeveloped country. An initial baseline measurement will be compared with interim and final measurements to identify results and relate changes to project activities.

The experiment is planned on a five year basis, with a total budget of $2,044,010. Approval is requested now for the initial three years; with a total budget of $1,127,820. The project will be conducted on a cost sharing basis. $1,022,680 in NSF funds are sought for the first three years; the five year desired funding is $1,466,260.

Section 1

INTRODUCTION

The NSF Program Framework

The NSF Experimental R&D Incentives Program was announced in 1972 as part of a broad effort to promote the increased utilization of new technology by all sectors of the economy and to stimulate greater non-federal investment in R&D. The process of innovation and technology transfer through the formation of new enterprise was evident in the M.I.T. - Cambridge area as early as 1940. The rapid expansion of this activity in the post World War II period has been widely publicized as the "Route 128 Phenomenon". The new enterprises and spin-off's from M.I.T. and associated laboratories have been studied by M.I.T.'s Sloan School of Management and by Arthur D. Little Company. M.I.T.'s Sloan School, with Professors Donald G. Marquis, Thomas J. Allen, and Edward B. Roberts, has perhaps been the principal source of rigorous research into the process of innovation, technology transfer, and new enterprise formation, In recent years, other institutions, including, for instance, George Washington University, Stanford University, the University of Michigan, and Harvard University, have begun to study this process as it has occurred in various locations. This other work has largely reinforced the findings of the M.I.T. group and has, as appropriate, been incorporated with the M.I.T. work in planning the proposed experiment. In the early 1970's, the national concern for enhanced technological progress was felt at M.I.T. in terms of increased pressure for relevance. The M.I.T. Development Foundation (MITDF) was formed in 1972, to develop better knowledge of the pertinent phenomena, and to stimulate one specific form of technology transfer, the translation of unexploited ideas at M.I.T. into viable new enterprises.

At about the same time, the State of Maine, in response to a generally lagging economy, undertook a variety of actions to plan for and to stimulate desired forms of economic growth. One action created, at the University of Maine (Portland-Gorham), a new Center for Research and Advanced Study (CRAS) to provide an academically affiliated institution for work directly related to Maine's economic problems and needs. Mr. Halsey Smith, Director of the CRAS, initiated discussions with the MITDF to explore possible areas of cooperative endeavor to find constructive solutions for Maine's problems.

The NSF Program announcement presented an appropriate framework, and a series of discussions between Mr. R. S. Morse, President, MITDF, and Messrs. R. L. Bisplinghoff, C. B. Smith, and Arthur Ezra of the NSF, confirmed the idea that a joint MITDF-CRAS experiment in innovation and technology gransfer in Maine would support NSF's national objectives.

Definitions

At this point, it is in order to define certain key terms as they are used in this report.

Innovation is the process by which a new idea proceeds from the conception or invention stage, through analysis, problem-solving, and development, to production and diffusion into use in the market place. It may apply to either product or process.

Technology Transfer is the process by which ideas move between people, organizations, and institutions.

A New Enterprise is a new business or organization operating where none existed before. In general, we assume that a new enterprise is part of the innovation process and that technology transfer is involved.

The Essential Experiment

The concept of the proposed experiment is simple. Based on the accumulated research results from more than a decade of serious studies of innovation, technology transfer, and new enterprise in the Route 128 area and elsewhere, it is believed that the elements missing in Maine, where little innovative new enterprise is developing, can be identified, and a plan designed to reduce these deficiencies and actually stimulate an on-going new enterprise process there.

The plan which follows outlines a five year program. At this time, funding is solicited for the first three years, on a decreasing, cost-sharing basis. The proposal includes the creation of two distinct new institutional elements in Maine and the operation of one of the elements to aggressively stimulate and strengthen communication and interaction among the people and institutions required for the innovation and new enterprise processes.

The Experiment Team

To be successful in Maine, this experiment must be a Maine project. The bulk of the actual activities and expenditures will, over

the five year life of the project, be in Maine. At the same time, the base of experience and involvement in mature processes of innovation and new enterprise formation represented by the MITDF is essential to the experiment. Thus, while the initial planning grant was made to the MITDF, the Phase II grant for implementation of the experiment is solicited for the University of Maine (CRAS). The MITDF will function as a sub-contractor to the CRAS for the project. In conjunction with the preparations for the planning effort, an advisory Board was assembled to provide Phase I guidance. Members were: Professor Patrick R. Liles, School of Business, Harvard University; William Elfers, President, Greylock Management Corp.; Dean Albert J. Kelly, School of Management, Boston College; Robert A. Duffy, Vice President, Charles Stark Draper Laboratories; Kenneth J. Germeshausen, Director and Consultant, E.G.&.G., Inc.; and Dean James S. Hekimian, College of Business Administration, Northeastern University. These members of the board were chosen on the basis of their broad experience in the venture capital-new enterprise process.

A Two Phase Program

In December, 1972, the M.I.T. Development Foundation submitted to the National Science Foundation an initial proposal for a Phase I, or Definition Phase activity aimed at the development of plans for a Phase 2, or Operational Phase experiment, in innovation and new enterprise formation in Maine. In June, 1973, NSF awarded Grant No. DI-39501 for the first, planning phase portion. This report is the result of that work and is the proposal for the Phase 2 project. The report consists of eleven sections, in two major parts, and Part III, the Appendices. Part I briefly summarizes the development of the project and describes the planned experiment. Part II includes detailed results of Phase I activities and is essential background for the plan in Part I.

Section 2

OBJECTIVES

The NSF RDI Program seeks to identify incentives or policies which can be applied nationally to achieve the goal of improved utilization of technology. The objective of this project is to test, by a measured experiment in Maine, a possible national policy. This potential policy can be described in terms of an experimental hypothesis as follows:

> If it is given that, (a) there are locations where particular people and organizations can be identified as key elements in the operation of mature processes of innovation, technology transfer, and new enterprise formation, and that (b) there are economically lagging areas where technology-based innovation and new enterprise would provide desirable economic growth; and then, (c) an active linking mechanism is established connecting the economically lagging area to key people in a location where mature processes are operating, it is hypothesized that the linking mechanism can be operated to stimulate the innovation, technology transfer, and new enterprise processes in the economically lagging area.

The project has three secondary objectives. One, expressed in terms of accomplishment in Maine, is to alter factors and influences affecting the level of innovation and entrepreneurial activity, so that the innovation and entrepreneurial processes will be activated in Maine. The second, a research objective, is to measure those factors and influences before, during and after the experiment, and with valid measurement techniques, demonstrate the relation between observed changes and experimental activities, thus substantiating, or denying, the validity of the hypothesis underlying the experiment plan. The third, necessary to the definition of a potential national policy, is to identify and inventory other United States locations, with specific combinations of people and organizations, that could fulfill, in other projects, the role envisaged for the MITDF in this project.

Satisfaction of these objectives will provide a solid basis for consideration of the hypothesized policy and other options available to state or federal governments. The identification of existing barriers and the determination of cause and effect relationships between project

actions and reduction of those barriers will permit delineation of specific guidelines for potential policy implementation.

Section 3

OVERALL PROJECT PLAN

Comparison of the baseline conditions described in Sections 10 and 11 with the research results stated in Section 9 lets us identify the essential changes which must occur if Maine is to have a self-sustaining innovation and new enterprise activity. Section 9 summarizes the background research in a series of assertions:

1. Innovation, technology transfer, and new enterprise formation are processes, not events.

2. As processes, innovation, technology transfer, and new enterprise formation occur through networks of people, who operate through a variety of communication and linking mechanisms.

3. Technical, financial, market and entrepreneurial elements must be present and effectively linked for the development of technology based new enterprise.

4. Though the basic elements must always be present, the particulars of each new enterprise situation will be different. Maine is not Route 128, but with appropriate substitutions, the Route 128 mechanism can be translated into an effective Maine mechanism.

What is missing now? In "A Maine Manifest" (1), Richard Barringer describing the characteristics that distinguish a growth center, concludes that such centers depend upon "... above all, perhaps, a complex network of people and institutions to gather and make profitable use of information concerning new investment opportunities and production techniques." The baseline descriptions indicate that this requirement is not, and has not been, met in Maine. On the other hand, such a network has clearly been present in observed areas of innovative new enterprise growth, as in the Route 128 case.

What does it take to constitute such a network? The research summarized in Section 9 indicates there must be at least:

1. Individual entrepreneur candidates.

2. Sources of venture capital and new venture know-how.

3. Educational and industrial activity exploring and developing a variety of technologies.

4. Educational and professional activity developing and practicing the non-technical skills required in new enterprise.

5. Institutions and linking mechanisms which facilitate and cause active communication among all these elements.

What specifically is absent in Maine? There are some entrepreneur candidates; bankers do receive inquiries for venture capital. Their number, however, is not large, and few, if any, involve technological innovation or fit the success pattern of the Route 128 experience. There are occasional, short-term, workshops or similar efforts to provide entrepreneurial education for limited audiences, but there is no long-term continuing activity in the state's formal educational system. There is technological research and development on a limited scale in the university. In the past, the industry-related activity had been primarily responsive to the needs of a few large firms, but recent efforts have directed more attention to a variety of Maine industries. There is little industrial R&D except in a few large, outside-owned companies. Finally, the situation described in Section 10 and the results of preliminary inquiries indicate that the existing institutional framework simply does not engender the needed activity forces and connecting links.

How is it proposed to change the situation in Maine? The plan calls for adding to and strengthening the existing institutional framework, so that the required active, complex networks will develop. The essential elements of the plan will be described here. Section 4 will cover each item in more detail.

The project will add two distinctly new institutional elements:

1. The most important new institutional element, and the pivotal center of the project, will be a Maine Institute for Innovative Enterprise (IIE). This will be part of the Center for Research and Advanced Study at the University of Maine at Portland-Gorham, and, hence, will be associated with both the Business and Law Schools of the University. This institute will house the principal project staff, and it will be responsible for execution of project activities in Maine.

The initiative and drive of this institute will be the tools used to form the needed linking mechanisms and stimulate communication within the networks. The IIE will be the Maine terminal of the linking mechanism connecting the MITDF to Maine. It will provide a receptive input point for outside stimuli and will maintain continuous collaboration with the MITDF.

2. Working with support and participation of experienced venture capital managers in Boston, the project will be the catalytic agent for organization of a Maine venture capital group, based initially on a consortium of Maine banks.

3. In other areas, such as university research, existing institutional arrangements, such as the Technical Service Program, and the Department of Industrial Cooperation, described in Section 10, will be used and strengthened to achieve the project goals.

In summary, then, the plan calls for:

1. Creation of a Maine Institute for Innovative Enterprise within the Center for Research and Advanced Study.

2. Establishment of a venture capital organization in Maine, and, then,

3. Operation of the IIE to stimulate the networks of communication and activity required for innovation and the formation of new enterprise.

Section 4

PROJECT PLAN - DETAILS

In the Route 128 phenomenon, two parameters were important. The Massachusetts Institute of Technology was present - and there had developed, around it, a group of associated or related specialized laboratories. Government requirements and government funding were crucial to this process and also provided assured initial markets for many of the spin-off businesses. Neither of these conditions is, nor can be, satisfied in Maine. The lessons of Route 128 must be interpreted and modified for fruitful application in the particular conditions in Maine. In Boston, M.I.T. and Federal funds provided a combined incentive or basis of confidence for entrepreneurial initiative. As one succeeded, more ventured, and the process grew. General economic slowdown and, particularly, reduced defense procurement tempered the growth. Government research funds still flow to M.I.T., however, and the M.I.T. Development Foundation's beginning projects show that the process can be accelerated by a different combination of stimuli. This suggests that the National Science Foundation R&D Incentives Program provides an opportunity, using NSF funds, to replace certain parameters of the Route 128 experience with others directly applicable in Maine. In our plan, these parameters are represented by the Maine Institute for Innovative Enterprise, its link to the MITDF and other external support, and its internal initiative and activities in Maine. Its role in Maine will be more than acceleration of an existing process; it will actually change the structure to bring the process to life.

The Maine Institute for Innovative Enterprise

The Maine Institute for Innovative Enterprise (IIE) will be the essential central node of the project. It will link the NSF and the MITDF with the CRAS, the University of Maine, and the State of Maine. It will be the course of energy for project activities during the NSF sponsorship period, and supported by the fruits of its efforts, (Section 7) it will continue to function after the NSF funded project is concluded and the restructured, active networks have become an integral part of the Maine environment.

This does not imply that the IIE must be a large organization. Like the MITDF, it will be a small, but aggressive and imaginative

entity, multiplying the effectiveness of its own resources by virtue of its catalytic role, and, in the beginning using the NSF funds for seed money, leverage, and motivation to create linking mechanisms and to nurture the innovation process.

The Director or Project Manager in the IIE has the pivotal role. He must be enthusiastic, aggressive, broadly knowledgeable, and must be persuasively effective in dealing with a wide variety of people and organizations. It is essential that he have a basis for a strong relationship with the MITDF and the M.I.T. - Boston community pertinent to the project's needs. The geographic spread of project activity may require an assistant or second man on the IIE staff. Basically, however, we see an essential requirement for a strong leader and a professional quality secretary-accountant-clerk. Additional IIE effort will be developed through other Maine participants. (See examples in Appendix B.)

This central individual, who will be responsible for creating in Maine an operation similar to the MITDF, but with additional roles, must be an outstanding man and must be rewarded accordingly. In the long run, his basic compensation (initially using NSF funds) must be drawn, directly or indirectly, from Maine sources. As in other areas, a specific cost-sharing approach is included in Section 7. More significantly for the success of the project, the IIE Director's potential reward should be directly related to his performance in the overall responsibility of developing new enterprise in Maine.

As the MITDF, the IIE is expected to be a vehicle for acquiring, for the benefit of the CRAS and the University of Maine, an equity share of each new enterprise spawned.

The Venture Capital Group

Venture capital money is available in Maine in small increments. Several bankers report that they keep a list of individuals who are ready to provide 5 to 15 thousand dollars for speculative investments. There are other funds which might be tapped; many Maine devotees, resident and non-resident, represent substantial wealth. The state regulation limiting banks to one percent of their total capital in venture investments has inhibited individual bank initiative; the largest bank has less than $20,000,000 of such capital. Total capital of Maine's 41 commercial banks is $130,500,000. Hence, it appears that a joint venture or consortium of banks approach can provide a financial base for a venture capital corporation, but additional sources of funds will have to be found. A group of Maine banks did join together to form the Maine Development Credit Corporation (MDCC) to accomodate ordinarily non-bankable loans. This has been active and moderately successful. It

is not a venture capital mechanism and does not appear to be an appropriate base from which to begin venture capital operations.

This project requires the formation of a new, broadly-based Maine venture capital group. Letters included in Appendix C reflect preliminary discussions with key bankers and state banking officials. They confirm the appropriateness and timeliness of the project for Maine. Under the guidance of the MITDF and experienced managers from Boston venture capital groups, an organization committee will be assembled from this group of key institutions. Alternative forms of organization and operation will be identified and evaluated, and a specific plan prepared for the group's implementation. Plans will ensure that other potential participants are appropriately informed of this activity to prepare for their eventual participation. This approach is essential to generate enough total capital for an effective scale of operation. Providing able management for the new venture capital group will be a critical problem. Experience has repeatedly shown that established, conservative bank managers are not usually effective in the venture capital field. So, while the participant banks can be expected to provide administrative support, it will be necessary to provide, from outside, venture capital management expertise. Until the organization is healthy enough to afford full-time, qualified staff, the project will generate this expertise from three sources. First, the MITDF will be directly involved. Second, the MITDF will obtain the participation of experienced Boston venture capital managers. Third, we will use the proffered services of retirees or other Maine participants. Brief resumes of some of these people are included in Appendix B. With successful operation and growth, the Maine venture capital corporation will be able to afford and attract qualified management for its continued operations.

This approach is expected to result in a funded organization, ready to consider its first venture capital investment within six to twelve months.

Direct costs to the project will include the time and expenses of the MITDF staff, some consultant fees and expenses for the Boston venture capital managers' activities, and some expenses for other Maine participants.

Project Tasks - Getting Organized

In the first six months, the project will complete essential organization tasks, make a complete set of baseline measurements for the experiment, and begin the project operational activities.

Organization of the IIE

The first commitment will be to select the IIE Director. This will be done by the CRAS and the MITDF. The selection will be subject to review and approval by the NSF. The Director will be chosen in accordance with previously stated qualifications, with particular emphasis on the combination of a commitment to Maine and effective ties to the M.I.T. - Boston community. Organization and preparation of articles of incorporation for the IIE will be completed in this initial period. The IIE will be equipped and staffed in the CRAS at Portland.

Baseline Measurements

The measurement scheme outlined in Section 5 requires an initial, comprehensive baseline measurement of innovation and new enterprise activity and related communications patterns, as well as completion of the assessment of the wood turners and shapers begun in Phase I. This work will be directed from the MITDF. Section 5 discusses the research basis for the measurement scheme, the planned methodology, and the elements to be measured. The mechanics of implementation will involve assembling and training a team of social scientists and interviewers prior to collection of the measurement data. The bulk of the team will be University of Maine personnel with some support from M.I.T. The proficiency of the survey personnel is critical to the integrity of the results, so, a formal, week-long training session will be conducted at M.I.T.

The MITDF will use experienced professionals, proficient in rigorous social science research, to direct the measurement program. Working with key people from the CRAS in Maine, they will prepare the survey plans and detailed questionnaires, organize and arrange the training session, analyze the data and lead the preparation of the baseline measurement report. These, too, will be completed in the first six months of the project.

This measurement activity will be used to establish a close tie between the project and the M.I.T. Center for Policy Alternatives, International Study in Science Policy and Technology. A member of the CPA study team will participate in this initial measurement and in all subsequent measurements to ensure a continuing, detailed knowledge of the project's aim and results.

Other Beginning Tasks

The first six months of the project will include beginnings on specific, primary, operational tasks. The individual task plans will

be described later. The tasks include:

1. Initiation of a Maine venture capital group.

2. Organization of a one-term new enterprise course in the University of Maine Business School.

3. Identification of specific areas where innovation can be beneficial to the wood turners and shapers.

4. Initiation, using the existing arrangements of the University of Maine, of research and development activity directly responsive to the identified needs of the wood turners and shapers.

5. Follow-up of other innovative ideas of potential benefit to the wood turners and shapers; i.e., marketing or related new enterprises.

6. Identify other Maine industries for involvement in the IIE's activities to stimulate innovation.

7. Collection and evaluation of identifiable markets and technological ideas that represent potential bases for new enterprise in Maine.

8. Identification and evaluation of entrepreneur candidates for new enterprise in Maine.

Project Operational Tasks

Finding Enterpreneurs

A primary task for the IIE will be to develop a bank - or list - of potential entrepreneurs for new enterprise in Maine. Drawing on the MITDF experience, several specific approaches have been identified, and, in the beginning, the MITDF will draw on its existing knowledge of potential entrepreneurs for the project in Maine. Sources for the long run include alumni associations, university placement offices, Boston venture capital organizations, Maine bankers, and personal contacts. The most important source, however, will be the lightening rod effect created by organization, identification, and operation of the IIE in Maine. In 1963, the Small Business Administration funded a study, the Demand and Supply for Entrepreneurial Talent in Maine (1). This confirmed that, though opportunities were few, a base for the development of entrepreneurial

talent did exist in Maine. This is still true, and there is perhaps more awareness of the need for activity to increase the opportunities. In these circumstances, we expect that, as the IIE begins to operate, entrepreneurs will learn of its purpose and take the initiative in making themselves known. This pattern has been demonstrated at the MITDF, and its close connection to the IIE will provide direct access to an already established network of entrepreneurs from M.I.T. and the outside community. Students going through the new enterprise course will turn out to be key elements of a similar network which will be developed in Maine.

In this role, we expect that the IIE will attract talented people who have left Maine -- or are non-natives -- and who would like to live and work in Maine. This should result in a useful register of people who are interested in or may help or participate in new enterprise in Maine. These people are the medium for effective technology transfer.

Finding New Enterprise Ideas

In the MITDF, the close association with M.I.T. is reflected in some concentration on M.I.T. ideas and in the emphasis, so far, on basic technical concepts or processes which offer a base for broad application. In Maine, we must take a more open view, since the success of the project requires relatively early realization of active results. The MITDF is about two years old. It has examined more than 80 new enterprise ideas, and selected four for active development. The first of those four is now within a few weeks of firm venture capital funding. In Maine, our goal is to reach that point in eighteen to twenty-four months in order to rapidly develop some momentum in the new enterprise process. Thus, the criterion for initial ideas is solely their potential viability in Maine.

The existence of a market or need will determine this viability. Thus, one reason for beginning with an existing industry is the certainty that their problems and constraints will lead to the identification of real needs.

New ideas will be collected from M.I.T. (the cataloging task), from the University of Maine, and from any other accessible sources. As in the case of entrepreneurs, the MITDF experience indicates that the establishment of the IIE and the evidence of its operation will attract people with new ideas. The immediate and vigorous coupling of the IIE to the MITDF will connect Maine initially to an already active network of idea generators and entrepreneurs.

New Enterprise Course

At M.I.T., the Sloan School has offered a formal, graduate level course in new enterprise for more than ten years. The course has had more than 250 graduates, and many of them have actually become involved in new enterprise formation. Others are in academic positions where they can contribute to education in the new enterprise process. A course within the University of Maine will fill the same dual-purpose role.

The MITDF will initially provide a course syllabus, reading lists, and essential teaching materials, including case studies and case analyses. In the M.I.T. course, student teams conduct actual case studies on convenient firms that have been recently through the new enterprise process. We will endeavor to incorporate this clinical education feature in the Maine course, but it will probably be necessary to depend heavily on written cases in the beginning. MITDF will also arrange for experienced entrepreneurs, venture capitalists, and others to participate as guest speakers to relate the students' academic learning to real world experience. Direct interactions with the IIE will provide another kind of clinical experience; i.e., observation of, or participation in, the process of new enterprise formation.

The initial course will be a part of the MBA program at the Portland-Gorham campus. This level of activity will best serve Maine's needs, generating new entrepreneur candidates and preparing others to spread the new enterprise gospel. Subsequent actions may include replication of the course on the Orono campus, and introduction of new enterprise material in the undergraduate curriculum.

Resource limits in the University of Maine constitute a barrier to the introduction of such a course, it is proposed that NSF funds be used to support a new University of Maine faculty position, 100% the first year, 50% the second year, and 25% the third year.

In the first year, this would make the faculty member available about half-time to the IIE as a prepaid consultant, a significant help in the critical early months when there will be much to do and the IIE will be least able to generate its own support.

The course should be available in the University of Maine curriculum within six months after the start of the project; i.e., Spring term for a Fall start, and vice versa.

New Enterprise Workshops

The graduate level new enterprise course described above is a required part of the desired long-term, self-sustaining network of people and activities. It is not, however, a sufficient educational response to ensure breakdown of existing barriers to communication and interaction. An active innovation and new enterprise process needs a continuous pattern of communication and interaction among the entrepreneurial, industrial, academic, and financial communities. This framework has repeatedly been observed in the background of successful technology-based new enterprise. To this end, the IIE will be responsible for initiating and organizing a regular series of new enterprise workshops to foster and encourage these relationships. These workshops will require initial financial support from NSF funds. They will last from one to three days, and, in the first year, they will be repeated at short intervals in different locations. In the second year, we plan two, and in the third year, one. Succeeding years will also involve an annual schedule, but they should not require full funding support.

Each workshop will involve an industry-university-financial-government team participating in discussion of the opportunities, methodology, and problems, in new enterprise in Maine. The available sources of help will be identified. The other participants in these workshops will consist of potential entrepreneurs and non-participating members of the industrial, academic, and financial groups. Specific workshop activities will include interaction with successful entrepreneurs and demonstration of required new enterprise preparation such as market analysis, development of a cash flow statement, and presentation of a business plan to a venture capital group. The workshops will be structured to maximize the opportunities for potential enterpreneurs to develop follow-up relationships with the participating "experts".

The decreasing frequency schedule reflects the need to shift with time from an intensive "spreading the word" to a regular, annual, state-wide workshop to report progress, review changed conditions, renew the linking mechanisms, and encouraging new entrepreneur candidates.

Stimulating Innovation

The process of innovation in existing industry may or may not lead to the formation of new enterprise, but it is clearly a powerful and important tool in building sound economic growth. As explaind in Section 11, a specific Maine industry, the wood turners and shapers, has been selected as an initial example for this kind of activity. That there are barriers to effective communication between this group and the world outside is evident from our personal visits and the results

of a preliminary survey. In the initial phases of the project, the IIE will extend project knowledge of the industry by additional visits and the MITDF/CRAS team will complete the industry survey. Some innovation opportunities common to most of the industry have already been identified in connection with exploitation of available raw materials, minimizing waste, and using or disposing of residual waste material. A series of meetings will be organized to begin exchanges between the industry and the academic technologists and others who may contribute innovative solutions to their problems. These meetings will, initially, emphasize communication from the industry to the potential problem-solvers. They will not duplicate or parallel, but be closely coupled with and strengthen the existing University of Maine arrangements such as the Division of Industrial Cooperation and the Technical Services Program. Although the university has devoted considerable attention to the Forest Products Industry in Maine, our preliminary survey indicates that there has been little or no interaction with the wood turners and shapers. There appears to be a large potential for development of a complementary relationship and synergistic interaction with the Technical Services Program.

Three or four such meetings with the wood turners and shapers may be held in the first year. After that, with multiple links effected between the industry, the IIE and the problem-solving resources, it will be possible to shift our attention to other industries. The program should continue to run at about the same pace. It will require NSF support for at least the first two years. Beyond that, useful results should encourage funding by industry and through university support for the IIE, so that little or no NSF support will be needed after the third year. How?

These meetings may take various forms, ranging from formal information-passing presentations to informal or semi-social arrangements in which a primary goal is to east social barriers which inhibit the free exchange needed to achieve positive results.

Innovation Directed R&D

The lack of empathy between, for instance, the wood turners and shapers and the academic technical community at Orono has meant that no university R&D was planned to serve their needs directly, and the industry has continued to hold its skeptical view of academia's ability to help them in their real world. If the establishment of effective communication is to lead to fruitful, confidence-building results, money support must be made available to provide the resource slack to begin this new activity.

The IIE, working with other University of Maine agencies, will collect and evaluate the results of the innovation meetings to define R&D

projects with a high likelihood of developing useful solutions for the industry. Selection of specific projects will reflect inputs from CRAS/MITDF, the industry, and the University. The selected areas will be chosen to build a base for a long-term mutually beneficial relationship between the industry and the academicians as well as to provide short-term response to the industry's needs. It is expected that useful results will lead to a self-sustaining arrangement with a combination of industry-university support, but NSF seed money is presumed on a 100%, 100%, 100%, 60%, 30% basis.

Other linking mechanisms will be explored and applied to enhance the ties between industry and the university. These include cooperative student programs, summer student internships, industrial sabbaticals for university faculty, and arrangement of joint appointments between Orono and the CRAS.

Shepherding a New Enterprise

This activity, the core of the MITDF charter, will also be required of the IIE. The collection of entrepreneurs and ideas and the organization of a venture capital vehicle are prelude to the fostering of specific new enterprises.

The MITDF experience indicates the scope and scale of activity required to achieve results. A common venture capital rule-of-thumb is that a successful new venture should triple its value in five years. Even with this expectation, it is obvious that multiple starts must be made, not only to allow for some failures, but to ensure build-up of the momentum needed to bring the process to life. It should be noted that the Route 128 experience with technology-based enterprise shows a lower failure rate than the usual failure for new businesses in general.

Since the Maine process cannot be expected to generate suitable candidates instantaneously, the MITDF will use its resources in the initial phases of the project to assist the IIE in assembling idea-entrepreneur combinations that are early candidates for implementation in Maine. In this period, there will be special emphasis on a dual approach. Identification of real markets or needs in Maine will be a primary guide to a viable area for new enterprise. On the other hand, identification of an idea that either meets a Maine need or has other apparent markets will also provide a positive signal.

The IIE process will exploit the experience and know-how of the MITDF and other Maine participants to accomplish preliminary assessment of ideas, location of suitable entrepreneurs, and support of the combination through the preparation of a sound business plan. At this

point, the new enterprise development and the new venture capital organization will be brought together to obtain funding for the new firm. In the Maine project these activities will be closely coupled from the beginning, so it can be expected that no enterprise will be supported by the IIE without preliminary endorsement by the venture capital group. This must be in order to minimize, if not eliminate, the waste motion inherent in rejection by the venture capital group. Other venture capital sources could be sought, but it is clear that the closely-coupled approach will best serve Maine and the NSF goals for the project.

This activity will involve expenditures above the direct costs of the IIE. MITDF experience shows that costs may include:

1. Support of the entrepreneur
2. Pilot or demonstration projects
3. Legal and professional fees
4. Preparation of a business plan

In some cases, as in the purchase of equipment, normal arrangements would require the replacement of the IIE money from the initial funding of the enterprise. These dollars then become available for another idea-entrepreneur combination's development. In the beginning, the IIE will be entirely dependent upon NSF funds. Amounts based upon MITDF experience are included in the Section 7 cost figures. Successful initial developments should set the stage for obtaining other funds to help carry the project until returns from accomplished results reach a self-sustaining level.

Cataloging Technology

The cataloging of technology at M.I.T. and other sources related to or near to M.I.T. will be conducted by the MITDF. The M.I.T. Industrial Liaison Program maintains a Directory of Current Research at M.I.T. This document is assembled primarily from the results of an annual survey by written questionnaire. It is designed to serve the needs of the ILP members - mostly large corporations with substantial R&D organizations - who are interested in general awareness of research activities at the frontiers of technology. It was not intended to be an idea book for new enterprises. The MITDF experience confirms that it has little value for that purpose. Further study in the cataloging of innovative ideas was sponsored by the MITDF. It was found that "ideas" were difficult to identify and often unrelated to the researcher's

primary areas of interest or activity. M.I.T. also publishes an Annual Report of Materials Research. It, too, is not a new enterprise idea book. Given a concept - or, more likely, a need, these and other published materials are helpful in locating the people or areas of potentially pertinent research, but by themselves, they are poor tools for this project's purpose.

It is concluded that the cataloging of technology for purposes of innovation and new enterprise must amount to a catalog of people identified with their areas of research and their other interests, experience, and capabilities that identify them as idea generators. A catalog of specific ideas does not seem feasible because of the problems of limiting access and protecting the originator's interests. The regular publications of the U. S. Patent Office provide such a catalog in an appropriately protected framework - after the issue of the patent - and much too late for the new enterprise process.

It would appear easy to gather such material by questionnaire, perhaps by additions to the annual ILP survey. Mark Brook's work, and discussions with Professor T. J. Allen, indicate, however, that this would not be effective. A direct, personal interview is required. Such a survey will be conducted early in the project. It will encompass M.I.T., M.I.T. associated laboratories, and such other institutions as may be arranged. The initial version of the catalog will be available by the end of the first year of project operations. Annual review and revision will be required to reflect changes in personnel. If the catalog proves useful, a complete up-dating will be desirable at five-year intervals.

It appears that a Maine Catalog of idea generators will also be valuable. Based on the M.I.T. experience, this will be undertaken by CRAS/IIE in the second six months of the program. Allen's studies in Ireland, where the small size of the nation facilitates publication of a complete register of scientific and technical personnel, indicate that such a catalog will be a useful aid in the project's efforts to stimulate communication and build linking mechanisms.

Identifying Foci of New Enterprise Activity

To substantiate the suggested potential national policy, it must be possible to identify other, geographically dispersed, United States locations, with specific combinations of people and organizations, that could fulfill in other projects the role envisaged for the MITDF in this project. This task will be performed by the MITDF. There are a number of already identified locations where the technology-based new enterprise process is in mature operation, such as Palo Alto and Ann Arbor. Other locations appear to be candidates and should be examined carefully.

Section 5

MEASUREMENT STRATEGY

The Model

In Section 9, there is displayed and discussed a graphic model of the innovation process. The basic premise of that model is simply that commercial innovation results from the coupling of some need, or market demand, with the technical means of satisfying that need. Innovation, as used here implies the commercial exploitation of some technical capability. As such, innovation is a process involving:

a. the recognition of an opportunity;

b. the generation of an idea to exploit the opportunity;

c. the solution of technical problems in order to establish the technical feasibility of the idea; and finally,

d. the implementation, or diffusion, or the innovation.

At each stage of the process, information is a necessary input. The innovator needs information to become aware of a need. He must have information about the mechanics of the marketplace in order to distribute his product. The innovator also needs sources of technical information, to supply him with his idea and to aid him in the development of his idea. If he is launching a new enterprise, he will also need information about sources of capital and personnel.

Thus, three separate concepts are implied in the model. Reversing the temporal sequence and discussing innovation first, it is possible to identify several dimensions of this concept which seem useful in the project context. These are listed in Table 1 of this section. Note that some variables of Table 1 measure net effects, thus acknowledging the fact that not every attempt at innovation succeeds. Table 1 is, in effect, a list of dependent, or criterion, variables. Data on these variables will be collected as part of the measurement plan. Much of this data can be gleaned from public sources; the cooperation of various local agents will be solicited to collect the remainder.

It is not expected that elements will be found in structures identical to that of the MITDF/M.I.T. complex, but different combinations of people and organizations can be assembled to perform the same function.

This effort will develop slowly. In the beginning, the MITDF will concentrate, with the IIE, on constructive initiation of project activities in Maine. As the IIE builds its own strength, the MITDF will be able to give more attention to this task. Preliminary identification of possible locations will be accomplished by a combination of literature review and exploitation of personal information channels. Subsequent steps to establish, for feasible locations, specific functional identification of people and organizations, will require extensive correspondence and follow-up by face-to-face discussions. When the project reaches major evaluation and reporting points, this work will provide necessary material for specofic substantiation of key elements of suggested national policy. The M.I.T. Center for Policy Alternatives will take part in the identification and definition of suggested national policies. Their participation in the Project New Enterprise measurement program will provide a base of knowledge from which to interpret project results in the light of their International Study in Science Policy and Technology. The cost of this task, as other direct MITDF costs, is considered an experiment-related cost, and hence, NSF funding is sought.

The second concept implied by the model is that of contributory factors. Two factors contributing to (or loosely speaking, "causing") innovation are recognized:

1. Economic factors, e. g., market demands for new products, cheaper factors, and more efficient processes. These also include various governmental mechanisms such as tax policy, etc. which can and do act as economic inducements or inhibitions to innovation.

2. Technical factors, or the entire pool of technological knowledge. This pool is increasing over time and so augments the range of innovation possibilities. In this sense, technical knowledge contributes to innovation.

Project activities do not bear directly on these contributory factors. Rather, they have been designed to alter the third concept, that of social integration. The elements of a social system (e.g., individuals and institutions) are said to be integrated when information passes freely among them. Social integration thus implies a communication network linking the system's elements. The more elements any particular individual is linked to, the more highly integrated is that individual. Similarly for institutions.

Table 1

Economic Growth Through Innovation

The Criterion Variables

A. Outcome Measures

1. New Enterprises
   a. No. of new companies created employing technical innovations.
   b. No. of new jobs created in these companies
   c. Size of the payroll in new enterprises

2. New Products (Sample firms)
   a. No. of new products introduced
   b. Rate of new product introduction
   c. Percent of sample firms' sales attributed to new products
   d. Percent of sample firms' profits attributed to new products

3. New Processes (Sample firms)
   a. No. of new processes introduced
   b. Per unit cost savings attributed to these new processes
   c. No. additional unit sales attributed to new processes
   d. Rate of new process introduction

B. Intermediary (Or Process) Measures

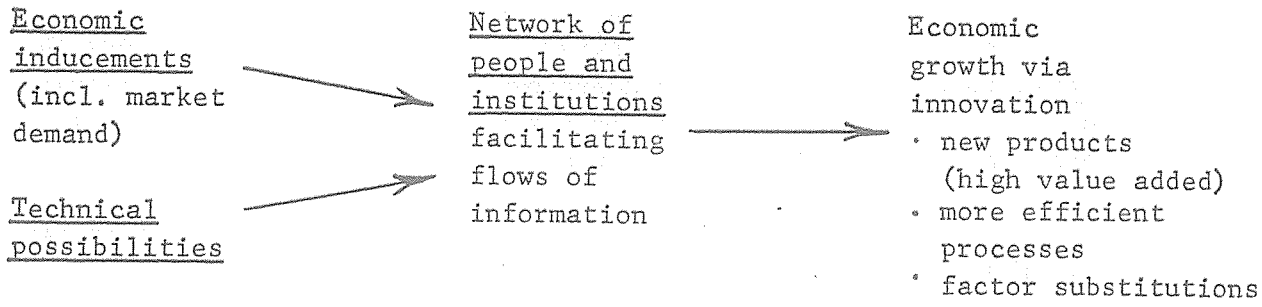
1. Acquisition of funds by sample firms
   a. No. loans requested (to implement innovation)
   b. No. loans granted (to implement innovation)
   c. Size of loans requested (to implement innovation)
   d. Size of loans granted (to implement innovation)
   e. Ratio of loans to loan requests (no. and size)

2. Acquisition of plant and equipment (to implement innovation) by sample firms
   a. Changes in debt-equity ratios
   b. Changes in sample firms' capitalization
   c. Dollars spent on new equipment

3. Acquisition of information
   No. of individuals from each sample firm attending project-sponsored conference or participating in project-sponsored activities.

Economic inducements and technical possibilities contribute to economic growth via innovation only if some innovator is able to bring together relevent information, information about the marketplace, about what it takes to raise capital, about what can be done to surmount development problems, etc. The existence of an active communication network is a contingency factor. Restating the proposition, economic inducements and technical possibilities will contribute to economic growth via innovation contingent upon the existence of an active communication network integrating all those people and institutions whose participation is required in the innovation process. This is shown graphically in Figure 1.

Figure 1. Relationships among contributory, contingency and criterion factors



Since the project will not alter contributory factors, the measurement task is to demonstrate that alteration of the contingency factor will "cause" an increase in the various indices of economic growth via innovation. Or restated, an increase in social integration among the appropriate people and institutions will lead to ("cause") greater economic growth due to innovation.

The Problems of Causality

Modern science approaches causality in terms of multiple determining conditions rather than with the expectation of finding a single factor that always leads to a given event. The word "cause" is used to mean "one of a number of determining conditions which together make the occurrence of a given event probable."

There are three major types of evidence that are relevant to testing hypotheses about causal relationships:

1. Evidence of concomitant variation, that is, that X (the assumed causal, or independent variable), Y (the assumed effect, or dependent, or criterion, variable) and Z (the contingency variable) are associated in the way predicted by the hypothesis. In the case of a hypothesis that X is a contributory condition of Y, contingent upon the presence of some third variable Z, this would mean that if Z is present Y should appear in more cases where X is present than in cases where X is absent. If Z is not present, there should be no relationship, or a sharply attenuated relationship, between X and Y.

2. Evidence that Y did not occur before X, or, as in our case, before the alteration of Z.

3. Evidence ruling out other factors as possible determining conditions of Y.

It must be stressed that such evidence merely provides a reasonable basis for inferring that X is or is not a cause of Y contingent on Z; it does not provide absolute certainty. The relationship can never be conclusively demonstrated. The cumulation of studies that point to one or the other conclusion (e.g., those cited in Section 9) helps to increase confidence in its probable correctness, but still does not constitute absolute proof.

How then can one collect the evidence needed to test causal hypotheses? In the classic experimental design, subjects are selected and assigned at random to test and control groups. Observations of criterion variables are made on both groups before and after the experimental treatment is applied to the test group. This procedure provides the strongest possible evidence that variations in the criterion variables are in fact, due to the experimental treatment. Variations in the control group account for maturational or developmental effects which might occur independently of the experimental treatment. Such variations also catch the effect of extraneous uncontrolled factors acting on both groups during the course of the experiment. The random assignment of subjects to groups insures the investigator against bias due to systematic, inherent variations in the subjects themselves (1).

Clearly this design is not available for the project. Randomized control groups are not available. What can be substituted for the classic design?

Whatever the form of a study, if it is to provide a test of a causal hypothesis, it must provide grounds for making inferences about causality and it must provide safeguards against unwarranted inferences. Non-experimental studies (i.e., those not using the classic experimental design) cannot provide safeguards as adequate as those given by (a) random assignment of subjects to experimental and control groups, (b) direct manipulation of the experimental variable, and (c) control over some of the extraneous variables that might operate during the course of the experiment.

What substitute safeguards are available? For <u>direct manipulation of the experimental variable</u> (i.e., integration within an interpersonal network), the investigator may substitute one or more of several lines of inference:

(a) comparison of people who have been exposed to contrasting experiences (such as those provided by project activities),

(b) attempts to determine the time order of variables that are associated; e.g., attendance at New Enterprise Workshop precedes or leads to acquaintanceship, which, in turn, leads to business partnership and founding of a new company, and

(c) examination of the relationship between variables in terms of the pattern of relationships that might be anticipated if one or the other were the causal factor (it is expected that exposure to many and diverse sources of information causes innovation, and develops a propensity to change and to take risks, rather than vice-versa).

For assignment of subjects to experimental and control groups, the investigator may substitute evidence which provides a basis for inferring that groups of people who have undergone contrasting experiences were or were not similar before those experiences (e.g., with baseline measures) or he may select from his total group sub-samples matched in terms of certain characteristics; e.g., membership in particular industry, but with contrasting experiences, such as contact with project activities; or he may restrict his sample to persons with certain characteristics.

For direct control over extraneous variables, either past or contemporaneous, he substitutes the gathering of data on other characteristics or experiences of his subjects which he believes may be relevant to position on the dependent variable, and makes use of these data in his analysis via standard survey analysis techniques (2).

The Measurement Techniques

A set of measurement techniques has been selected and combined in a way which, it is believed, will demonstrate the causal link between manipulation of the contingency factor and variations in the criterion variables (Table 1).

The basic technique is the panel survey. A series of surveys will be conducted, the first at the beginning of the project (a baseline survey) and the remainder at 20 month intervals thereafter.

Data will be collected from the same set of respondents at each wave. Where possible a control group will be established to guage interview effects, as explained below.

Interviewers will elicit two types of information. A communication survey, similar to that conducted in the Republic of

Ireland by Professor Thomas J. Allen (3), will determine alterations in the structure of technical communications within Maine. The respondents for this aspect of the survey should be the entire "knowledge disseminating" population: the faculties of the University of Maine's engineering school, the forestry school, the school of business education, and private consultants. Our principal purpose here is to determine changes in the relationship between "knowledge disseminators" (principally in the institutions of higher education) and "knowledge users" (principally in industry). We are also interested in the extent to which "knowledge disseminators" within Maine are integrated into a larger network extending beyond Maine. Project activities will be initiated to encourage these "knowledge disseminators" to act as Maine's window on the (technical) world.

An innovation survey will be conducted over a cross section of Maine industry to determine (1) what sort of innovations are being introduced, and (2) what sources of information are being used to generate ideas, identify needs, solve development problems, finance the innovations, etc. This methodology has been used before in studies of innovation, such as the NSF-sponsored study executed by Marquis and Myers (4), and, more recently, the Irish small-industry study conducted by Allen (5).

Where the investigators discover a company in the process of innovating, special efforts will be made to observe this case closely over time. A small set of such cases will increase the validity of the major portion of the data which must, necessarily, come from the respondents' own memories of past events.

There will be two other sources of data. The director of the IIE will maintain a tape diary of daily occurrences which have a bearing on the project. Each evening, he will record the names of people he has met, or heard of; activities he undertook to foster linkages; and ideas he generated and/or suggested to others. To prevent the omission of valuable data, a standard set of items will be developed and reported on each day. These tapes will be forwarded to the MITDF weekly where they will be typed and stored in a project file. This will be read frequently by the project's research director so he will stay abreast of events as they unfold. In addition, these protocols will be an invaluable source of research data.

The cooperation of state agencies and banks will be solicited in order to gather data on the criterion variables. Every effort will be made to collect this data unobtrusively and continuously. Intermittant investigations of companies will be made when called for; e.g., when profits are radically altered, where a large loan is negotiated, etc.

In this way, the research may be able to focus on an emergent situation and collect longitudinal data. Close review of critical events as they unfold is the best type of data to study the dynamics of innovation and its relationship to project activities.

The Panel Technique - Advantages

Since the panel technique is the principal measurement tool, it will be discussed in more detail and its superiority over standard methods underscored. The panel technique involves interviewing the same group of people on two or more occasions. As a research instrument, the panel is mainly used for studying changes in behavior and attitudes. Most panel studies contain a set of core questions or observations which are repeated on all or nearly all the waves. Considerable coolateral information is also obtained from respondents, to be used in interpreting changes found in the core questions.

The panel reveals not only the total extent of change - the net change - but also the complete "turnover" - who changes and in which direction (See Figure 2).

The panel also enables location of changes without relying, as do standard polling techniques, on the subjective recollections of the respondents. Once these changes have been objectively identified, one can deal with the following questions: (1) what specific stimuli are effective in producing attitude or behavior change? and (2) what characteristics differentiate the changers from the non-changers?

The panel procedure, because of its temporal sequence, makes possible the determination of causal relationships which cannot be obtained from simple correlations. The panel cross classification is not different from any other cross tabulation. But because the panel provides, as a rule, more information on the causal chain than normal survey techniques, the panel can guard against spurious correlations and provide insights superior to those derived from normal survey data. The panel can approximate the controlled experiment better than any other survey operation. It permits relating observed shifts to experimental treatment or non-treatment and focuses on individual behavior. Zeisel (6) presents a fascinating example of how the panel technique simulates the controlled experiment; his example is presented in its entirety at the end of this section.

Figure 2. Although net differences are identical (marginals), the dynamics of change are radically different in these two cases (Excerpted from Zeisel (6)).

Changes in Approval of President Johnson's Policies
1965 - 1966, Hypothetical Case A

	1965		
1966	Approved	Did not approve	Total 1966
Approved	58%	-	58%
Did not approve	16%	26%	42%
Total 1965	74%	26%	100%
			(1,500 interviews)

Shift in Approval of President Johnson's Policies
1965 - 1966, Hypothetical Case B

	1965		
1966	Approved	Did not approve	Total 1966
Approved	32%	26%	58%
Did not approve	42%	-	42%
Total 1965	74%	26%	100%
			(1,500 interviews)

Problems of the Survey Technique - Reinterviewing Bias

The very fact of having been interviewed once before about a particular topic may influence the result of subsequent interviews. If the interview brought the topic to the respondent's attention, his reactions may become self-conscious and hence biased. Generally speaking, the danger will be small if the topic is one which the respondent has been well aware of anyway. But if he had not thought of it before, the danger may be considerable.

The means by which precise information is obtained on the magnitude of the reinterviewing bias is the classic controlled experiment. One group - the panel - is reinterviewed periodically several times while the control group is interviewed only twice, once at the time of the first panel interview and again at the time of the last interview. Whatever differences are then observed between the two groups beyond the normal sampling error can be attributed to the interviewing effect.

Problems of the Survey Technique - Interviewing Events

In observing change and relating it to the factors presumably responsible for change, the experiment faces the problem of determining what part of the observed change is due to factors unconnected with the problem being studied. In general, one method of dealing with this problem is to examine data on the hypothesized relationships while controlling for the effect of these "extraneous" factors. Such a procedure demands a considerable amount of flexibility on the part of the investigator, for it means that he must include on his second (or subsequent) wave questions relating to these "extraneous" issues. This technique is discussed in several works (e.g., 2).

Problems of the Survey Technique - Respondent Mortality

1. Drop-out loss is loss from the number called for by the original sample design due to reluctance to cooperate. At least some sort of sample of "drop-outs" should be obtained to determine whether their behavior differs systematically from those of the respondents.

2. Intermediate losses may occur after initial contact is made but before respondents have actually started to participate in the panel. We can eliminate part of the bias introduced by the loss by making replacements from a reservoir of spare respondents. They should be matched case by case to the delinquent respondents on the important demographic characteristics.

3. Mortality during the study occurs as respondents drop out permanently or only temporarily after answering one or more panel waves but before the completion of the study. These losses can be studied more intensively than the other two types, since considerable data are generally available from the first wave with which to compare them to the group of respondents which answers all the waves.

Preliminary studies of this type of mortality in several panel studies have been made and in almost all cases there are no sharp differences between the characteristics of the mortality and the constants (Rosenberg & Theilens, (6)).

A Panel Survey Example

The remainder of this section is devoted to replication of an example showing how panel data can simulate the controlled experiment. The example is excerpted from Zeisel (6), pp. 222-229.

A cross section of 2,442 television set owners was interviewed in February and again three months later in May of the same year. Each time it was ascertained whether or not the interviewee had been viewing a certain program and whether he (or she) had been buying the product advertised on it. Hence we had four possible viewing patterns and four possible buying patterns (Table 13-21).

Table 13-21

Viewing and Buying Pattern

Viewing

In February

In May \ In February	Yes	No
Yes	+ + continued	- + started
No	+ - stopped	- - never listened

Buying

In February

In May \ In February	Yes	No
Yes	+ + continued	- + started
No	+ - stopped	- - never bought

The + + individuals are those who continued, the + - ones those who stopped in the second period, the - + ones those who started in the second period, and the - - ones those who never listened or bought. Each individual then would have to fall into one of the four viewing patterns and one of the four buying patterns; by combining the two we obtain (4 x 4 =) 16 possible behavior (viewing and buying) patterns. Table 13-22 is this sixteen-cell table.

Table 13-22

Viewing and Buying in February and May

(first symbol (+ or -) refers to February; second symbol (+ or -) to May)

Buying		Viewing: Continued (+ +) Number		Stopped (+ -) Number		Started (- +) Number		Never Viewed (- -) Number	
Continued	(+ +)	(82)	12.0	(31)	9.8	(27)	9.2	(104)	9.0
Stopped	(+ -)	(53)	7.7	(28)	9.0	(20)	6.8	(80)	6.9
Started	(- +)	(57)	8.3	(24)	7.6	(24)	8.4	(81)	7.0
Never bought	(- -)	(481)	72.0	(231)	73.6	(219)	75.6	(891)	77.1
Total viewing		(673)	100.0	(314)	100.0	(290)	100.0	(1,156)	100.0

The (82) individuals in the first cell constitute those who viewed and bought in both periods (+ +, + +); the second cell downward contains the (53) individuals who continued viewing (+ +) but stopped buying (+ -), and so forth. The four columns of numbers are then also translated into percentages from which several pertinent analytical statements can be derived.

We compare, first those (column 3) who started viewing the program after February (- +) with those (column 4) who never viewed it (- -). In this way we can assess the effect of having started to view:

1. Gaining new buyers: Among those who started viewing 8.4 percent started to buy, as compared with 7.0 percent among those who never viewed, an increase of 1.4 percentage points or 20.0 percent (1.4 over 7.0).

2. Holding old buyers: Among those who started viewing, 6.8 percent stopped buying as compared with 6.9 percent among those who never viewed, an increase of 0.1 percentage points or 1.4 percent (0.1 over 6.9).

By combining effects (1) and (2), we can determine the over-all gain attributable to having started to view the program:

3. Among those who started viewing, the percentage of buyers increased from February to May from 16.0 percent (9.2 plus 6.8) to 17.6 percent (9.2 plus 8.4), that is, by 1.6 percentage points or 10.0 percent (1.6 over 16.0).

4. Among those who never viewed, the percentage of buyers increased from 15.9 (9.0 plus 6.9) to 16.0 percent (9.0 plus 7.0), that is by 0.1 percentage points or 0.6 percent (0.1 over 15.9).

5. Hence, having started to view increased the number of buyers in that group by 9.4 percent (10.0 minus 0.6) over what it would have been had they not started.

Similarly, by comparing columns 1 and 2, those who continued viewing with those who stopped viewing, we assess the effect of having continued viewing:

6. Gaining new buyers: Among those who continued viewing, 7.7 percent stopped buying as compared with 9.0 percent among those who stopped viewing, a decrease of 1.3 percentage points or 14.4 percent (1.3 over 9.0).

By combining effects (6) and (7) we can determine the over-all gain attributable to having continued viewing the program:

8. Among those who continued viewing, the percentage of buyers increased from February to May from 19.7 (12.0 plus 7.7) to 20.3 (12.0 plus 8.3), that is by 0.6 percentage points or 3.0 percent (0.6 over 19.7).

9. Among those who stopped viewing, the percentage of buyers decreased from 18.8 (9.8 plus 9.0) to 17.4 (9.8 plus 7.6), a decline of 1.4 percentage points or 7.4 percent (1.4 over 18.8).

10. Hence, continued viewing increased the number of buyers in that group by 10.4 percent (3.0 plus 7.4) over what it would have been had they stopped viewing.

We can now move to the final step. the over-all evaluation of the effect of the television programs in terms of the added numbers of buyers of the advertised products as compared with what that number would have been without the television programs. In this operation we must consider not only the effect of started and continued viewing, as compared with stopped and never viewing - but also the frequency with which people started, respectively, continued viewing. We return, therefore, to Table 13-22 with the following consideration: had all the 290 people who actually started viewing (column 3) stopped (e.g., if the program had been cancelled), they would have reacted as the 1,156 people who never viewed (column 4). The number of May buyers among the 290 were 51 (27 - 24); had this group of 290 not started viewing, there would have been 4 fewer buyers in it according to statement (5) above.

Similarly we can compute the loss of buyers among the 682 people who continued viewing (column 1) for the hypothetical case that they had stopped viewing as the 314 people (column 2) actually did. The 139 May buyers (82 + 57), had they not continued viewing, would have been reduced by 13, according to statement (10).

We now compare the three groups of figures in Table 12-23.

Table 13-23

Actual Buyers in February	Actual Buyers in May	Computed Buyers in May (if program had not been available)
425	430	413
The totals of lines 1 and 2 in Table 13-22 (244 plus 181). Expressed as percentage of the total sample (2433) this is	The totals of lines 1 and 3 (244 plus 186). Expressed as percentage of the total sample this is	430 minus the 17 (4 plus 13) buyers who would have been lost had the program been canceled. Expressed as a percentage of the total sample this is
17.5%	17.7%	16.9%

Thus the over-all effect of having had the program continued through May was an increase among buyers from the hypothetical 16.9 to the actual 17.7, an increase of 0..8 percentage points, or 4.7 percent, over the February level.

Reversal of Cause and Effect

Our sixteen-fold table, relating viewing and buying at two different time periods, also permits investigation of a collateral problem which had researchers often puzzled: the possibility that there is not only an effect of viewing on buying (as we have so far assumed) but also a reverse effect of buying on viewing; that is, the possibility that buyers of a particular brand tend to view the sponsor's program more frequently than nonbuyers. Thus, there could be a feedback or reinforcement factor operating that produces, or at least increases, the correlation found between buying and viewing.

Two tests of the reinforcement hypothesis can be made with our panel data by comparing February buyers and nonbuyers:

1. February buyers more than nonbuyers should claim that they started viewing between February and May;

2. February buyers more than nonbuyers should claim that they continued viewing the program after February.

A significant difference in the proportion of buyers and nonbuyers who report starting and continuing to view would be evidence that there is indeed, a reversal of intended cause and effect operating within the data.

Table 13-24

	February Buyers	February Nonbuyers
(a) Number who are nonviewers in February	231	1,215
(b) Number of February nonviewers who started to view between February and May	47	243
(c) as percentage of (a)	20.3%	20.0%

Test A: We test whether there are more claims of starting to view among buyers than among nonbuyers. We divide the 1,446 nonviewers in February into two groups: those who were buyers in February and those who were not. We then compute for each group the proportion who report in May that they had started to view between February and May. Table 13-24 reports the results of this computation: No such effect is apparent.

If it were true that buyers had been more apt to start viewing than nonbuyers, a greater proportion of buyers should report starting to view during the three-month period. Actually, this proportion is the same for buyers and nonbuyers.

Test B: The other test examines whether proportionately more buyers than nonbuyers continue viewing. Here we take the 996 people who were viewers in February and trace their later viewing separately for buyers and nonbuyers (Table 13-25).

Table 13-25

		February Buyers	February Nonbuyers
(a)	Number of viewers in February	194	793
(b)	Number of February viewers who continued viewing after February	135	538
(c)	as percentage of (a)	69.6%	67.8%

Here too the difference in viewing is insignificant. If reinforcement were operating we should find a higher proportion of continued viewing among the February buyers.

Since neither of the two tests shows a significant difference, we must conclude that there is no evidence of a reinforcement effect, causing buyers to view. It is conceivable, though, that such reinforcement might operate with more substantial durable products, such as automobiles.

Section 6

SCHEDULES

Most of the activities that make up Project New Enterprise are continuous in nature; as noted in Section 9, they are processes, not events. Thus, they are not readily defined as a series of milestones.

Further, the expected results are goals, not predictable accomplishments, so it is unrealistic to try to assign them specific calendar dates far in advance.

The following paragraphs describe time schedules associated with each of the major activities of the project.

IIE

The IIE must have a form of organization and a relationship to the CRAS and the University of Maine specifically tailored to its combined roles of operational agent for the project, counselor for new enterprise, and mechanism for returning to the University an appropriate share of the anticipated economic growth. This framework should be defined and formally implemented within the first six months.

New Enterprise Course

Finding and hiring an appropriate new faculty member is the most critical step in getting the new enterprise course started. This can be done in three to six months. The MITDF, working with the IIE and the University of Maine Business School, will complete the initial course syllabus and other preparations in this same period. Thus, the course can be available in the second academic term after the project begins.

The course will be continued each year, probably on a one term per year basis until demand justifies more frequent offering.

The faculty member will participate actively in IIE planning and operations during the first year. In successive years, this involvement will decrease and more time will be devoted to building a

research program and to expanding the formal teaching program to other locations and other courses.

Venture Capital Group

An organizing committee for the venture capital group will be convened at the beginning of the project. It is expected than an appropriate organization plan can be devised and implemented in six months. Thus, the venture capital group will be ready to consider its first investment six to twelve months after the start. Investigation and consideration of potential investments will be a continuing process from then. As noted in Section 4, it is expected that the IIE will expose its new enterprise concepts to the Maine venture capital group early in their development -- earlier than would be the case if alternative sources of venture capital were readily available. It is also expected that other sources of new enterprise ideas will be attracted to the Maine venture capital organization once it is established. Thus, the pace of new venture financing will be determined by the funds available and the time required for evaluation and processing. If new ventures were funded, on the average, at a rate of about 1.5 per year, the five year program would result in 7 or 8 new enterprises. If the average funding was $300,000, the total investment would be $2.1-2,400,000, a substantial but not impossible goal.

Shepherding New Enterprise

The IIE activities in direct support of budding new enterprises must precede the venture capital funding step and be carried on at about the same rate. This emphasizes the importance of an intensive effort at the beginning to identify and develop a concept for the initial enterprise which can be ready when the venture capital organization is formed and funded. Over the long run, the IIE must collect ideas and entrepreneurs intensively. The MITDF first year record of 4 projects selected from about 80 considered is a higher percentage return than can be assumed for the Maine situation, so the IIE will plan to collect and screen possibilities at a rate of several hundred per year.

New Enterprise Workshops

Organizing and conducting a series of 3 or 4 new enterprise workshops in the first year is a crucial step in establishing the IIE in Maine and setting the stage for subsequent activities. Detailed planning will begin promptly after project funding. The goal is to conduct the workshops as early as possible in the second half of the first year. 2 or 3 will be prepared and carried out in the second year; then, it is anticipated that an annual workshop will be an appropriate

way of maintaining interest and exchange of ideas. Geographical factors may, however, dictate implementation on a different basis.

Stimulation of Innovation, Directed R&D

The first industry meeting for stimulating innovation will be planned and carried out within the second quarter after go-ahead. Subsequent meetings involving various Maine industries, will be planned and scheduled about three times a year. Tasks for Directed R&D will be derived from these meetings, and specific plans and schedules will follow up to the limits of funding and the availability of required capabilities.

Measurement

Planning and preparation for the initial baseline measurement are expected to take about three months. Data collection will require one to two months. Analysis and report preparation will require about 3 months, so the baseline measurement report should be complete in 7-8 months.

The 20 month and 40 month measurements will require less time. Planning will begin 1-2 months ahead, and interim measurement reports should be complete in the 25th and 25th months.

The final measurement, at the end of the five year program, will take longer. Detailed planning will begin in the second quarter of the 5th year, with the goal of accomplishing the data collection in the last quarter of the final year. The final measurement analysis should be completed six months later.

Cataloging Technology

It is planned to begin immediately after project start-up to plan and carry out the technology cataloging effort at M.I.T., with the goal of completing the initial catalog at the end of the first six months. The Maine catalog, following this pattern, is planned for assemply in the second six months. This time separation reflects the fact that the bulk of the baseline measurement data collection effort must be accomplished in Maine in the first six months of the project.

Each subsequent year, in the third quarter, a check will be made for deletions and additions required for the catalogs and an updating addendum issued.

The five-year, thoroughgoing revision of the catalogs is planned in the last half of the fifth year.

Section 7

COSTS

Background

The MITDF, which is expected to operationally accomplish only a portion of the role prescribed for the IIE, began in 1972 with initial seed money from M.I.T. Its unique identification with M.I.T. and the experience of Mr. R. S. Morse, its President, made it possible to quickly augment the M.I.T. funds with one time grants from major industrial corporations in technology transfer and in participating in the MITDF experiment.

These circumstances do not apply in Maine. Not only are many of the Route 128 factors missing or undeveloped, but, without an institution like M.I.T., an accelerating mechanism like the MITDF cannot be established without outside help. It is also obvious that a state lagging in economic growth does not have slack resources to support the rapid introduction of new activities in an innovation and new enterprise network. The NSF experimental R&D Incentives Program appears to be a vehicle designed for just such a situation. The barriers to innovation and new enterprise in Maine are primarily barriers of omission. Seed money funding is required to correct these omissions and develop the process to a healthy, self-sustaining condition.

Cost Sharing Approach

In Maine, there are three potential long term sources of support for the activity generated by the project.

As with the MITDF, it is expected that the IIE, for the benefit of the CRAS and the University of Maine, will acquire an equity in each of the new enterprises spawned under its aegis. The specific portion may vary from one venture to another, but, on the average, it should be about 10 percent. With successful project results, this should provide a long-term benefit to CRAS and the University of Maine which will justify their provision of operating funds for the IIE.

In the course of the project, teaching and research resources of the University are to be expanded through NSF start-up funds. When

these actions produce demonstrable positive results, then it can be expected that University budgets will be adjusted to sustain them beyond the life of the project. The University of Maine at Portland-Gorham has already provided written expression of its readiness to proceed in this manner. (See Appendix C.)

Finally, a successful project will alter the situation, so that some industrial and business support for the IIE and its activities, for teaching, and for research, may be obtained.

The specific cost estimates which follow reflect the assumptions above. Cost sharing schedules are different for different elements of the project, reflecting anticipated differences in the time and the difficulty involved in obtaining alternate funds.

For these cost estimates, CRAS and MIT overhead rates, 47.4% and 58%, have been used for the first year where directly applicable. Where both rates are involved, as in the Measurement Task, an average rate of 52.7% has been used. Allowance has been made for increased salaries and increased overhead rates in succeeding years of the program.

IIE

The IIE estimated costs for the five year program are summarized in Figure 1.

Figure 1. IIE - Cost Estimates

Item	Year 1	2	3	4	5
Salaries Director Assistant Sec. & Acct.	60,000	63,000	66,500	70,500	75,000
Expendable Supplies & Equipment	3,500	3,500	3,500	3,500	3,500
Travel	5,000	5,000	5,000	5,000	5,000
Publication	2,500	2,500	2,500	2,500	2,500
Consultants	6,000	6,000	6,000	6,000	6,000
Conferences	4,000	4,000	4,000	4,000	4,000
Indirect Costs Including Benefits	28,440	30,910	33,210	35,230	37,280
Totals	109,440	114,910	120,710	126,730	133,080

We propose that NSF fund these costs over the first four years, 100%, 100%, 50%, and 25%. Self-sustaining status in the fifth year will be clear evidence of the project's sound basis and successful execution.

Measurement Costs

The first year includes a complete baseline measurement, involving planning, training, collection of data, and analysis and reporting. This will be directed by an experienced professional, as a consultant to the MITDF; the data collection will be performed by personnel in Maine.

The follow-up measurements at 20 (second year) and 40 (fourth year) months will require less preparation and only informal refresher training.

The final measurement, in the fifth year, will require more planning and more analysis and reporting effort to review the entire history of the project.

These costs, shown in Figure 2, are required only to constitute a valid experiment, so should be wholly funded by NSF.

Figure 2. Measurement - Cost Estimates

Item	Year 1	2	3	4	5
Salaries Data Collection Planning & Analysis Support	24,000	19,500	-0-	21,000	29,000
Expendable Supplies & Equipment	2,300	1,500	-0-	1,600	2,600
Travel	5,000	3,000	-0-	3,500	7,000
Computer	2,000	1,000	-0-	1,500	3,000
Consultants Measurement Program Direction	10,000	6,000	-0-	7,000	14,500
Indirect Costs Including Benefits	12,700	11,000	-0-	11,610	16,860
Totals	56,000	42,000	-0-	46,320	72,960

Cataloging Technology

The technology cataloging task will not require as complex an interview structure as the baseline measurement in Maine. It will, however, be larger in numerical scale, and even more so if extended beyond MIT-associated institutions. At MIT, data collection will be done by local research assistance. They will be hired through the MITDF. In Maine, planning, data collection, and compilation will be supported by CRAS and University personnel.

The annual review of the catalogs involves checking for deletions and additions, interviewing the additions, and revising the compilation - or preparing an addendum. Hence, the second, third, and fourth years would involve only nominal costs.

It does not appear that this activity can become self-sustaining, at least not in the initial five year period. Therefore, the entire costs of the initial cataloging, annual review, and the first five year up-date are solicited from NSF funds. Figure 3 tabulates cost estimates for the combined effort encompassing the MIT associated institutions.

Figure 3. Cataloging Technology - Cost Estimates

Item	Year 1	2	3	4	5
Salaries Data Collection Planning & Compilation Support	34,000				41,000
Expendable Supplies & Equipment	2,000	Up-Date Only Required			2,500
Travel	2,500	Nominal Estimate			3,000
Computer (Indexing)	2,000				2,000
Consultants Planning & Direction	5,000				6,000
Indirect Cost Including Benefits	17,500				22,110
Totals	63,000	10,500	11,030	11,580	76,610

New Enterprise Course

The costs of this course, shown in Figure 4, will be primarily those associated with a new faculty position at the University of Maine. Additional costs are included for nominal expenses for course materials, etc., and for guest lecturers. In the first year only, an allowance has been included to provide a nucleus for a library in this field, a new area at the University of Maine.

The NSF share of this course is expected to decrease over four years, 100%, 50%, 25%, and 0%.

Figure 4. New Enterprise Course - Cost Estimates

Item	Year 1	2	3	4	5
Salary Faculty	20,000	21,000	22,050	23,152	24,310
Expendable Supplies & Equipment	1,000	1,000	1,000	1,000	1,000
Travel Faculty & Guest Lecturers	2,000	2,000	2,000	2,000	2,000
Library First Year Only	20,000	-0-	-0-	-0-	-0-
Consultants Lecturers	1,000	1,100	1,200	1,350	1,500
Indirect Costs Including Benefits	9,480	10,050	10,580	11,068	11,680
Totals	53,480	35,150	36,930	38,770	40,710

New Enterprise Workshops

Personnel costs associated with planning and preparation for these workshops are reflected in the IIE cost estimates. The estimated direct costs of organizing, publicizing, and conducting these workshops are tabulated in Figure 5.

Figure 5. New Enterprise Workshops - Cost Estimates

	Year 1	2	3	4	5
Direct Expenses	20,000	15,000	5,000	5,000	5,000

It is proposed that decreasing NSF support be provided in succeeding years, 100%, 100%, 50%, 25%, 0%.

Stimulating Innovation

As for the workshops, staff costs for planning and preparation of innovation stimulation activities are included in the IIE cost estimates. These meetings will be less complex in concept and in organization, hence feasible at a lower direct cost. They will not, however, fall off in frequency, but should continue on a regular basis as various industries are involved. Figure 6 shows the annual cost estimates based on three meetings per year. Decreasing NSF support is sought, 100%, 100%, 50%, 25%, and 0%, in successive years.

Figure 6. Stimulating Innovation - Cost Estimates

Item	Year 1	2	3	4	5
Direct Expenses	15,000	15,000	15,000	15,000	15,000

Directed R&D

The R&D projects generated from the industry-oriented innovation meetings will provide a major impetus to the active networks we seek to develop. It is not possible to plan and cost a schedule of specific projects, but an appropriate scale of operation must support, in effect, at least one full-time new researcher. Projects may be either short or long-term and funding plans must reflect both possibilities. The development of useful results will take substantial time, and only then can we expect to successfully solicit research funds within an on-going Maine framework.

Figure 7 shows the estimated budget for this purpose. Full NSF funding is sought for the first three years, with decreased support, 50%, 50%, in the 4th and 5th years.

Figure 7. Directed R&D - Cost Estimates

Item	Year 1	2	3	4	5
Total Budget	30,000	50,000	60,000	65,000	70,000

Shepherding New Enterprise

The miscellaneous costs associated with developing new enterprise are not large, but the availability of funds can be important. Based on the MITDF experience, we believe an annual budget should include $20,000 for these needs. Additional funds ($10,000 & $5,000) are added in the first two years (Figure 8) to facilitate a rapid start. NSF funds are sought on a year-by-year decreasing basis, 100%, 100%, 75%, 50%, and 25%.

Figure 8. Shepherding New Enterprise - Cost Estimates

Item	Year 1	2	3	4	5
Direct Expenses	30,000	25,000	20,000	20,000	20,000

MITDF

In the preceeding paragraphs, the bulk of the estimated project costs have been identified by tasks. There remain only the costs associated with MITDF participation and support. These costs reflect the project involvement of key members of the MITDF staff, the administrative effort required to support sub-contracted tasks in measurement technology cataloging, and the work required to perform the survey and evaluation task required to identify and formulate potential national policies.

Figure 9 tabulates these cost estimates.

Figure 9. MITDF - Cost Estimates

Item	Year 1	2	3	4	5
Salaries	30,000	30,000	30,000	30,000	30,000
Expendable Supplies & Equipment	2,000	2,000	1,500	1,500	1,000
Travel	2,500	2,000	2,000	2,000	2,000
Publication	2,000	2,000	1,500	1,500	2,000
Conferences	3,000	2,000	1,000	1,000	1,000
MIT Overhead	17,400	17,400	17,400	17,400	17,400
Fringe Benefits	5,130	5,130	5,130	5,130	5,130
Totals	44,630	43,130	41,130	41,130	41,130

Cost Summary

These cost estimates are combined and displayed, and Maine's planned contribution is emphasized, in Figure 10.

Figure 10. Estimated Costs - Project New Enterprise

Item	Year 1	2	3	4	5	Totals
Maine						
MITDF	-0-	-0-	-0-	-0-	-0-	-0-
IIE	-0-	-0-	60,350	95,050	133,080	288,480
Measurement	-0-	-0-	-0-	-0-	-0-	-0-
Catalog	-0-	-0-	-0-	-0-	-0-	-0-
N.E. Course	-0-	17,570	27,700	38,770	40,710	124,750
Workshops	-0-	-0-	2,500	3,750	5,000	11,250
Innovation	-0-	-0-	7,500	11,250	15,000	33,750
Research	-0-	-0-	-0-	32,500	35,000	67,500
New Enterprise	-0-	-0-	5,000	10,000	15,000	30,000
Total Maine	-0-	17,570	103,050	191,320	243,790	555,730
NSF						
MITDF	62,030	63,560	64,560	67,780	71,170	329,100
IIE	109,440	114,910	60,360	31,680	-0-	316,390
Measurement	56,000	42,000	-0-	46,320	72,960	217,280
Catalog	63,000	10,500	11,030	11,580	76,610	172,720
N.E. Course	53,480	17,580	9,230	-0-	-0-	80,290
Workshops	20,000	15,000	2,500	1,250	-0-	38,750
Innovation	15,000	15,000	7,500	3,750	-0-	41,250
Research	30,000	50,000	60,000	32,500	35,000	207,500
New Enterprise	30,000	25,000	15,000	10,000	5,000	85,000
Total NSF	438,950	353,550	230,180	204,860	260,740	1,488,280
Project Total						
MITDF	62,030	63,560	64,560	67,780	71,170	329,100
IIE	109,440	114,910	120,710	126,730	133,080	604,870
Measurement	56,000	42,000	-0-	46,320	72,960	217,280
Catalog	63,000	10,500	11,030	11,580	76,610	172,720
N.E. Course	53,480	35,150	36,930	38,770	40,710	205,040
Workshops	20,000	15,000	5,000	5,000	5,000	50,000
Innovation	15,000	15,000	15,000	15,000	15,000	75,000
Research	30,000	50,000	60,000	65,000	70,000	275,000
New Enterprise	30,000	25,000	20,000	20,000	20,000	115,000
Total Project	438,950	371,120	333,230	396,180	504,530	2,044,010
Cumulative Total						
Maine	-0-	17,570	120,620	311,940	555,730	
NSF	438,950	792,500	1,022,680	1,227,540	1,488,280	
Project Total	438,950	810,070	1,143,300	1,539,480	2,044,010	

PART II

PHASE I RESULTS

Section 8

ADMINISTRATION

The project contractor to NSF will be the University of Maine, through the Center for Research and Advanced Study. The IIE will be initially organized as a fifth institute within the CRAS. Its framework may be modified as necessary to establish legal provisions and protections relative to the IIE's role in acquiring an interest in new enterprise for the benefit of the University.

The MITDF will participate in the project as a sub-contractor to the CRAS. Other University of Maine elements and other Maine organizations will also be sought as sub-contractors to assemble the complement of needed skills and capabilities with a minimum need for new organizations in Maine.

Project accounting and funds administration will be handled by the IIE and CRAS, under the supervision of the CRAS Director of Finance for Grants Administration.

The IIE will be responsible for ensuring that the project is properly documented and that reports are provided to the NSF. Letter progress reports are planned on a quarterly basis. Annual reports will include review of progress accomplished, an outline of plans for the next year, a funding status report, and a budget to support Grant Renewal for the next year.

Other documentary results of the project will include Measurement Reports at each measurement point, the MIT and Maine Technology Catalogs and addenda, and a final Project Report with analysis of overall results and recommendations for potential National policies.

Section 9

RESEARCH RESULTS

A plan to alter factors and influence affecting the level of innovation and entrepreneurial activity implies prior identification of these factors. This section of the plan summarizes research results contributing to that identification.

Except for specific recent studies, this is not a report on "new" research. It is primarily a combination and consolidation of material representing the results of studies from the late 1950's until the present time. The Route 128 phenomenon has been extensively studied by Professor E. B. Roberts and his students at M.I.T., as well as by the A. D. Little Co. Professor Roberts has also devoted considerable attention to the characteristics of the entrepreneur and to other new venture mechanisms. Studies of particular new enterprise situations have been done under Mr. R. S. Morse. James M. Utterback has dealt extensively with the process of innovation and technology diffusion and has done extensive work in compiling and relating the work of others, such as Professor D. G. Marquis, in the field. Professor T. J. Allen, at M.I.T., has done pioneering studies on the nature of technological communications networks and their role in technology transfer. This section draws heavily on all these contributers. Excerpts from their work have been incorporated without paraphrase or change; further editing seemed, in most cases, superfluous. The debt is acknowledged and credit assigned where it belongs, to those who performed the significant research.

This section has five parts:

1. A look at the Route 128 experience and identification of the initiating, building, and facilitating forces creating that phenomenon.

2. A summary, via Utterback and others, of the accumulated understanding of the process of innovation and the factors that influence that process.

3. An examination of the character of the entrepreneur, and some observations on the key factors in the entrepreneurial process.

4. A look at technology transfer and, in particular, at the relevant communications networks and the leverage they exert on technology transfer.

5. A summary of the conclusions of this research background.

Route 128

"Route 128" is a convenient label for a series of unplanned but interrelated events. The observed behavior was the result of combination of a multiplicity of factors - direct and indirect, internal and external. It will be obvious that the Route 128 situation was unique; an exactly similar combination of factors is not likely to be found in any other situation.

The effective forces can be roughly divided, as in an A. D. Little study, into three groups: initiating forces, influencing the beginning of the process; building forces, supporting and nurturing the process; and facilitating forces, smoothing the path as the new enterprise takes it first steps. Figures 1, 2 and 3 display graphically the elements of the initiating, building and facilitating forces in the Route 128 situation.

Figure 1
Initiating Forces
Route 128

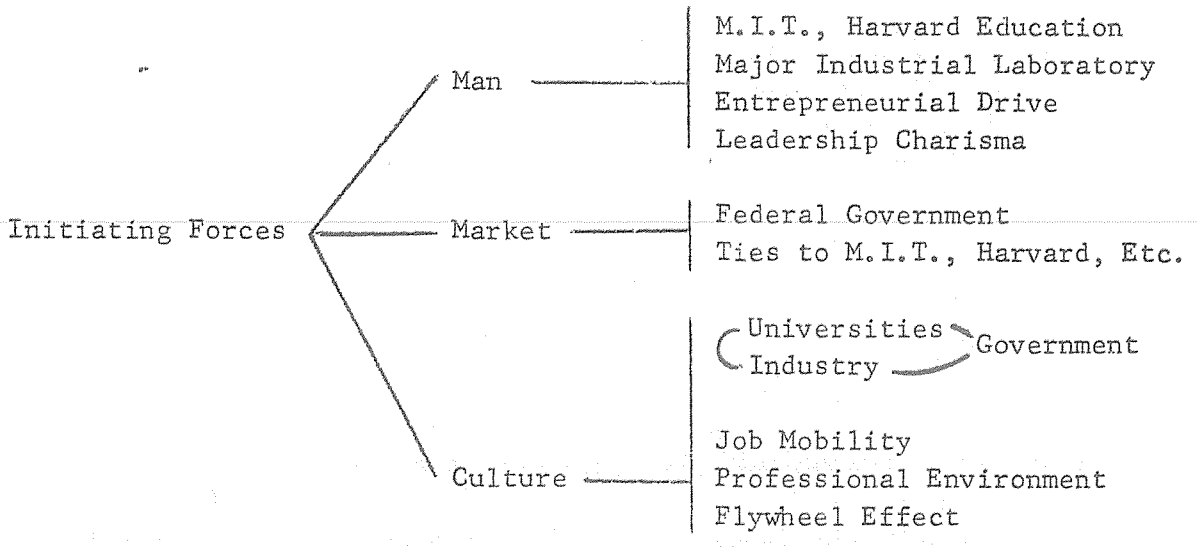


Figure 2

Building Forces

Route 128

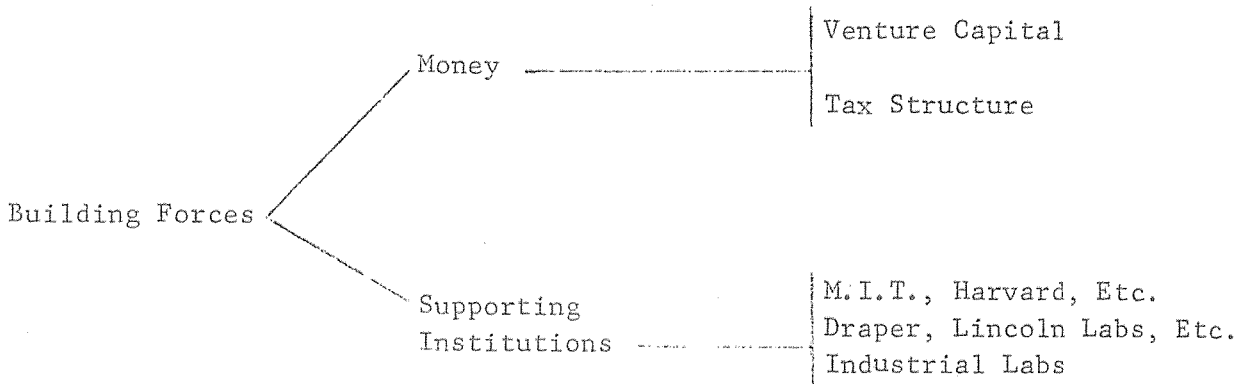


Figure 3

Facilitating Forces

Route 128

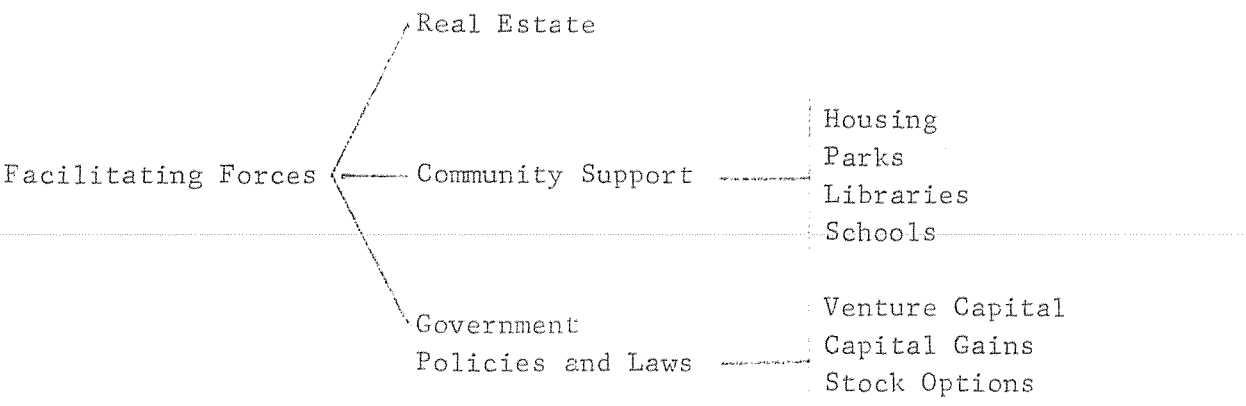


Figure 1 shows the initiating forces, man, market, and culture. The man is identified with a strong school and/or a vigorous industrial or government laboratory. He is achievement motivated - an entrepreneur, and displays a charisma which makes him an effective leader of others in organizing to initiate innovation and create new organizations. The market, a major initiating force, was, in most Route 128 cases, the Federal Government, either directly or indirectly via a subcontract. This customer placed extra value on the close ties the new organizations maintained with institutions like M.I.T. and Harvard. The culture was a more complex entity. It included an established three-way interaction among the universities, industry and government. Job mobility was high; personnel from one organization could easily move to another organization doing similar work. Studies by Professor E. A. Schein have indicated an increasing ascendance of loyalty to the profession over loyalty to the organization. The culture was characterized by a widespread professional ethic and a high level of commitment to stringent standards of performance and success. Finally, the new organizations became both supplier and customer for one another; a momentum was created which acted as a flywheel sustaining the new enterprise process.

Building forces included money effects and supporting institutions - entrepreneurs often maintained dual associations in the critical, formative phases of their new firms. This gave them continued access to the resources of their original organization, reducing both technical and personal risks in their new enterprise. Because of the early successes in the area, Boston was one of the places where venture capital was available. The initiating forces had worked on the financial community, too. With a good idea and a reasonable business plan, funding could be obtained. In the period of most intensive Route 128 activity, the U. S. income tax structure encouraged venture capital investment. Ordinary income tax rates up to 92% compared unfavorably with the 25% capital gains tax on venture investments. This made the high-technology based company, with a large growth potential, an attractive investment. Which, of course, also meant that the entrepreneur had to sacrifice equity for funding. Boston being a long established center of technical education, there were strong academic institutions at hand. Government research contracts, with their frequent objectives of specific techniques or hardware, were practical in nature and encouraged many academically oriented scientists to think in terms of real world exploitation of their knowledge. Government contracts also sparked the creation of special institutions like Lincoln Laboratories, thus creating substantial pools of factory labor and technical professionals and facilitating personnel mobility in the area.

The facilitating forces shown in Figure 3 enhanced the rate of growth of the Route 128 phenomenon and eased the process for individual

entrepreneurs. Land in appropriate quantities and desirable locations was available on attractive financial terms. In Massachusetts, the local community maintained considerable direct control of its development. Local ordinances are established by direct voting on specific issues. Communities provided facilitating support to new ventures in a variety of ways. These included such things as establishing appropriate zoning conditions; establishing low valuation for tax purposes; or providing for temporary outright tax relief; offering to build access roads and extend such services as sewars and fire and police protection; offering to help share in the cost of facility construction; setting up committees to help find housing for new employees moving into the area; and improving parks, libraries, school systems, and other community supported activities which make a community attractive to the kinds of highly educated personnel who are apt to be employed by these new firms.

The final facilitating force came about through government policies and laws. This facilitating force was by no means a 128 related function and, since such laws are under Federal control, they apply equally to the entire United States. However, they were applied effectively, although subconsciously, in the development and encouragement of the high-technology industry in the Boston periphery.

The pecularities of the income tax laws in this country as they affect venture capital were mentioned earlier. For reasons which have had nothing whatsoever to do with the encouragement of investment capital, the tax laws have inadvertently forced the proprietor of a large fortune to avoid safe investments which provide ordinary income and to seek riskier investments which promist to provide large capital gains. The Federal tax laws forced him into the position of needing a money market in which to gamble and the new Boston technology firms provided that market.

Another significant feature of the tax laws which influenced the growth of these companies was stock options. These are agreements made between companies and their key employees in which the company sets aside stock at a given price for the employee to purchase, if he wishes, in later years when the market price of the stock has appreciated. Since the appreciation is (a) not subject to taxation until the employee sells the stock, and (b) is then taxes as a capital gain, stock options have proven to be an attractive form of extraordinary compensation. It has been an especially desirable technique for new, small companies to use to acquire talented personnel without having to pay burdensom salaries. Its effectiveness is, of course, applicable only if the stock price ultimately rises well above the option price, which has been the usual case in the high-technology companies. Recent laws and regulations have reduced the stock option's attractiveness. A longer holding period for

capital gains treatment and detailed SEC rules have made the small company's situation more difficult.

This, then, is a framework containing and interrelating the forces which created the 128 phenomenon.

The "128 phenomenon" has continued to thrive in the Boston area. Although M.I.T., founded as a Land Grant College to foster innovation and create jobs, has been a principal focus of the activity, the new enterprise process has been area-wide in action. New firms have arisen from many of the Boston area universities, Government laboratories, industrial laboratories and academically associated laboratories. The latter category includes the Radiation Laboratory, begun in 1942, and Lincoln and Draper Laboratories. Draper has recently become a spin-off itself, acquiring independent corporate status. The area's interest in technology and new enterprise is demonstrated in directly related activities of the Boston Chamber of Commerce and the New England Council, as well as in informal associations, such as the 128 Presidents Club and two Research Directors Clubs in Massachusetts. These groups provide direct people-to-people transfer linkages. The wide-spread, diffuse nature of the innovation and entrepreneurial networks is shown by the 800 attendees at one of the M.I.T. Alumni Series of Seminars in New Enterprise in 1971 and also by the fact that 20 percent of the ideas so far considered by the MITDF originated outside of the M.I.T. community.

The Innovation Process

These paragraphs reflect Utterback's (84) summary of the factors which influence and limit technical changes and innovations. The potential for technical innovation is considered a function of its environment, including economic, social, and political factors, as well as the state of development of technology and information about relevant technology.

The ability of a firm to achieve this potential is viewed as limited by two sets of factors. First, barriers to communication between the firm and its environment will limit the firm's knowledge of social and market needs, new and existing technology, government programs, incentives and regulations, etc. Second, barriers to communication and action within the firm, its resources, organization, and other internal characteristics will limit its ability to originate, develop, and implement innovations in response to communication with its environment.

The term innovation refers to technology brought into use. The process through which innovations occur can be viewed as a number of separate steps or phases. At each successive step, the innovation in

the making becomes more tangible, and the further steps required to bring it into use become more programmed in nature. Three distince phases seem to be the minimum needed to describe the process usefully (32)

1. Generation of the idea.

2. Development of the idea and problem-solving to bring it to a workable design.

3. Implementation (tooling, plant start-up, market introduction, etc.) needed to bring the design to first use.

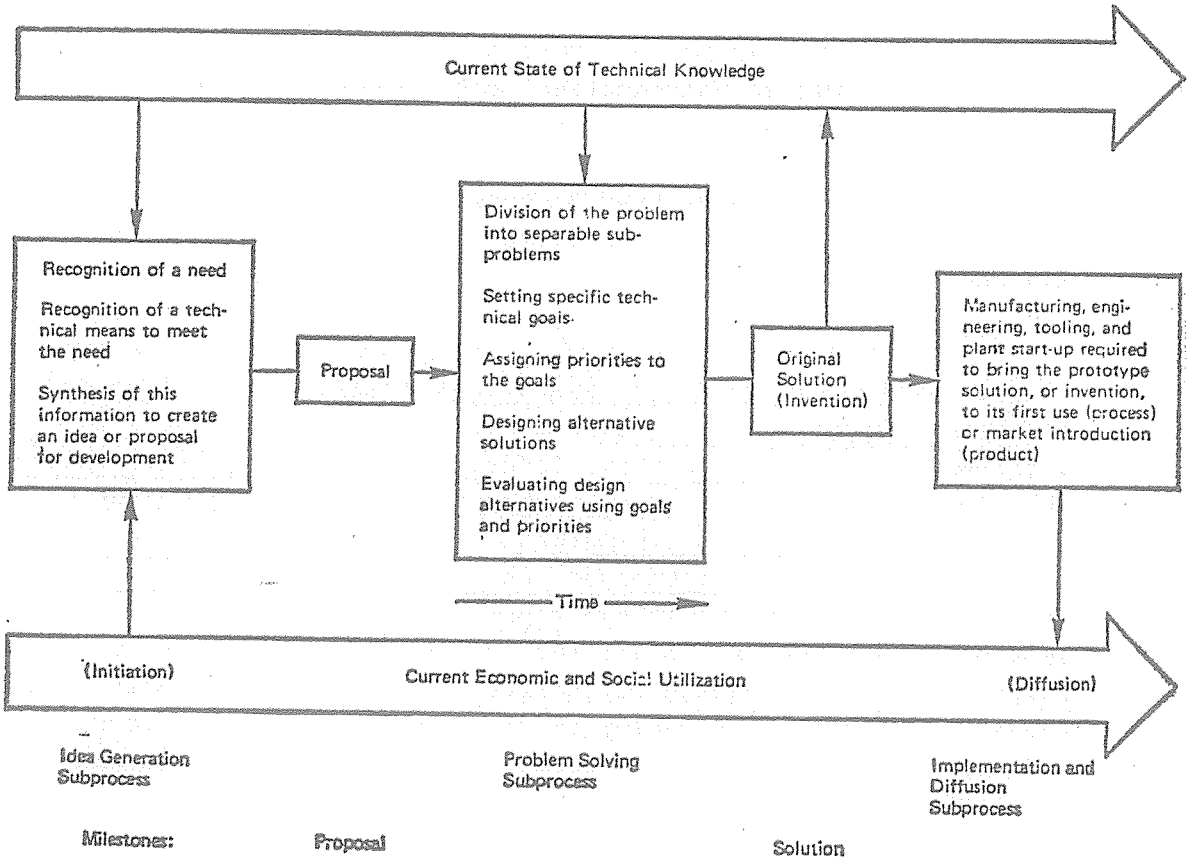
More complex models have been proposed, but this one can be used to advantage in comparing most research findings and educing their implications for policy.

Innovations occur with varying degrees of complexity: (1) Very complex systems involve many years to implement and involve resources far beyond those of a single firm; (2) major breakthroughs in technology alter the character of a whole industry and are usually initiated outside that industry; (3) innovation of new products is carried out within the firm and is vital to its commercial success; and (4) incremental improvements in products and processes reduce costs and/or improve quality (48). To say that innovations at the highest level of complexity have a greater economic and technical impact than do those at the lowest level of complexity is not necessarily correct. In fact, incremental improvements appear to be the major factor in technical and economic advances in some industries. Finally, areas of technology differ from one another in terms of complexity and rate of advance.

The process of innovation is embedded, as is the firm in which it occurs, in an environment with political, social, and cultural elements in addition to other elements. Two of these elements seem crucial with respect to the definitions of invention and innovation given above. The first crucial element is the current state of technical knowledge in the form of publications, training, and current techniques and devices. Technical knowledge is viewed as continuously changing with time, as shown at the top of Figure 4. The technical-knowledge aspect of the firm's environment is defined to include all existing and applicable technical information and knowledge concerning the sources (such as specialized libraries, abstracts, and expert individuals) of this information. The second crucial element is the degree of economic and social use of existing products and processes, as well as factors which lead to the recognition of needs and wants for new products and processes; this also is viewed as changing with time, as

Figure 4(77)

The Process of Technical Innovation



noted at the bottom of Figure 4. The current economic usage input of the firm's environment is defined by other firms in the industry, by potential competitors in other industries, and by customers and potential customers.

Many retrospective studies of innovation have been done. Utterback (85) analyzed the results of those listed in Table 1 in the framework of Figure 4, and reached the following conclusions:

First, market factors appear to exert a primary influence in the organization of innovations. It appears that 60% or 80% of important innovations in a large number of fields result from a response to practical demands, needs, conflicts, and problems. The remainder have

Table 1 (79)

Some Retrospective Studies of Technological Innovation

Author	Industries Studied	Sample Size
Arthur D. Little (8)	Textiles	12
	Machine tools	6
	Construction	8
	Semiconductors	12
Carter and Williams (13)	116 British firms	204
Enos (22)	Petroleum refining (processes only)	11
	Other industries	35
Goldhar (30)	Winners of Industrial Research Award	108
Hamberg (33)	Major innovations 1946-55	27
Jewkes, et. al. (37)	Major innovations 1900-45	61
Langrish (39)	British innovations given Queen's Award in 1966 and 1967	51
Mansfield (47)	Iron and steel	49
	Petroleum refining	66
	Bituminous coal	28
	Railroads	10
Materials Advisory Board (50)	Major materials developments	10
Mueller (52)	Dupont's Major Innovations 1920-49	25
Myers and Marquis (53)	9 Railroads	79
	14 Railroad Equipment Suppliers	125
	53 Housing Suppliers	196
	12 Computer manufacturers	90
	23 Computer Equipment Suppliers	77
National Science Foundation (53)	Magnetic ferrites Video tape recorder Oral contraceptive pill Electron microscope Matrix isolation	5
Peck (59)	Aluminum	194
Sherwin and Isenson (72)	Weapons Systems	20
Utterback (79)	Instruments	30

resulted from a response to new scientific or technological advances and opportunities. Rate of growth of markets and factor costs appear also to exert a positive effect on the rate and direction of innovation.

Second, most innovations seem to have their origins in sources outside the firm that actually develops the innovation. A related point is that 20% to 30% of innovations judged of greatest commercial importance to a number of firms were wholly adopted from others.

Third, larger firms do not seem to develop a greater proportion of innovations relative to their market share than smaller firms do. In fact, in some cases, the most advanced technologies appear to be developed by firms outside the group which dominates industry sales, and by new firms which "spin-off" from larger organizations.

Fourth, many innovations of great commercial significance are of the relatively low-cost, incremental type.

Fifth, there is a substantial lag between the time when technical information is generated and the time of its use in an innovation. This lag is significantly shorter for innovation stimulated by a technical advance than for those stimulated by market factors.

Sixth, basic research seems not to be a significant source of innovations. However, basic research plays a critical role in the production of knowledge and, thus, has a significant impact via education. Innovators tend to be well educated and to rely on personal contacts and consultation with others as a source of information.

Points three and four support the contention that innovations can be active in relatively poor or less developed areas. Points one, two, five and six emphasize that a high level of integration of the firm, its markets, and source of technical information and know-how is important. This strengthens the belief that building linkages between these elements can be expected to encourage the innovation process.

If any single element dominates the situation in assuring that an innovation will be commercially successful, it is the market or need orientation of the idea. It is also clear that successful innovations usually exploit old inventions; they do not derive from current research at the frontiers of knowledge.

Where data on the individuals involved in generating successful innovations are reported, the general conclusion is that they are a well-educated group; however, individuals with all levels of education are represented. The median education of the founders of new firms, Roberts

reports, is the master's degree (67); this is also the case for the originators of innovations reported by Utterback and by Goldhar (79, 30). Approximately 40% of the respondents in each of these samples hold the Ph.D. Personal contacts, education, and experience constitute by far the largest proportion of information sources used in originating ideas for innovations. These data suggest that education is a primary avenue through which basic scientific findings are translated into practice.

The potential of a firm for technical innovation was considered a function of its environment, including market and technical factors. Flows between the firm and its environment, as shown in Figure 4, include primarily information about market needs and technical possibilities during the idea-generating phase, and acquisition of technical information during the problem-solving phase. Barriers to these flows of communication between the firm and its environment will limit the firm's potential for innovation. Conversely, policies which tend to reduce the barriers to communication or to enhance the flow of information should decrease any discrepancy between the potential determined by the environment and that perceived by the firm. Past efforts to promote this flow have been notable mostly for their failure. This failure was due probably to concentration on formal, as opposed to informal, flows of communication.

Consultants, consulting activity, and information resulting from diversity in work assignments appear to play major roles in the generation of ideas for successful innovations. For example, outside experts played a crucial part in the generation ideas for sixteen of the thirty-two new instruments studied by Utterback (79). Peters has explored the relationship between consulting, diversity in work assignments, and idea-generation in interviews with faculty in four departments at M.I.T. He found that 96% of those reporting ideas engaged in consulting as opposed to 28% of those not reporting ideas (60). Gordon and Morse also note that consultation outside the work setting tends to enhance idea generation (31). These findings might be explained by the central requirement for systhesis of information in forming ideas; both consulting and diversity in work assignments would tend to assist in bringing together information both about needs and about technical possibilities.

Two important flows from the firm are of interest in considering policies to stimulate industrial innovation: these are flows of new products and processes to other firms and users, and flows of technical information and skilled persons who become involved in the creation of additional innovations. One might consider flows of technology between industries, between firms and other types of organizations and institutions, and between different institutions as well (76). However, there is little information describing even the simple case of flows between innovating firms and markets.

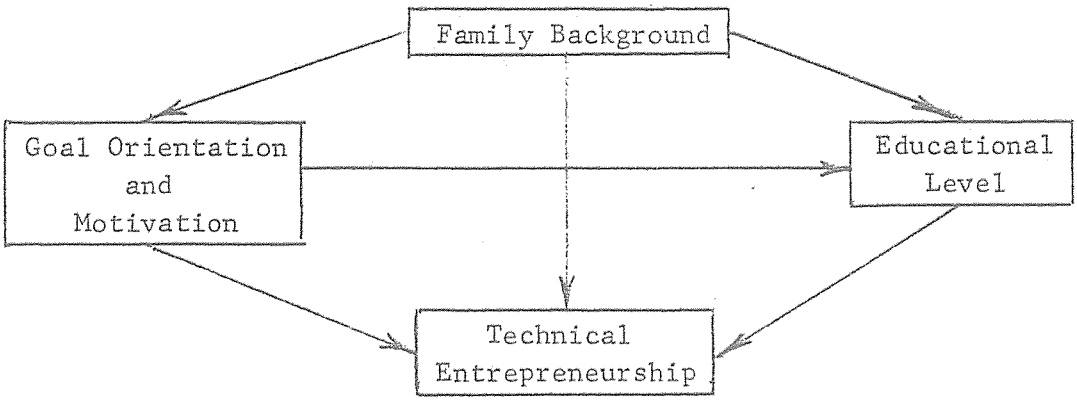
A second type of flow from the firm to its environment is the flow of technical information and skilled people who become involved in the creation of additional innovations. Roberts and Cooper have studied such transfers and "spin-offs" in the Boston and Palo Alto areas, respectively (66, 17). The economic and social impact of new ventures formed by technical entrepreneurs leaving established firms can be seen from data gathered on spin-offs from the M.I.T. Lincoln Laboratory. The fifty new ventures formed prior to the study had resulted in total employment greater than that of the Lincoln Laboratory itself, a constant 1800 people. Similarly, thirty-six ventures which were spin-offs from a large Boston electronics firm over a five-year period had total sales exceeding those of the parent at the end of the period. The better-performing half of eighty-four firms studied by Roberts (67) exhibited a high degree of technology transfer from the parent organization. This finding is extended by Utterback's (79), that a large proportion of the originators of new instruments had also started their own firms (ten of twenty-seven respondents who had originated ideas). These entrepreneurs, as a group, were involved in firms whose rate of sales growth (43% per year) was nearly double that of the other firms he studied, though their firms were smaller and newer than the others.

The Technical Entrepreneur

It has long been recognized that the initiation of new enterprise and the probability of the individual firm's success are directly related to and dependent upon the character of the entrepreneur(s) (98, 97, 96, 67). All of the research results sustain the premise that the difference between mere technical invention and successful innovation is largely attributable to the personal role of the entrepreneur. Better understanding of him and of the personally based technical innovation process will lead to more rapid and more beneficial technically based economic growth. Where the inventor is not entrepreneurially inclined, the MITDF role of finding, introducing, and supporting an appropriate entrepreneur may make the difference between a successful innovation and an idle, unexploited invention.

Some of the factors and relationships involved in understanding the technical entrepreneur are incorporated in Figure 1.

Figure 1. Model of Factors Influencing the Development of an Entrepreneur



McClelland (98) laid much of the ground work for understanding the personality of the entrepreneur in his work relating a measurable achievement motivation characteristic to the capabilities and performance of entrepreneurs. Detailed studies of the Boston (66, 67, 74, 96, 97) and the Palo Alto (17, 18) experiences have concentrated attention on the technical entrepreneur and his activities.

These studies have confirmed the association of high achievement motivation with entrepreneurial initiative and drive (97). In fact, it was possible to identify combinations of personality factors, not only associated with entrepreneurs in general, but correlating with higher and lower performance in actual new technological enterprises (66). Further analysis of these data (96) has identified home environment factors, such as father's occupation, father's educational level, and the family religious background, which influence the individual's goal orientation and motivation and educational level, hence affecting his entrepreneurial inclination and performance. In the so-far limited experience of the MITDF, the entrepreneurs seem to share some of these characteristics, but the dominant identifying element is that they had all engaged in technical entrepreneurial activity prior to their association with the MITDF.

Other factors have been identified as strong determinants of the success of a new technical enterprise (66). They are not individual personality elements, but do reflect, again, the background of the

entrepreneur and specific choices he makes in his approach to his new enterprise. Table 2 lists these and shows their relationship with high and low business performance.

Table 2 (66)

Non-Personality Factors Affecting the Performance of New Technical Enterprises

	FACTORS
HIGHER PERFORMERS	High degree of technology transfer Moderate educational level Specific business function ? Entrepreneur concerned about personnel matters Marketing department
LOWER PERFORMERS	Low degree of technology transfer High educational level No specific business function Entrepreneur not concerned about personnel problems No marketing department

It is worth noting that Von Hippel (95), although concerned primarily with innovations (new products) in existing enterprise, showed, also, the importance of attention to market orientation in determining a successful outcome.

These research results provide clear guidelines for the search for entrepreneurs for Maine. In addition to a Maine origin or orientation, desirable personal characteristics are identified, and important elements of the catalytic agencies' role are indicated.

Technology Transfer & Communications

The following paragraphs summarize two studies recently completed by Professor T. J. Allen (89, 90) in Ireland. These studies were done in the interest of understanding the process of technology transfer into underdeveloped nations. The results apply to a wide range of situations, but they appear particularly appropriate for Maine. There are many similarities between Maine and Ireland. For instance, they both lack economic growth, are isolated, and suffer an out-flow of their educated youth. One study, using a critical incident approach, sought to identify the sources of new technology in Irish industry. The second assessed the communications patterns of the Irish technical and scientific community. Sample questionnaires from both surveys are included in Appendix D.

During the summer of 1972, 48 Irish firms, in seven industries, agreed to cooperate in a study of technical change. The 48 firms were mostly small in size, with but two in excess of 250 employees. This bias was introduced purposely for two reasons. First, it is representative of Irish industry, generally. And second, there is particular concern with the problems of bringing new technology to the smaller firm where the problem of capturing new technology is particularly acute.

The method used to determine the sources of new technology was very simple and straightforward. The general manager (or his designate), in each firm, was asked to think back over the last several years and then describe what he thought was the most significant change, in either product or process, that had occurred within the firm. The principals who were involved in introducing the change were then interviewed in some depth.

There were two main goals in the interview. The sources which first brought the new ideas to the attention of the firm were sought first. Then respondents were asked to describe any problems that were encountered in the course of introducing the new technology, and the manner in which such problems were resolved, including any assistance that was sought or obtained from outside of the firm.

After learning as much as possible about the firm's "innovation",* the interviewers went on to gather background data from the principals regarding their previous work experience, general use of information sources, and their degree of contact outside of the country.

*The term innovation is taken to mean something new to a particular firm. Even if every other firm in the industry is already using it, it is new to the firm under consideration, and it will be called an "innovation."

The mean age of 46 innovations disclosed is about three years. There are some differences across the seven industries, but these should not be taken as measures of the degree of "innovativeness" of the industries. As a matter of fact, there would almost seem to be a positive correlation between age and the degree of technological sophistication involved. The two industries with the most complex innovations (electrical and creamery), are also toward the high end in the length of time between introduction of the innovation and our interview.

Sources for initial ideas were many and varied. Almost a quarter of the messages** came from within the firm, but an approximately equal number came from within the same industry as the recipient firm. Most of the firms providing were foreign. The next most important category is the supplier or vendor of manufacturing equipment. Together these first three categories supplied 71 percent of the messages, which stimulated a product or process change in the 46 firms. The remaining 29 percent came from a wide variety of other sources.

Several interesting points should be noted in these data. First of all there is the usual discovery that nearly all of the information is obtained through direct personal contact. Less than 5 percent of the messages were delivered through documentation (86, 92, 91). Then, there is the preponderance of foreign contact. This occurs both with firms in the same industry and with suppliers. In the case of firms in the same industry almost none of the foreign contacts are British. They are mostly continental with a few contacts in the United States.

There is little information that came from either Irish or British firms in the same industry and the recipient. This no doubt results, in both cases, from the fact that they are competing in essentially the same market. Continental and American firms did not generally see the Irish as direct competitors and were therefore much more free with their information. Suppliers were primarily foreign for the simple reason that there are so few Irish manufacturers of equipment such as that used in most of the innovations.

At the low end of the frequency spectrum, none of the ideas resulted from any work in universities either Irish or foreign. Furthermore, the government sponsored research institutes (Institute of Industrial Research and Standards; An Foras Taluntais; and An Foras Forbartha) together account for less than two percent of the messages. The position of the universities is not surprising, although this does not make it any less distressing. The situation with the research

**When a respondent cited one or more sources as contributing components of the initial idea, each was credited with having supplied a "message."

institutes is both surprising and distressing. One of the goals in establishing such institutes is that they produce new concepts and ideas with a potential for new products and processes in Irish industry.

A further point of interest lies in the fact that although more than one-fourth of the firms were subsidiaries of foreign firms, less than 6 percent of the messages came from a foreign parent firm. This is not to say that foreign-owned firms were less innovative. Only that they did not obtain their new ideas from what one might consider the most likely source.

After a firm decides to go ahead with a new product or process, it normally encounters a series of problems which must be solved before implementation is successfully completed. While many of these problems can be solved by the staff of the firm, aid is often sought from outside. Three-fourths of all the problem-solving messages originated outside of the firm. The most important category outside the firm is, not surprisingly, the supplier or vendor. The manufacturer of production equipment is often bound under warranty agreement to solve any problems which arise with the use of his equipment.

Private consultants are also brought in a bit more at this stage. However, there is still precious little resort to the research institutes, and even less to the universities.

While foreign sources are still the most important, domestic sources do increase in importance, at this time. This is the point at which the research institutes might be especially helpful, it a means could be devised to encourage firms to approach them when they encounter problems in implementing new technology.

Allen infers a number of lessons from these data. First of all, the importance of personal contact. If one's goal is to introduce new technology into Irish industry, it is obvious that reprint and documentation services will be only marginally useful. One has to go far beyond this type of service and tackle the far more difficult problem of bringing the right people together.

Now if one believes that at least some of those "right" people work in universities and research institutes, some means must be found to remove the barriers that presently exist between them and their potential industrial clientele. There are a number of possible ways of doing this. Trinity College, for example, has recently established an Industrial Liaison Office (94). The Massachusetts Institute of Technology has for many years operated such a venture, with at least some apparent success. Another scheme being attempted by some countries

is to funnel at least part of the government's funding to the universities and research institutes, through industry. Industrial firms are provided budgets that can only be spent to support research in a research institute or university. The firm, itself, however, has complete authority within these limits over selection of both project and source.

Such mechanisms, and there are many others that might be tried (93) will be most effective for the larger firms. In the case of the smaller firm, the problem is a bit more difficult. To get the manager from the small firm to approach such an exalted institution as a university, is, to say the least, very difficult, if not impossible. He says he's too busy with day-to-day problems. This may be true, but more likely he means that he doesn't know how to approach them (particularly the universities) and would just feel very uncomfortable making the attempt. They operate in a different culture, and he sees the cultural barriers as far too great. If anything is to be done, the initiative must come from the other side. This means that researchers in the universities and research institutes will have to be encouraged to acquaint themselves directly with the problems of industry, and employ this knowledge in formulating their research portfolios.

Allen suggests that a first step should be the formation of technically competent teams of individuals from potentially relevant disciplines to go on site inspections of firms in specific industries. The team's goal would be not to help specific individual firms, rather to search out general problem areas where the application of their research might benefit an industry. The experience of cataloguing areas for potential improvement of either production processes or products will prove invaluable in directing and selecting research projects later on.

The rapid expansion of the world's store of scientific and technological knowledge presents the small nation with a particularly vexing problem in maintaining its scientific and technological communities abreast of foreign developments. To assure its survival and growth the small country must not only acquire foreign scientific and technological information, but it must also solve the more difficult problem of seeing that this information is disseminated to those points where it can be utilized.

The problem of dissemination is a particularly difficult one. Most of the recent work in the field of technical information has gone into the development of hardware and software packages which provide at best, only partial resolution of the dissemination problem. National dissemination of scientific and technological information is highly dependent upon the ways in which science and technology are organized

in the country, upon the existing institutional forms, and upon relations among both institutions and people. This is true whether the source of information is domestic or foreign. To advocate reorganizing or establishing new or additional institutions without first understanding the roles in the dissemination process of existing ones would indeed be foolhardy. As a first step, a thorough investigation must be undertaken to ascertain the respective roles and the effectiveness of the various types of institutions which exist in the country.

Any country, whatever its size, would certainly benefit from a better understanding and evaluation of its strategies for acquiring and disseminating technical information. For the small, growing nation, however, the need is at once both more acute and more capable of fulfillment. Fortunately, because of its size much more can be learned about the functioning of science in a small country. The entire country can be made a unit of analysis, and the entire scientific and technological community can be reached and studied in considerable detail, at reasonable cost.

The rationale for this approach to the problems of small countries grows out of a program of research, which was initiated at the Massachusetts Institute of Technology in 1963. The implications of this work have been widely disseminated (87), and are well known in the context of individual research laboratories in government and industry, where many of the earlier studies were carried out.

More recent work suggests, however, that the relevance of these questions, and the answers provided by communication research, goes beyond the individual laboratory and deserves the attention of national governments, international organizations and other agencies concerned with the relation of information transfer or dissemination to economic development.

The Irish government in recent years has sought to stem excessive emigration and create more and better employment opportunities by a series of development programs. These have used grants to agriculture and industry, investment in state-sponsored (or "semi-state") companies and improved services to agriculture and industry. One of the objectives of policy is to improve the contribution of science to economic and social development.

A survey was conducted in 1970 and 1971 of the communication patterns of 1.500 research and development scientists and engineers then working in Ireland. The techniques used in studying industrial firms were adapted to suit the conditions within a country. Data collection was in two stages. In the first, covering one major research institute,

responses were received from almost 200 scientists. These were analyzed and results published (88). In the national survey, responses were received from more than 1,200, or 80 percent of the population responded.

The structure of the internal communication network was modelled by examining responses to the questions regarding each scientist's "most frequent" discussion partners. This gives an index to the number of colleagues who turn to a given individual for information, or the number who can (potentially) be reached by information held by that person. Someone who is consulted by many colleagues is likely to be an important information source for his colleagues; he may be called a "communication star".

The data from this phase of the survey did, in fact, show that technical discussion stars do receive significantly more international technical information than non-stars, as measured by frequency of foreign correspondence and attendance at foreign scientific and professional society conferences. They also read a significantly greater number of foreign journals. The gatekeeper hypothesis is quite strongly supported.

There are three principal classes of organization performing research in Ireland. They are: the Universities, the Research Institutes and Industry. In addition, there are a number of smaller organizations including Research Sections in several government departments.

Broadly, the main communications are provided by the universities and the research institutes. There is relatively little contact between the other organizations. The relative strength of the bonds show communication to be heaviest between research institutes and industry and weakest between universities and industry.

Allen analyzed the survey data in detail, looking at communications within each sector, foreign contacts in each sector, and the way in which the individual sector networks combined to create an overall communications network for Ireland's scientific community.

The implications of these results are unambiguous. If international transfer of technology is to be fostered, nations should seek to open those interpersonal channels through which information flows most effectively. They should assist able, domestically educated research personnel to do research abroad. They should encourage researchers to have foreign sabbaticals, fellowships, and other forms of extended foreign technical experience. They should help gatekeepers to perform their role as an efficient mechanism for transfer by providing funds to maintain existing contacts through foreign travel. They should stimulate contact among organizations by the mechanisms described in this paper.

They should assist organizations in properly developing their specific roles vis a vis technology transfer. The development of interpersonal and inter-organizational contacts is not in itself the complete answer to international technology transfer. It is, however, an essential part of the process. Where it works it is doubtless the least expensive of the available mechanisms -- and we are now learning ways to further improve its effectiveness.

Summary of Research

Review of the background research leads to an understanding of the phenomena of innovation, technology transfer, and new enterprise formation. This understanding can be expressed as a series of assertions forming the basis for the planned experiment.

1. Innovation, technology transfer, and new enterprise formation are processes, not events.

2. As processes, innovation, technology transfer, and new enterprise formation occur through networks of people who operate through a variety of communication and linking mechanisms.

3. Technical, financial, market, and entrepreneurial elements must be present and effectively linked for the development of technology-based new enterprise.

4. The particulars of each new enterprise situation will be different, even though the basic elements must always be present. Maine is not Route 128, but with appropriate substitutions, the Route 128 experience can be translated into an effective Maine mechanism.

Section 10

MAINE

The State of Maine is widely recognized, internally and externally, as an economically lagging area. Surveys by an independent research group have recently reported Maine's ranking at 49th in the United States in economic growth (1). Other measures of economic health are equally discouraging. In spite of this, there is evidence that the current national concern for "quality of life" is reflected in the desires of organizations and individuals to locate in Maine. The CRAS, for instance, sees 40 to 50 inquiries or interviews a month from people seeking opportunities in Maine.

It is a basic premise of the NSF Program that technology-based innovation and new enterprise are effective ways to improve such a situation. Hence, the plan for an experiment in Maine. The beginning point must be an examination of conditions as they currently exist in Maine. This section provides a brief summary of pertinent indicators of the climate for innovation and new enterprise in Maine.

The information is based on data gathered from a variety of sources noted in the bibliography, together with interviews with public officials, members of the CRAS staff, and leaders in the business community. The material is organized under seven major headings, as follows:

Topic

An Economic Profile of the State of Maine

The Tax Climate within the State

The Capital Climate in Maine

Transportation in Maine

Available Assistance, Consultants, and Research and Development

Education in Maine

The Ecology of Maine

An Economic Profile of the State of Maine

General

The State of Maine, with a total land area of 33,215 square miles, nearly as large as the rest of New England combined, is, with the exception of its mountainous northwestern section, essentially a broad plateau sloping from the western boundary eastward and southward. By far the most predominant and influential characteristics of physical Maine are her vast woodlands, large number of lakes, and her rugged coastline. Table 1 compares these elements of Maine's land characteristics to those of the other New England states. It will be noted that 88.9% of Maine's total area is in forest and inland waters, the highest proportion in the U.S.

Table 1 (22)

Forest and Water Resources, 1963
(Square Miles)

	Total Area	Total Forest Area	Total Inland Waters
Maine	21,258	17,425	1,460
New Hampshire	5,954	5,019	173
Vermont	6,150	3,730	214
Massachusetts	5,284	3,288	271
Connecticut	3,206	1,990	89
Rhode Island	777	434	106
New England	42,629	31,886	2,313

In a period of concern over the depletion of natural resources one is surprised to find that the total forest land area in the State has shown small increases over the past 15 years, even though the composition of the timber growth has changed (11). It has been estimated that the stumpage value of the 1970 timber harvest from Maine's forests amounted to almost $27 million (11). In 1970 forest-oriented manufacturers accounted for 38% of the State's total value of manufactured product.

An airline measurement of the Maine coast amounts to only 228 miles. If, however, one measures the total shoreline of tidal waters, this measurement becomes 3,478 miles, a better indication of its economic importance.

This shoreline imparts a considerable current economic impact to Maine as well as an even greater potential impact. The coastal economic "situation" may be divided into three components: Aquaculture, Energy, and Recreation (34). Each of these components, in turn, gives rise to a multiplicity of activities. For example the energy component covers nuclear and fossil fuel power generating stations, off-loading of super-tankers and the establishment of oil refineries, and off-shore drilling for oil.

Of the three, the recreation component has been the furthest developed and aquaculture the least. In general, development has been conscientiously slow as Maine has grappled with her priorities and goals. The decision, direction, and goal determining process is a long one; and the end is not in sight.

Industry and Commerce

Economic activity in Maine is mainly concerned about the existence and exploitation of primary raw materials with which nature has endowed the State. It is conceivable and perhaps desirable that Maine's economic activity could be expanded in the secondary phase of manufacturing and processing of its own raw materials. However, the relatively remote location of the State with respect to major market centers will encumber significant development as either a processor-exporter of imported raw materials or as a center for the tertiary or service level of economic activity.

Another important resource for commerce and industry in Maine is her labor force. The State enjoys a reputation for a reliable, hard-working labor force which is willing to work for relatively low wages. Recently several electronics plants have located in Maine to take advantage of this resource by using the female component of the labor force for assembly operations.

Table 2 presents a listing of employment by industry, indicating the relative importance of each industry as a source of employment.

One area of employment not shown in Table 2 but considered to be important to Maine is the tourist or recreation "industry". Since this is really an "activity" rather than an "industry", its economic impact is difficult to identify and measure. Estimates of the dollar

Table 2*

Employment in Maine Industries

1972 (thousands)

	Employment	
Manufacturing		102.6
Paper	17.3	
Food	12.1	
Leather	19.6	
Lumber and Wood	13.5	
Textiles	9.0	
Other	31.1	
Agriculture (est.)		14.4
Retail and Wholesale Trade		68.2
Finance, Insurance and Real Estate		12.5
Service		49.5
Transportation and Public Utilities		17.6
Contract Construction		17.3

*Maine Employment Security Administration, Annual Average Wage and Salary Employment in Non-Agricultural Industries in Maine, 1958-1972, Agusta, Maine: 1973.

volume of tourist activity, as made by various State departments, range from $275 million to $600 million annually. There are several reasons for these varying estimates. Strictly speaking, tourism and recreation are not synonomous. Recreation covers all aspects of tourist business, but it also includes the economic impact of summer homes and related activities meeting the needs of many permanent residents of the State, as well as the needs of seasonal residents and tourists. There is a question of how much of Maine's recreation activity is done by Maine residents and how much by out-of-state visitors. For the purpose of this report, however, the distinction is not currently important, but it should be pointed out that the value of this "industry" and the advisability of its promotion is a continued subject of debate among Maine's citizens. Opponents cits its seasonability, low wages, and adverse environmental impact as detrimental characteristics. Proponents look to the development of a four-season tourist "industry" as an answer to many of these objections.

At the present time, four-season tourist activity is not a reality, although a few mountain-side developments on the shores of lakes are attempting to promote their locations as centers for summer lake activities, fall hunting, winter skiing, and spring fishing.

Business Starts and Failures

Table 3, presented below, lists the annual business failures and business incorporations in Maine for the period 1964-1972. While there is no basis for comparison, it can be noted that business failures run less than 10% of business incorporations and these figures could be related to a statewide population of about one million persons.

Table 3*

Business Failures and Business Incorporations in Maine 1964 - 1972

Year	Business Failures	Business Incorporations
1964	56	672
1965	72	864
1966	59	708
1967	57	684
1968	23	276
1969	28	336
1970	59	708
1971	27	324
1972	42	504

*New England Economic Computer Statistical Data Source.

People of Maine

The population of the State of Maine has been fairly stable over the past twenty years at slightly under one million people. This stability of the census count, however, hides several dynamic characteristics in the population. Firstly, one cannot help but notice the

increasing influx of seasonal visitors not counted in the census. One source has estimated that as many as five million people visit the State annually, mostly in the summer. A second dynamic characteristic is the decrease in the population of Northern Maine and the increase in population in Southern Maine, particularly in the urbanized areas in the lower valleys of the Kennebec and Androscoggin Rivers and along the coasts of Sagadahoc, Cumberland, and York Counties (36).

The third dynamic characteristic of the population is the movement by age group. Significant proportions of those in the 14-44 age group leave the State in search of employment. This statistic is one of the most important indicators of the problems and challenges that face the State in the 1970's. The population age group of 45 and over has increase in absolute terms. The proportion of the population in this group is greater in Maine than in the U. S. indicating, perhaps, that given the opportunity, people will move to Maine. A recent questionnaire from the Alumni Office of the University of Maine to a list of graduates with out-of-state addresses brought replies indicating that an overwhelming majority would like to move back to Maine if suitable employment opportunities should become available. Letters to editors in Maine newspapers, together with occasional editorials, indicate that the people of Maine are concerned about this movement of so much of the young-adult population out of the State, and that there is a wide-spread desire for an increase in business enterprises that will provide better opportunities for the employment of youthful heads of families.

Projections of the 1980 population in Maine suggest that the State population will finally increase to slightly more than one million persons (35). It has been suggested that this slight growth in total population will be a result of a lower net-out-migration rate brought about by improved employment opportunities within the State (35).

Employment and Income

Table 4 indicates that since 1960 the manufacturing sources of employment have not grown as fast as the non-manufacturing sources, such as services, government, and retail trade. It should also be noted that the five largest categories of employment in the manufacturing industries in Maine accounted for a smaller number of employees in 1972 than in 1960. While this trend broadens the employment base, it also contributes to significant unemployment hardships for those who previously worked in the affected industries.

Table 4*

Maine Employment

1960 - 1972 - By Industry

(in thousands)

Industry	1960	1972	1972/1960 x 100
Total	277.5	337.4	121.6
Total Manufacturing	104.5	102.6	98.2
Durable Goods	29.3	32.3	110.2
Lumber and Wood Products	16.9	13.5	79.9
Metals and Machinery	4.9	10.9	222.4
Other Durable Goods	7.5	7.9	105.3
Nondurable Goods	75.2	70.3	93.5
Food and Kindred Products	11.4	12.1	106.1
Textile-Mill Products	14.0	9.0	64.3
Apparel	2.7	3.3	122.2
Paper and Allied Products	18.1	17.3	95.6
Leather and Leather Products	24.1	19.6	81.3
Other Nondurable Goods	4.9	9.0	183.7
Total Nonmanufacturing	173.0	234.8	135.7
Contract Construction	13.6	17.3	127.2
Transportation & Public Utilities	18.1	17.6	97.2
Wholesale and Retail Trade	53.9	68.2	126.5
Finance, Insurance & Real Estate	9.0	12.5	138.9
Services & Other Nonmanufacturing	30.2	49.5	163.9
Government	48.2	69.7	144.6

*Maine Employment Security Administration, Average Wage and Salary Employment in Non-Agricultural Industries in Maine, 1958-1972, Agusta, Maine: 1973.

Table 5 presents nine basic occupational categories as defined by the U. S. Census Bureau, listing the number of Maine workers in each in 1969, and projecting the number estimated for 1980 by the Maine Department of Manpower Affairs. The projections suggest that the higher growth rates will occur in the professional and service groups, that there will be a smaller expansion in the blue collar and sales areas, and that there will be a notable decline in employment in the labor and farm groups.

Table 5 (27)

Number of Workers in Occupational Categories
(in thousands)

	1969	1980	(1980/1969) x 100
Professional, Technical & Kindred Workers	44.7	59.8	133.7
Managers, Officials & Proprietors	30.8	33.2	107.8
Clerical & Kindred Workers	48.9	60.2	123.1
Sales Workers	24.6	27.6	112.2
Craftsmen, Foremen & Kindred	53.6	63.0	117.5
Operatives & Kindred Workers	94.1	98.9	105.1
Service Workers	41.7	49.1	117.5
Laborers, except farm	21.0	19.5	93.3
Farmers and Farm Workers	12.6	6.5	51.6
Total	372.0	417.8	112.0

The projections in Table 5 suggest that, in all but two categories of employment, there will be an increase in the number of workers during the 1970's. Although a decrease in the two employment categories of "Laborers, except farm" and "Farmers and Farm Workers" is predicted, this does not necessarily mean that there will be an actual decrease in manpower needs in these categories. This is because the total manpower needs arise from two factors: (a) replacement of workers retiring or otherwise leaving the labor force, and (b) the increase in economic activity, or the expansion component. The figures in Table 5 represent only the expansion component.

Table 6 presents average gross wages for some of the larger industries in Maine, comparing these wages to the U. S. average for each of these industries.

A comparison of Table 6 with Table 2 would lead to the conclusion that much of Maine's employment is in low-paying industries. This conclusion is confirmed by a Federal study, published in 1971, which indicates that a higher than average proportion of Maine's labor force is employed in industries which pay wages below the national average for manufacturing employment, a situation which serves as one

Table 6 (48, 26)

Average Gross Wages of
Selected Maine Industries
1971

	Maine	Approximate Percent Relative to the U. S.
Food	$5,409	78.7
Textiles	5,314	100.4
Apparel	4,185	93.5
Lumber & Wood	5,631	88.5
Paper & Allied Products	8,446	107.0
Printing	6,096	75.8
Rubber Products & Plastics	5,214	73.5
Leather	4,755	96.2
Transportation Equipment	9,841	104.3

of the causes of the lower than average incomes prevalent in Maine (12).

The industries selected for Table 6 are the major sources of industrial employment in Maine. Consequently, it can be seen that Maine cannot be considered a utopia for the working man, because (a) Maine has a disproportionately large number of low-paying jobs, and (b) wages in Maine appear to be lower than the national average for many industries. On an overall basis, the average hourly earnings of production workers in Maine in 1971 was only 80% of the national average. This, however, represents a small improvement over the 1960 figure of 78.3%.

Table 7 shows the per-capita personal income in Maine in relation to that of New England as a whole, and the national average. The data in the table indicates that Maine has the lowest per-capita income in New England.

The reasons for Maine's very low per-capita income distribution are many and varied. Some of the reasons have been indirectly touched upon in the preceding section.

Table 7*

Per Capita Personal Income Data
Maine, New England, & U. S.

	1971	1968	(1971/1968) x 100
United States	4,156	3,436	121.0
New England	4,454	3,740	119.1
Maine	3,375	2,794	120.8
New Hampshire	3,796	3,245	117.0
Vermont	3,638	3,045	119.5
Massachusetts	4,562	3,762	121.3
Rhode Island	4,126	3,558	116.0
Connecticut	4,996	4,290	116.4

*U. S. Department of Commerce, Survey of Current Business, Vol. 52, No. 8, (August, 1972), p. 22 and Vol. 52, No. 4, (April, 1972), p.20.

A summary of the factors that cause Maine incomes to fall so far behind the New England or national averages would include:

1. the seasonal characteristics of many jobs;
2. the absence of large local markets;
3. the distance from metropolitan markets and population centers;
4. the geographic isolation caused by the fact that Maine is bordered on the north and the east by a relatively rural and sparsely populated section of Canada, on the southeast by the Atlantic Ocean, and on the greater part of the west by mountain ranges along the New Hampshire border;
5. the relatively low value added by Maine workers to raw materials extracted within the State;
6. the relatively high proportion of retired persons and the relatively low proportion of younger workers within the State;
7. the high proportion of low-wage industries.

The matter is made somewhat worse by the expenditures required to survive in the Maine climate, where the growing season for foodstuffs is much shorter than most American states, where the winter heating season

persists until nearly the beginning of summer, and where warmer and consequently more expensive clothing is required than in most other parts of the United States. On the other hand, the fabled self-reliance and independence of Mainers enables some of them to improve their quality of life in ways that are not reflected in income statistics.

While the total personal income of Maine has grown more slowly over the long run than any of the other New England states, a recent projection by the Bureau of Economic Analysis of the U. S. Department of Commerce suggests that Maine and the rest of Northern New England will grow, in terms of total personal income, more rapidly than the states in Southern New England (13). Certainly they have a greater need to grow.

The Tax Climate Within the State

Maine's tax climate for industrial business enterprises has generally been considered favorable in comparison to that of many other States, and it has been further improved by changes in tax laws enacted by the 106th Legislature during the summer of 1973. Maine now ranks in the middle range of state and local per capita tax burdens, but somewhat lower than average in taxes imposed upon businesses.

The principal taxes affecting Maine industry and business are: (1) the Real and Personal Property Tax, which was substantially modified in 1973 for the benefit of Maine business; (2) the Sales Tax, also modified in 1973 to exclude any sales tax on the purchase of new machinery used directly and solely in the manufacture of tangible personal property for sale; and (3) the Corporate Income Tax.

The 1973 legislation excluding stock in trade and industrial inventories from personal property taxation is particularly important. In 1971 a total of $9,508,550 had been collected from Maine business enterprises through the personal property tax on stock in trade, while $3,831,620 had been collected through the personal property tax on industrial inventories (7). Such taxation is now abolished, as well as any personal property taxation on agricultural produce, forest products, or water and air pollution control facilities. Provided that tax revenues from sales and income taxes continue to rise more rapidly than the current, rather conservative projections, it is not inconceivable that additional categories of personal property taxation will be eliminated by future legislatures.

Reforms in the taxation of real property, enacted in 1973, also should benefit the climate of business and industry in Maine. The State has now relieved local government from a much larger share of the support

of public school education, partly through a uniform State Property Tax, but largely through a greater apportionment of support from general State revenues, derived principally from the State Sales Tax and the State Personal and Corporate Income Tax. These reforms provide a much more equitable tax environment for Maine business enterprises, particularly in years of low profits.

The 1973 legislation excluding the payment of sales taxes on the purchase of new machinery used directly and solely in the manufacture of tangible personal property for sale is also of marked benefit to business and industry. Since the cost of new machinery is usually very substantial and the owners of small manufacturing or processing plants usually have to borrow to meet such major capital expenditures, the elimination of the 5 percent sales tax on such machinery represents a major benefit to Maine business and industry, amounting, according to preliminary estimates, to a tax saving of $4.0 million each year (7).

Prior to the enactment of the 1973 legislation, a survey was made of the opinions of business leaders and spokesmen for the major business and industrial associations in Maine concerning possible legislation which might result in a more equitable tax climate for Maine business and industry. The consensus was that real and personal property taxes should be reduced insofar as possible, because they were imposed regardless of business profit or loss during the year for which the taxes were assessed, whereas a partial offset through an increase in Corporate Income Tax rates would be considered equitable. Accordingly the Corporate Income Tax rate for 1974 has been set at 5 percent of the first $25,000 in profits, and 7 percent of profits in excess of $25,000.

The Capital Climate in Maine

There is no established equity venture capital organization within the State of Maine, nor is there any orderly capital market in Maine for marketing securities. Any industry seeking to finance its move to Maine must normally seek financing sources outside the State. Those equity monies available in Maine normally are invested elsewhere. Accordingly, Maine lacks the necessary mechanism to link investors and the capital market with Maine businesses.

One, relatively large, life insurance company has its home office in Maine. Five years ago this company founded a venture capital organization, which operated for three years. The company invested about $1 million in eight projects and ended close to a break-even status, but none of these funds were invested in Maine.

Outflow of Capital

There are many Maine families with considerable liquid assets, but interviews conducted with some of the principal Maine bankers indicate that such families tend to place their monies with out-of-state investment managers, usually in New York or Boston. The traditional attitude of monied families in Maine is that such an action is a sound business practice, the prudent thing to do, and that it achieves greater safety, a higher rate of return, or both. Even the Maine State Retirement Fund is handled in this manner. Approximately $150 million in State Retirement monies is now being managed in Boston.

Funding

"Fundamentally, financing for a new company is obtained by renting, leasing, or buying funds. A loan or short-term debt is rented by paying interest. Money is leased through debentures or bonds with a relatively long fixed pay-back period. Money is bought through stock offerings (15). The following subsections will treat these matters in reverse order, starting with a discussion of equity funding, followed by a more detailed analysis of the problems of debt funding for the Maine businessman.

Equity Funding

Entrepreneurs in many States obtain equity funding for new businesses by raising as much capital as possible from their own resources and from investment loans from family members and friends and then by selling stock in their company through public offerings. In Maine, however, there is no real capital market vehicle for marketing securities. Only one company in the State, H. M. Payson & Company, is currently engaged in equity financing, and it does this on a very limited scale. Even the State's legal counsel for bond placement is an out-of-state firm.

There is a saying in Maine that "all venture capital stops at the Massachusetts-New Hampshire border." From a practical point of view, this appears to be a fact. For some years it had been hoped that some of the very wealthy summer residents in Maine might be interested in providing venture capital for the development of Maine business, but experience has not upheld this hope. Venture capital may be obtained outside the State, but there is no organized source of venture capital in Maine.

It might be argued that national banks are permitted to create venture capital firms through holding companies, and that State banks

are allowed to create small business investment corporations. There are currently five qualifying holding companies and over forty banks in Maine that could legally enter into the venture capital business in this manner. To date, however, only a few small State banks in Aroostook County have gone into any business of this sort, and those banks restrict their venture capital business to assistance of the potato farmers in the Aroostook area.

Federally assisted sources of venture capital are similarly limited in Maine. The Portland Capital and Business Assistance Corporation, initially funded by HUD through the Portland Model Cities Agency, was set up more than two years ago to provide investment capital and managerial assistance to any business that will provide direct benefits to low-income residents of Portland. After two years of planning and several months of operation, this agency was able to make only one placement of funds, for most potential applicants could not demonstrate that their proposed business ventures would "provide direct benefits to low-income residents."

Debt Funding

Provided that a Maine businessman does not require too large an amount of capital for debt funding, Maine has a good number of commercial banks, savings banks, and savings and loan associations which are able to make debt capital available to qualifying businesses. The one drawback is that the banks in Maine are relatively small units with low legal lending limits, as indicated in Table 8.

Table 8

Maximum Lending Limits To One Customer

Bank	Type of Charter	Amount*
Canal National	National	$1.0 Million
Maine National	National	1.5 "
Northeast	State	1.0 "
Casco	State	2.0 "
Depositors Trust	State	1.5 "

*This signifies the combined lending power of the bank rather than that of an individual branch.

It must be remembered that the lending limit for national banks is ten percent of their reserve in capital and that for State chartered banks the limit is twenty percent of their capital reserve. Naturally, their ability to loan varies from time to time, but an indication of the legal lending limits to any one customer by each of the five largest banks in Maine is shown in Table 8. The total amount of loans possible, all five banks taken together, is less than $10 million.

Equipment and working capital loans are also limited by a company's net worth, since bankers must relate debt to worth in their analysis. Interviews with leading bankers indicate that Maine bankers are more liberal in their attitude toward equity than bankers in many other States. In the opinions of some of the bankers interviewed, most Maine companies are undercapitalized. Accordingly, Maine companies which have demonstrated a history of a high level of managerial ability usually obtain somewhat liberal treatment.

Life insurance companies and finance companies provide other sources for debt funding. Maine is the location of the home office of one relatively large life insurance company, which keeps approximately $25 million invested in mortgages and direct loans in Maine, but most of this amount is apportioned to hospitals or major development projects.

Finance companies, of course, make business loans for debt funding, but they charge relatively high rates. Larger businesses attempt to obtain loans on less expensive terms, but finance companies apparently play an importnat role with the smaller businesses.

A third source of debt funding is provided by various State and Federal agencies. The titles, functions, and loan requirements of each are listed in the following paragraphs. It should be stressed that some of the loan requirements are negative in character; in other words, the borrower is eligible for a loan only after he has demonstrated that he cannot secure financing from conventional channels, such as the banks in his area.

Maine Municipal Securities Board (MMSB)

A State agency, formerly known as the Maine Industrial Recreational Finance Approval Board, with exclusive authority within Maine to certify industrial and recreational projects, and grant municipalities the right to issue Industrial Revenue Bonds in conformity to the provisions of the MSSB Act. Certification requirements give heavy emphasis on the applicant's contribution to Maine's economic development.

MSSB does not make, insure, or guarantee loans. A formal application prepared by an industry and a municipality must be accompanied by a letter of intent from a responsible purchases committing himself to purchase Municipal Industrial Revenue Bonds when issued. Credit negotiations are conducted with the bond purchasers prior to filing the application.

MSSB bases certification decisions on conformance of facilities, bond issue, referendum and other procedural matters within the stipulation of the MSSB Act, together with an MSSB appraisal of the general feasibility of the project and its economic contribution to Maine.

Table 9

Maine Municipal Securities Board

Current Status August 1973

Financing Projects Completed Since 1966	$39,925,000
Number of Projects	20
Approved Projects Not Completed	32,025,000
Number of Projects	7

Maine Recreation Authority

A State agency insuring mortgage loans made by banks and other financial institutions to recreational enterprises located in Maine. Mortgage loans for plant, equipment, construction, modernization, and expansion may be insured. Hotels, motels, golf courses, marinas, etc., are typical eligible facilities provided they are part of a comprehensive recreational development.

Loans may be insured up to the lesser of $3.4 million or 75% of real estate and equipment costs, with up to 25 years of maturity at MRA's discretion. The minimum insured loan in $100,000.

No refinancing except for expansion, modernization, etc., is available; and no working capital or intermediate term financing can be provided. The construction financing must be arranged elsewhere, as the MRA insured permanent mortgage is not issued until the project is completed.

Detailed information is required on project cost, employment potential, economic feasibility, and recreational impact. Normally, the personal guarantee of the principals is accepted, but a pledge of outside assets may be required.

Table 10

Maine Recreation Authority

Current Status September 1973

Loans Guaranteed To Date	$9,029,989.05
Total Projects	30
Loans Outstanding	6,204,319
Current Projects	23
Commitments Outstanding	6,370,102

Maine Industrial Building Authority

The MIBA is a State agency insuring mortgage loans made by banks and other financial institutions to industrial, fishing, and agricultural enterprises located in Maine. It insures loans for plant and equipment construction, modernization, and expansion.

The MIBA insures loans up to the lesser of $8 million or 90% of real estate cost plus 75% of equipment cost; up to 25-year maturity on real estate and 10 years on equipment, subject to the discretion of MIBA. The MIBA insurance fee is 1%; the interest rate on the loan is to be negotiated with a bank. The equity requirement is furnished by the development corporation without restriction as to the sources.

No refinancing is available, except for expansion, modernization, etc.; and no working capital or intermediate term financing can be provided. The construction financing must be arranged elsewhere, as the MIBA insured permanent mortgage is not issued until the project is completed.

Detailed information is required on the project cost and employment potential. A comprehensive balance sheet and earning information are required to establish the applicant's ability to service the debt. Normally, the personal guarantee of the principals is accepted, but pledges of outside assets may be required.

Table 11

Maine Industrial Building Authority

Current Status March 13, 1973

Loans Guaranteed to Date	$50,519,702
Total Projects	62
Loans Outstanding	24,845,404.59
Current Projects	40
Commitments Outstanding	3,858,000

Small Business Administration Loan Programs

The Small Business Administration is a Federal agency making direct loans to small business concerns that are ineligible for bank credit. This agency also participates in or guarantees loans made to small businesses by conventional financing institutions, with the general objective of assisting and strengthening the small business community.

The SBA offers a wide variety of term-loan programs. The major programs offer term loans for various business purposes for periods up to 10 years, working capital up to 6 years, and new construction up to 15 years. The size of the available loan varies with the program. Major programs permit SBA to guarantee bank loans to $350,000, purchase participation in bank loans to $150,000, and make direct loans up to $100,000 to companies ineligible for bank credit.

The SBA Section 502 program offers direct and participated loans to development corporations for terms up to 25 years at 5½%, 20% equity capital required. Loans are available for plant and equipment, as well as construction and expansion. Several programs are available for displaced businesses, natural disaster assistance, and lease guarantees; but working capital loans are not made. Precise information of officers and major stockholders are accepted, as well as claims on company and outside assets to secure a loan. A comprehensive term-laon agreement is required. Considerable flexibility is available, verying from program to program with respect to loan, collateral value relationship, refinancing of existing debt, etc..

A ½% guarantee is charged by SBA on guaranteed loans. The interest rate is negotiated with the lender subject to a 7 3/4% limit. The interest rate on SBA direct loan and participations is 5½%.

Small Business Administration Lease Guarantee

The SBA lease guarantee is an insurance policy issued to the small business proprietor and guaranteeing to the landlord that rent payments will be made. This type of credit assistance by the SBA in cooperation with long-term lenders helps smaller businesses to obtain leases in choice business locations, such as shopping centers or industrial parks, when they do not have the AAA credit rating required by developers.

Any small business that can qualify for the SBA loan can quality for this insurance.

Development Credit Corporation of Maine

The Development Credit Corporation of Maine is a private development corporation organized and financed by Maine banks and industry to promote economic development by providing flexible long-term financing to Maine industrial, recreational, agricultural, and service enterprises that are unable to secure loan funds from conventional sources.

A wide variety of long-term arrangements is available, with terms tailored to individual needs. Loans are made up to $100,000 and, under certain exceptional conditions, for larger amounts. The maturities are usually restricted to 10 years. There are no fixed loan-to-security ratios, and no fixed equity requirements. Loans are available for real estate, equipment, and working capital. The interest rate ranges from 2% to 6% over the prime rate listed in the "American Banker", with a floor of 8%.

First or second security positions may be taken. Collateral, personal guarantees, etc., are usually required to secure the loan. A comprehensive term-loan agreement is required. Refinancing, workouts, etc., may be considered if future prospects are good and the company can make a contribution to Maine's economy.

Transportation and Maine

General

New England is an "almost island," surrounded on all four sides by the ocean, major rivers and lakes, or wide expanses of forested mountainous country. Land access to the States west of New England is

severely limited by mountains, the Hudson River, and Lake Champlain, forcing most of the land traffic between New England and the other American States either through the southwest corner, near New York City, or through a mountain pass to the banks of the Hudson at a point close to Troy, New York, on the western bank. In this way, northern New England is effectively cut off from any easy land access to northern New York State or the Great Lakes region, except by way of a detour, either through southern New England or else through Canada.

Within New England, the State of Maine is the most isolated from the rest of the United States. Within its boundaries are nearly half of the square miles of all six New England states, combined. Prior to 1850 much of this large area was opened up and used for agriculture, but during the past century an increasing amount of former farm land has reverted to forest. Today, nearly 90% of Maine is classified as forest land, and the population is becoming increasingly concentrated either near the coast or in the lower valleys of the major rivers.

Concentration of Land Transportation Near the Coast of Maine

The transportation route patterns in Maine in 1973 reflect the concentrating effect of the widening forest land area. From the New Hampshire border at Portsmouth to Bangor, Maine, the principal rail and highway routes either hug the coast or pass only a few miles inland from tidal waters. The East-West rail routes are important, because they originate traffic derived from paper mills and other wood-processing industries, but nearly all rail freight has to be detoured south through Massachusetts before it can be moved to Mid-western markets. The only feasible alternative for westward rail freight shipment is across the international boundary to Montreal, but this requires extensive use of Canadian railroads.

Maine's Lack of the Type of National Rail Subsidy Program Enjoyed by Maritime Canada

In order to help the Canadian Maritime provinces to participate in creating an East-West oriented nation, Canada has used transportation subsidies to shorten the "economic distance" between Halifax and the cities of Quebec and Montreal. This program has helped Halifax to develop into a modern port for all kinds of shipping, including modern container ships, and it has done much to build up the economic prosperity of the entire Halifax area. No similar policy or action assistance is available to Maine's industries through its railroads, motor carriers, or air carriers.

The Increasing Obstacles to Improved Transportation

The travel problems of Maine citizens are gradually becoming more serious. The obstacles include (a) a reluctance of permanent residents to approve an increase in the gasoline tax, (b) an increasingly difficult regulatory path to win environmental approval for construction of new divided highways, (c) inability to find ways and means to overcome the inadequacy of poorly maintained railroad tracks, (d) lack of revenues to modernize travel, and (e) lack of revenues to modernize airports with inadequate runways or terminals.

Desirability of Reactivating Rail Passenger Service

A desirable trade-off between increasing visitor travel and environmental constraints would be to reactivate Maine's railroads as passenger carriers. The run-down condition of the railroad tracks and the need for massive railroad subsidies postpone such a trade-off until some sort of Federal subsidy program may be established. In the meantime, the lack of adequate roads leading inland away from tidal water and the deficiency of inland airports to serve mountain and lake resort areas may retard the rate of growth of tourist travel to and within Maine's forest-lake-mountain area, forcing increasing summer traffic congestion in the already overcrowded coastal area.

New Developments in International Commerce

There are two bright spots in an otherwise drab and apathetic picture of Maine's current transportation situation. These are the recent development of "flag stop" status for international air carriers desiring to use the Bangor International Airport and the "roll-on, roll-off" ocean terminal development at Portland, used by truckers moving goods by ferry between Portland and Yarmouth, Nova Scotia.

The Bangor Airport was originally built by the Air Force to meet high operational standards. With its improvement for present civilian use, it is one of the best airports in the United States. The Civil Aeronautics Board has just given it the status of a "flag stop" for international carriers that choose to use it. This opens the door for direct shipment of air cargo to and from Maine and Europe. This supplements the increasing use of Bangor as an intermediate stop by the semi-regulated carriers flying tour groups to and from the United States.

The Swedish ferry operation between Portland and Yarmouth, Nova Scotia, has grown rapidly since it began operation three years ago. Its main sources of income are passengers and their automobiles. However, it is attracting steadily increasing numbers of loaded trucks.

One of its potentials is the transportation of containers to and from Maine and the Halifax container port. In the future is the possibility of a Trailer and Container train operating daily between Potomac Yard in Washington, D.C. and Portland. Because of its Canadian traffic volume, Halifax has attracted the ocean container ships. Halifax, for the United States, is a spillover or secondary port, supplementing the main port of New York-New Jersey container facilities and ocean services.

Boston has high hopes to become a large scale container port. If it does, the Portland roll-on, roll-off facility would make possible use of Portland as an Outport to Boston as well as to Halifax.

Intermodal Transportation

Intermodalism in the freight area has not made as much impact in Maine as in more highly industrialized parts of the United States. Most of the piggyback transfer facilities are of the primitive end loading type. In general, they are underutilized. There is a substantial volume of export-import traffic, most of it using the Port of New York-New Jersey. Facilities at Portland and Searsport for handling containerized merchandise are primitive, and are used now and then. Very few cargo vessels visit Maine ports.

Intermodalism in the passenger area is highly developed, perhaps in volume equal to any state. The two part journey using a private automobile to and from the airport and commercial or private aircraft beyond is, of course, universal in the United States. Another example is visible to all who travel the highway. In the summer it is the passenger car towing the boat trailer or in the winter the snowmobile being hauled to selected departure points for recreation. This combination of winter and summer use of intermodal movement gives the high volume of such usage.

The urban and rural passenger carriers are very inadequate. This is particularly true in meeting the mobility needs of that large segment of Maine's population made up of the aged, the children, the incapacitated, and the very poor. Many in these groups do not have access to private automobiles and must rely on the passenger carriers. Yet in some areas none exist.

Possible Petroleum Pipeline Developments

Because of environmentalist opposition, there seems little likelihood of the establishment of an oil refinery at a deep-water port within the boundaries of the State of Maine. An added obstacle is the research conclusion of the Corps of Engineers, that the logical

place for a new deepwater oil port is offshore, near the refinery complex on the lower Delaware River. Unless some means is found for handling giant tankers efficiently in the outer harbor, the pipelining of crude oil from Portland to Montreal may not grow in volume from present volume levels.

Development of oil and gas wells in the Gulf of Maine is not yet proven, geologically or economically. Assuming that it is, and that at the very least, the environmental considerations can be met by an offshore transfer terminal, Maine will have another important intermodal movement. It will consist of pipelines from the wells to the transfer terminal, with transfer at that point to deep draft tankers for movement to refineries in the New York or Philadelphia areas.

Available Assistance, Consultants, and Research and Development

An entrepreneur who is interested in setting up an industrial operation in Maine would probably do well to start his search for the most promising location for his operations by contacting the major utility company that serves the general area in which he is interested. For example, the largest utility company in Maine, the Central Maine Power Company, has an Area Development Department which offers a number of helpful services. The basic function of this department is to work with new and present industries and also with government and civic groups to create a positive climate for increasing employment opportunities. It acts as a "match maker" between the prospective entrepreneur, with his requirements for plant, location, labor force, financing, etc., and the individual municipality or agency which is best suited to help him fill that need.

The Central Maine Power Company also publishes and distributes three listings at regular intervals. These are (1) Industrial Development Committees and Individuals to Contact in Communities in the CMP Company's Service Area, (2) Industrial Parks and Districts in Maine, and (3) Available Manufacturing Space in the Company's Service Area.

Utility companies in the eastern or northeastern parts of Maine, such as the Bangor Hydroelectric Company in the Bangor area, provide somewhat similar manufacturing locations in the service areas of such companies.

Once the entrepreneur has tentatively selected the municipalities in which he is most interested as sites for potential manufacturing operations, he can easily find the other types of assistance available from municipal or governmental sources. For example, the Greater Portland Building Fund offers financial assistance for construction of plants and

other physical facilities. Other services are available from specific municipalities, most of which in the more urbanized areas of the State have industrial park developments and industrial development committees. Some of the larger municipalities, like South Portland, have extensive programs through which they make available roads, water mains, sewerage, and financing for applicants which meet their standards. Portland divides its available land into three categories: (a) industrial parks for light manufacturing, (b) sites for heavy industry, and (c) locations for waterfront operations.

Consultants

Consulting services operating in Maine include technical and engineering consultants, management consultants, market research firms, and marketing management consultants. The following listing is fairly inclusive, containing both relatively large firms and also, as in the case of some of the management and market consultants, professionals who provide individual consulting services on a part-time basis.

Technical Consultants

Company	Capabilities
Engineering Services 844 Stevens Avenue Portland, Maine	Structural-Architectural and Sanitary Engineers
Kleinschmidt & Dutting 73 Maine Street Pittsfield, Maine	Hydraulics, Water Supply, Waste Disposal
Edward C. Jordan Co. 379 Congress Street Portland, Maine also: 555 Maine Street Presque Isle, Maine	The largest technical consulting firm in Maine. Engineers-Planners, Architects-Civil-Environmental-Structural-Mechanical-Electrical-Industrial Soils - Landscape Architecture Community & Regional Planning
Wright, Pierce, Barnes & Wyman 99 Main Street Topsham, Maine	Water Systems, Sanitary Waste, Electrical Systems, Highway Systems, Industrial Waste, Surveying, Recreation and Land Development
Maine Engineering Services Co., Inc. 93 High Street Auburn, Maine	Consultants Electrical-Mechanical

Company	Capabilities
Jordan & Gorrill Associates International Airport Bangor, Maine	Consultants of Government and Industry in Engineering and Testing of Soils, Concrete, and Bitumens. An affiliate of Edward C. Jordan Co.
Prentiss & Carlisle Co., Inc. 107nCourt Street Lewiston, Maine	Civil Engineers
Aliberti LaRochelle & Hudson Eng., Corp., Inc. 436 Main Street Lewiston, Maine	Consulting Engineers, Investigations, Reports, Designs, Supervision and Inspection of Construction
Dale E. Caruthers School Street Gorham, Maine	Municipal Engineering, Land Surveying and Development, Water Supply, Sewerage, and Waste Treatment
J. U. Wiesendanger East Winthrop, Maine	Sanitary, Structural, Airport, Surveying, Land Subdivisions
Gray Engineering, Inc. 309 Cumberland Avenue Portland, Maine	Architectural, Sanitary, Structural, Civil Engineering
Alonzo J. Harriman Asso., Inc. 292 Court Street Auburn, Maine	Architectural, Structural Mechanical, Electrical Engineers
Allied Engineering, Inc. 381 Maine Street Gorham, Maine	Architects, Engineers, Architectural, Dechanical, Civil Design and Supervision

Management Consultants

Social Systems Research Corp.
61 Maine Street, Bangor

Altenburg Kirk & Co.
587 Spring Street, Westbrook

Associated Business Consultants
835 Forest Avenue, Portland

Beneficial Management Corp. of America
523 Deering Avenue, Portland

Dyke Associates
309 Cumberland Avenue, Portland

Kasu Corp.
696 Broadway, South Portland

Nor Mark Industrial Management
76 Main Street, Yarmouth

The Alan Associates, Inc.
70 Blanchard Street, Cumberland

Women's Training and Resource Corp.
143 High Street, Portland

Community Systems Foundation
83 Western Avenue, Augusta

Management Services, Inc.
Glidden Street, Newcastle

Recreation Research & Marketing
Old Post Road, Bowdoinham

Market Research Firms

Dunn & Bradstreet, Inc.
449 Forest Avenue, Portland

Environmental Planning & Design
520 Ocean Street, South Portland

Hooper-Holmes Bureau, Inc.
449 Forest Avenue, Portland

Market Search, Inc.
1150 Broadway, South Portland

Modern Business Services, Inc.
562 Congress Street, Portland

Gorham International Research, Inc.
209 Mosher Road, Gorham

Northeast Markets, Inc.
Yarmouth, Maine

Management Services
73 Main Street, Pittsfield

New England Institute for Business Research
561 Elm Street, Biddeford

Marketing Management Consultants

Harry J. Waters
340 Ludlow Street, Portland

Robert L. Schmidt, Jr.
Falmouth Shopping Center, Falmouth

Lists like those which are provided above require constant updating, which can be obtained annually from the Maine Register, which is published each year by the Tower Publishing Company, 163 Middle Street, Portland, Maine 04101, a concern which also publishes the Portland City Directory. The Maine Register provides updated listings of State, county, and municipal officials, statistics of municipal populations and valuations, professional listings, and business listings arranged both by municipality and general category.

Research and Development

The University of Maine system houses the largest research laboratories and the largest number of scientists and research engineers in the State. In many areas of specialization, the University provides the only laboratory facilities or highly educated specialists that are available in Maine. The needs of Maine manufacturers in these areas are coordinated with the University facilities by the University of Maine Technical Services Program.

This program, commonly known as the UMTS, is operated as a state-wide technical service to Maine manufacturing firms. The administrative offices are located at the Orono campus of the University of Maine.

Services provided by UMTS are primarily oriented toward (1) technical referrals, (2) technical problem solving, (3) new product development, and (4) work shops and seminars for practicing engineers. Eighty percent of the services are initiated as the result of requests from individual firms.

UMTS is made up entirely of two, full-time, salaried engineers. The program is completely funded and there is no billing to the customer. The UMTS engineers spend much of their time "on the road" and have a number of regular stops throughout the state. For the most part, they perform an advisory function in the area of technical problem-solving (engineering). On occasion, other members of the University staff may be asked for advice, but the contributions of these "outsiders" is generally limited. Most UMTS projects are small in scope, do not involve anything approaching a major research effort, and can be handled in one or two visits.

The Department of Industrial Cooperation

Another vehicle used by the University of Maine to serve business, industry, government agencies, individuals, and communities

is the Department of Industrial Cooperation, commonly known as the DIC. This department performs services which cannot be done well by other agencies or private firms, including both short-term projects and also in-depth long-term contracts.

DIC research, advisory, and other professional personnel are University faculty members who generally have other (usually teaching) duties. Customers are billed, the charges including reimbursement for the faculty member(s) plus a University (DIC) "overhead" charge. Since DIC really involves the entire University community, the range and scope of projects which it accepts exceeds that of UMTS. In a number of instances, UMTS will advise a customer with a complex problem to go to DIC.

Most customers not familiar with University organization usually seek out an individual faculty member known to be knowledgeable in the area of interest. The faculty member then informs the customer that, if he is to use University facilities, the research or other assistance must be channeled through DIC. DIC then screens the proposal and makes a judgment as to whether or not it is acceptable. In fact, a major function of DIC is to "protect" faculty members from undesirable projects. In this way, DIC functions as the administrative arm of University-associated industrial research and consultation.

The industrial research activities of the University faculty provided through DIC are not restricted to any particular group of customers. Firms and business organizations of all sizes and types are served, as well as individual citizens and even organizations of a semi-political nature, such as COMBAT, the Consumer Protection Group.

Over the past few years DIC's annual billing has ranged from approximately $30,000 to about $70,000, but most of the individual contracts are for less than $200, including the overhead charge. A number of firms, however, require more extensive services, with contracts in the range of $5,000 to $6,000. The largest contracts are for about $80,000 for activity normally extending beyond a single calendar year.

Since Maine possesses so many paper manufacturing plants, the University of Maine has extensive laboratory facilities to provide research for the pulp and paper industry. The larger mills in Maine also conduct much research in their own industrial facilities, such as the plants of the Oxford Paper Company, Great Northern, and S. D. Warren.

Education in Maine

During the past ten years Maine has made marked improvements in the educational services it provides its people. Thirteen Regional Technical Vocational Centers for secondary students have been established, and six Vocational Technical Institutes have been developed for the benefit of post-secondary students. The programs of the University of Maine system have been broadened, including the inauguration of a number of two-year programs in agriculture at the Orono campus and in business administration at the Portland campus. In addition, the 106th Legislature enacted a bill during the summer of 1973, providing for a much broader proportion of State support for public school education. All these matters will be discussed on the following pages.

On the other hand, it must be remembered that Maine for many years had lagged in educational support behind the other States in the northern half of our nation, and some years will be required before the practical effects of recent progressive legislation will become apparent. During the period when the 106th Legislature was considering bills for public school education, Business Columnist Frank Sleeper, reporting a new study on the quality of life in the United States, noted that, on the basis of 1972 data, Maine ranked 47th among the fifty States in the quality of educational services provided for its people (1). This was still true at that time, in spite of the fact that during 1971, as Table 12 indicated, Maine had expended far more per student enrolled in post-secondary vocational education than any of the other New England

Table 12*

Post-Secondary Vocational Education Enrollment (New England and U.S. Total) and Expenditures per Student Enrolled in 1971

State	Total Enrollment	Expenditure per Student
Connecticut	6,674	$ 82
Massachusetts	8,711	$ 849
New Hampshire	1,820	$1,136
Rhode Island	1,081	$1,292
Vermont	173	$1,555
Maine	1,628	$1,846
(U. S. Total)	(1,141,071)	($ 531)

*Enrollments - U. S. Office of Education Form 3138
Expenditures - U. S. Office of Education Form 3132

States. Graduates of these Vocational Technical Institutes are in great demand, as manufacturing processes are becoming more sophisticated and there is an increased need for workers with a foundation knowledge of technical theory supplemented by shop training in technical processes.

The graduates of Maine's secondary and post-secondary vocational programs tend to take jobs within the State, provided that the local wage levels are not too far below those offered for similar work elsewhere. Graduates of four-year State University programs, however, especially those with degrees in technology, tend to leave the State because too few local positions offering competitive salaries are available.

The out-migration of many of Maine's most talented college graduates will continue until both wages and opportunities within the State are brought up to competitive levels. The Director of the Placement Office at the University of Maine's Campus at Orono has reported that the ratio of out-of-state placement to in-state placement of technology graduates with a B. S. or higher degree is greater than 2 to 1.

There is a danger, however, in overemphasizing the problem of out-migration because an undetermined number of graduates who leave the state to gain experience return to Maine later on in middle management positions. Moreover, every state has a significant number of highly trained graduates who leave that state for any number of reasons not related to job opportunities. The Maine situation is primarily significant as an indication that Maine is turning out highly trained technology graduates who represent an indigenous trained population that might be wooed successfully by in-state industry in the future.

Educational services are certainly one of the factors that industry looks to in considering location within the State, even though the factors of labor supply and transportation may be of greater importance in many cases. Much of the economic development in Southern Maine has proceeded hand in hand with educational development. To a large extent, however, economic development in this region has out-distanced the educational services available. A survey of the 210 largest businesses in Southern Maine representing 50% of the workforce in that area indicated that these employers would hire 1,400 associate degree graduates per year.* The University of Maine at Portland-Gorham (UMPG) and the Southern Maine Vocational Technical Institute, which are the

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*University of Maine at Portland-Gorham, Office of Academic Planning, Survey conducted during February and March, 1973.

only two state-supported institutions of higher education serving this area, graduated approximately 300 associate degree candidates in 1973. Most of these graduates stay within the state. For example, the Placement Office at UMPG reported that 28 of 30 two-year business graduates who registered with the Placement Office in 1973 remained within the state. That still leaves many jobs in Southern Maine that could be filled with associate degree graduates, indicating that associate degree programs should continue to be expanded.

The Coles Commission Report, published in 1966, indicated that only seven percent of all the jobs in Maine required a college degree, while more than fifty percent of the jobs of a technical, trade, or distributive nature require technical training (2). At the time the report appeared, there were only four post-secondary vocational technical institutes (VTI) and three secondary level regional technical vocational centers (RTVC) in the State, located in the more densely populated areas along the Interstate 95 urban transportation corridor.

The VTI's have since increased in number to six, and the RTVC's have increased to thirteen. In the intervening period, enrollments doubled in the VTI's and increased sixfold in the RTVC's. During the summer of 1973 the Maine Legislature created eleven new vocational regions and set-up guidelines for the establishment of cooperative boards (P.L.605). As RTVC's are built in these regions, rural areas of the State will have quality vocational education within easy access.

Regional Technical Vocational Centers

The Regional Technical Vocational Centers provide secondary level vocational training for young people of high school age. Adult evening programs are also offered at all RTVC's, but they are, for the most part, supplemental rather than preparatory. In other words, the evening adult programs deal in specific skill areas which are usually considered separately rather than as a part of a rounded and complete program of study.

As Table 13 indicated, only three RTVC's existed in 1966-67. Eight more were established in 1969-70, and two others, including a major center in Portland, Maine's largest city, were added in 1971-72. The total number of students served has increased almost six-fold during this period, and every center in existence in 1969-1970 has shown an increase in enrollment.

The full-time day programs of the RTVC's represent a great advance over the former "shop" programs of localized high schools.

Table 13*

Fulltime Enrollments in the 13 Regional Technical Vocational Centers Since Their Inception

RTVC	66-67	69-70	71-72
Augusta	270	387	466
Waterville	519	647	910
Westbrook	573	628	714
Lewiston	---	523	679
Sanford	---	719	752
Dexter	---	233	260
Presque Isle	---	540	569
Bath	---	492	539
Biddeford	---	516	736
Bridgton	---	216	234
Farmington	---	203	331
Portland	---	---	1,028
Skowhegan	---	---	464
Totals	1,362	5,104	7,682

*Bureau of Vocational Education, Form 501.

The technical RTVC courses are taught by specialists with an up-to-date understanding of the skills needed in the various trades for which their students are being prepared. The programs are geared to the needs of modern industry, and the equipment and techniques used are those which the students will be expected to encounter as they start work after graduation.

Vocational Technical Institutes

The Vocational Technical Institutes provide post-secondary level technical training in many fields, which are being constantly expanded. Entrance requirements are set to insure that the high school graduates admitted to the various programs have sufficient educational background and mathematical and English skills to do the theoretical classwork which is part of each program, as well as sufficient aptitude for the practical technical training in the various shop or laboratory courses. Equipment and methods used are kept up to date, and the technical courses are taught by specialists in their respective fields.

As Table 14 indicates, VTI enrollment has approximately doubled between 1967 and 1972. The newest unit, the Kennebec Valley Vocational Technical Institute, is expected to grow very rapidly, for it is located in Augusta, the State Capital and a thriving commercial center within easy commuting range of Waterville and other industrial cities in the lower Kennebec valley.

Table 14*

Enrollments
Vocational Technical Institutes (VTI)

Institute	66-67	69-70	71-72
Southern Maine SMVTI	525	678	782
Northern Maine NMVTI	226	285	353
Central Maine CMVTI	140	265	286
Eastern Maine EMVTI	103	316	374
Washington County WCVTI	---	7	90
Kennebec Valley KVVTI	---	---	96
Totals	994	1,551	1,981

*VTI Reports to Bureau of Vocational Education.

As Table 15 indicates, the Vocational Technical Institutes offer a diversity of highly practical programs, each Institute offering a selection of those courses which are felt to meet the local employment needs most adequately. The programs are being constantly expanded, and new courses may be added when requested by an industry, provided suitable instructors are available and provided a large enough group of students can be registered to fill a class. Many of the technical training programs are also offered in the evening to provide valuable in-service training in advanced technical skills for persons already employed in full-time jobs during the working day.

Table 15

Vocational Technical Institute Courses of Study
1973-74

	NM	WC	EM	KV	CM	SM
Accounting	*					
Air Conditioning & Heating						*
Auto Body Repair	*					
Auto Mechanics	*	*	*		*	*
Boatbuilding		*				
Carpentry	*	*		*		
Construction & Maintenance Trades			*		*	*
Culinary Arts						*
Distribution & Marketing			*	*		
Diversified Occupations					*	
Domestic Home Construction		*				
Drafting	*					
Electrical Technology			*			*
Electricity	*					*
Electronics Technology			*			*
Environmental Technology			*			
Fire Technology			*			*
Graphic Arts					*	
Health Assistant				*		
Health Occupations				*		
Heavy Equipment Maintenance				*		
Hotel-Motel Management	*					
Industrial Electricity					*	*
Institutional Foods			*			
Junior Computer Programmer	*					
Law Enforcement Technology						*
Machine Tool Technology			*		*	*
Marine Electronics		*				
Marine Technology						*
Masonry	*					
Medical Assistant				*		
Medical Laboratory Technology			*			
Oceanographic Technology						*
Plant and Soil Technology						*
Plumbing & Heating	*					
Practical Nursing	*		*		*	*
Process Control					*	
Radio & TV Repair	*					*
Radiologic Technology			*			
Secretarial and Related	*			*		
Secretarial Science				*		
Sheet Metal	*					
Wastewater Technology						*
Wood Harvesting		*				

NM - Northern Maine VTI
WC - Washington County VTI
EM - Eastern Maine VTI
KV - Kennebec Valley VTI
CM - Central Maine VTI
SM - Southern Maine VTI

A good example of the way in which some of these VTI evening programs serve the needs of Maine industry is the Graphic Arts course offered both during the day and the evening at the Central Maine Vocational Technical Institute. During the past few years, Maine printers have been converting more and more of their equipment from letterpress to offset. Printers trained in the older methods found they needed to learn entirely new techniques, and printing companies from miles around the Lewiston-Auburn area have been sending employees to CMVTI to learn these modern Graphic Arts techniques in the evening.

Although most of the programs offered by the VTI's are of a definitely technical nature, some are more closely related to those commonly found in an Associate of Arts, two-year college program. Programs of this sort are commonly available at a VTI only when no similar two-year program of the University of Maine is offered within easy commuting distance of the VTI center. Accounting, for instance, is offered at Northern Maine Vocational Technical Institute, but not at SMVTI which is close to the Portland campus of the University, where a two-year associate degree program in business administration and accounting is offered. For similar reasons, Accounting is not offered at KVVTI or EMVTI, because University programs at local campuses already meet that need.

Community Colleges

Prior to September 1973 the University of Maine offered associate degree programs in agriculture at its Orono campus, in business administration at its Portland campus, and in a larger range of community college subjects at its campuses at Bangor and Augusta. As of September 1973, a new joint venture between the University of Maine at Portland-Gorham and the Southern Maine Vocational Technical Institute has resulted in the York County Community College Services, with evening and Saturday classes in facilities provided by local institutions at Biddeford and Sanford. The certificates and associate degrees provided by these services will be awarded by both UMPG and SMVTI as an addition to the degrees already awarded through each institution's regular associate degree programs.

Continuing Education Division

The Continuing Education Division of the University of Maine provides adult college-level evening courses, including a number for certificate or non-degree credit as well as many for credits towards bachelor's and master's degrees. Courses are offered at all University campuses as well as at satellite centers. Over 20,000 adults a year participate, more than 6,000 of whom are enrolled in a broad range of

courses offered at the University of Maine at Portland-Gorham during evening hours. A deferred degree program permits adults who cannot meet normal college entrance standards to enroll for an introductory program of freshman-level courses. Such adults are carefully counseled and supervised during this part of the program. Those who complete a schedule of courses equivalent to those required of a college freshman are allowed to register as degree candidates, provided they have maintained a satisfactory grade average during their trial period as a Deferred Degree candidate.

Private Colleges

In addition to the University of Maine system, with its campuses scattered throughout the State, there are a number of small private colleges, the oldest and largest of which are Bates, Bowdoin, and Colby. As Table 16 indicates, however, these three largest private colleges in Maine reported only 594 Maine students enrolled in 1972,

Table 16*

Undergraduate Enrollments at Maine Colleges Fall 1972

College	Maine Students Enrolled	Total Enrollment Maine & Out-of-State
Bangor Theological	NA	39
Bates	137	1,202
Beals	212	218
Bowdoin	225	1,132
Colby	232	1,607
College of the Atlantic	26	32
Husson	445	890
John F. Kennedy	7	8
Nasson	84	847
Ricker	121	486
St. Francis	56	503
St. Joseph's	125	288
Thomas	387	472
Unity	101	253
Westbrook	279	496
University of Maine		
Augusta	687	691
Bangor	839	893
Farmington	1,301	1,428
Fort Kent	412	422
Machias	485	501
Orono	5,286	6,607
Portland-Gorham	3,047	3,501
Presque Isle	816	861
Maine Maritime Academy	268	475
Totals	15,578	23,872

*State Department of Education, Bureau of Higher Education

as compared to their total enrollment of 3,941. The smaller private colleges tend to enroll a higher proportion of Maine students, but their total enrollment is not enough to serve the needs of very many.

All the private colleges in Maine served the needs of only 2,437 Maine residents in the 1972-73 academic year, while the publicly supported University of Maine and Maine Maritime Academy met the needs of more than five times as many, or a total of 13,141 Maine residents.

Educational Projects for Undereducated Adults

Approximately a quarter of Maine's total adult population has not progressed further than an eighth grade education. Percentages derived from 1970 Department of Education and Cultural Services data indicate that Androscoggin County has the highest percentage of adults who have not gone beyond the eighth grade level, 35.8 percent. Washington, Aroostook and Somerset Counties each have an undereducated adult population that measures about 30 percent by these standards.

Two recent developments show possible directions adult education for the undereducated may take in the years ahead. The first is the Urban Adult Learning Center in Portland, administered by the Continuing Education Division as a specialized project with seed money from the Model Cities program of Portland. This center provides a combination of resource testing and tutoring tailed to fit the individual needs of seriously undereducated adults in the inner city area. The programs offered are very flexible and highly individualized, helping adults to meet specific short-term needs, such as learning to read sufficiently to pass the written test for a driver's license, but many adults are helped to broaden their objectives to the point where they are enabled to pass their high school equivalency examinations.

The most recent development is the establishment of the York County Community College Services, previously referred to. In addition to regular community college programs, the YCCCS also provides counseling and tutoring services at all levels for any person 18 years of age or older, helping to bring them up to the entrance levels for the various community college programs that are offered. In addition to more conventional programs, the YCCCS offerings include such vocational programs as Building Construction and Law Enforcement Technology. The community college concept exemplified by the York County Community College Services can effectively be extended into rural areas to provide a range of educational opportunities for adults at all educational levels through the use of existing high school and RTVC facilities during the evening hours.

Recent Tax Reform in the Support of Public School Education

The quality of elementary and secondary education in Maine's municipalities has been until this year a function of the revenues generated by local property taxes. Obviously, the poorer communities which could not generate sufficient local revenue by this means were the communities that suffered the most. Effective January 1, 1974 the financial support of school units will come from a combination uniform state property tax and state subsidy (P.L. 556). The effect of this tax reform will be a significant equalization of educational opportunity throughout the State.

The Ecology of Maine

Industries contemplating a move to Maine will find themselves protected as well as regulated by a complex and rather patchwork assortment of environmental laws: laws that reflect the high level of awareness of Maine's people that few, if any, benefits outweigh permanent, irreparable damage to the ecostructure. The intensity of this awareness, and fragility of the ecology, however, differ greatly from region to region.

Most of the municipalities in Southwestern Maine, between the New Hampshire border and the Kennebec River, have already adopted either Subdivision Ordinances or Zoning Ordinances or both. Municipalities in the more urbanized area around Bangor also operate under such ordinances, as do a number of summer resort towns and several of the larger towns in Aroostook County, far to the north.

Many of the smaller municipalities in the central part of the State have not yet adopted such ordinances, but the largely unorganized territories of forest land encompassing almost two-thirds of the land area of Maine throughout the greater part of the northern and northeastern regions fall under the jurisdiction of the Land Use Regulation Commission. LURC, one of the newest and perhaps most radical land-use controls, has virtually complete control over the wildlands and unorganized territories of Maine, which are owned chiefly by large pulp and paper companies. Charged with developing a comprehensive zoning plan for its vast domain by 1975, LURC presently relies on interim zoning based on existing use, which essentially rules out any industrial development in their area at this time.

The noticeable density of towns protected by various ordinances in the southern coastal region reflects the increasing pressures of residential development now being felt by this area. The ordinances are not aimed at excluding industry, which might well be welcomed to broaden

the tax base as long as it did not damage the way of life or endanger, by pollution, the tourist industry.

There are two other important environmentally oriented land-use regulations which have not previously been mentioned: Mandatory Shore Land Zoning and the Department of Environmental Protection's Site Selection Law.

Mandatory Shore Land Zoning, which goes into effect on July 1, 1974, concerns all land within 250 feet of any natural pond of ten acres or over, or any man-made pond of 30 acres or over, or any lake, river or stream from the point where such bodies of water drain 25 square miles or more, or any shore bordered by salt water. This legislation, designed to protect Maine's lakes and streams from further pollution, and also to protect the fishing industry, virtually precludes any but the "cleanest" industry from the areas protected by the Mandatory Shore Land Zoning Law.

The Site Selection Law covers all of the State except that under LURC. Any industry, or residential development of over 20 acres, must pass a DEP hearing, even if it conforms to a town's zoning ordinance. The DEP works closely with the Department of Commerce and Industry, however, to make sure that potential industries understand the environmental laws and the means of complying with them.

In the absence of a comprehensive land-use plan for the state, it should be noted that each DEP decision is made on the merits of the individual case. Hearings concern themselves with financial capacity and traffic movement as well as soil suitability and "adverse effects on the natural environment."

It must not be assumed from Maine's relatively strong array of environmental laws that the state is not anxious for incoming industry. The most cursory economic analysis shows the need for additional private income and better living standards. The decline of the fishing industry and the unprofitable aspects of farming are creating additional pockets of poverty in an already poor state.

Industrial development in Maine seems to be evolving along what is known as the "corridor." The Corridor generally follows the Maine Turnpike from Kittery to Bangor, connecting nearly all of Maine's major cities and airports; also, it is far enough from the fragile coastline and related tourism. The corridor area contains 65.4% of the State's population and, in general, the highest educational levels. The already high rate of development in the area has created a tolerance for environmental trade-offs, where the ecology is relatively stable

and does not form as essential a component of the economy as it does inland or along the shore. This combination of factors creates a climate favoring natural development and beneficial to both the State and industry.

The recent widely publicized controversy over the introduction of major oil industry along the Maine coast has, perhaps, created a false picture of the environmental climate in Maine. The supertanker based industry presents very clear environmental hazards in an area where people depend on the land and the water for their livelihood. The harsh climate allows little leeway for trade-offs. For example, an oil spill might easily take a month to clean up, spoiling half the fishing season. In addition, the industry is something new to Maine, completely outside the experience of Maine's people. Because of this unfamiliarity, Maine citizens have no feeling that they would be able to control the situation in case a supertanker ran aground and ruptured its tanks.

Forestry, agriculture, and fishing -- the woods, the fields, the waters -- have formed the basis of Maine's economics for generations, along with a tourist industry based not on casinos or amusement parks, but on the simple enjoyment of nature.

Industry is sought after and welcome in Maine, providing it brings with it the assurance that the essential qualities of Maine's environment will not be sacrificed.

Section 11

AN EXISTING INDUSTRY IN MAINE
THE WOOD TURNERS & SHAPERS

Innovation can aid economic growth by application in existing industry as well as in sparking new enterprise. In addition, attention to the innovative opportunities in an existing industry often leads to identification of the need for a new enterprise. In the course of the project, it is expected that the IIE's efforts to stimulate innovation will be directed toward a variety of existing industry situations. For an initial test, the project will be concerned with a specific Maine industry, known as the wood turners and shapers. This industry, a sub-group of the wood products industry, consists in Maine of 60-70 firms. Their annual sales total is not known, but is probably not more than $50,000,000. Seven of the firms have more than 100 employees; they probably account for $15-20,000,000 of this total. This industry is selected for this experiment because:

1. Among Maine's principal industries, they are <u>not</u>:
   a. Dominated by outside-of-Maine ownership
   b. Concentrated in a few large firms
   c. Involved in, or affected by, political or other controversy
   d. The subject of other investigations, studies or experiments.

2. The industry is not homogeneous, but the range of variations in products, processes, and technology is moderate.

3. The industry in Maine is part of a larger group in New England, and extending to some extent throughout the Eastern half of the United States.

4. Within Maine, the industry is part of a much larger wood products industry.

4. Leaders of the industry are enthusiastically interested in participating in the project.

A preliminary sample survey of three of the industry's leading firms made during the Phase I period. The following paragraphs describe the results.

During August 1973, the CRAS project team conducted a survey of the wood turning and shaping industry of Maine. The purpose of the survey was twofold:

1. First, to verify, by use of systematic research methods, the qualitative assessments of the industry voiced by various informants. These informants included: (a) Project participants at the Center for Research and Advanced Study, (b) a paid consultant specializing in problems of Maine's forest products industries, (c) the executive director of the Wood Turners and Shapers Association (an industry group), and (d) representatives of the industry's three leading firms. For the most part, the survey did confirm the broad picture depicted by these parties. In addition, it uncovered several particulars not visible to most of the informants. These particulars concern the industry's profitability and use of capital sources.

2. The second purpose follows from the first. It was desired to bring into sharp relief those factors inhibiting economic innovation and growth within the woodturning and shaping industry. The informants voiced their opinions; it was desired to focus on those conditions they identified and make some baseline measurement, at least to the extent permitted by time and resource constraints. This effort was exploratory, one which will help guide the design and execution of more elaborate measurement schemes described in chapter 8 of this plan.

Survey Methods

The data collection instrument used in the survey was a structured interview, developed jointly by personnel at the CRAS and the MITDF. A copy of the questionnaire can be found in Appendix E. Two members of the University of Maine's faculty (School of Business) who participated in the questionnaire design conducted all of the interviews. The tabulation and analysis of the data was performed by the MITDF.

The titles of the respondents varied a good deal and included: plant manager (3), general manager (5), vice president (2), assistant manager (2), superintendent (1), treasurer (1), product sales manager (1),

and president (1). It was clear from the interviews, that with the exception of the product sales manager and one unspecified respondent, all interviewees were directly responsible for plant operations. It is reasonably certain that the respondents were in a position to provide accurate data.

The Maine Buyer's Guide (Maine Department of Economic Development, 6th ed.) is a business directory which lists sixty two (62) Maine-based firms manufacturing wood turning products. A wood turning product is one which, very simply, has been made on a lathe. Such products include: balls and beads (mostly used in jewelry), dowels (e.g., furniture parts), tool handles, and toy parts. Some of these firms also engage in wood "shaping", a term applied to the manufacture of flat wooden products such as toothpicks, tongue depressors, and components of products such as sleds and tobaggons.

The Maine Buyer's Guide indicates firm size by number of employees rather than sales volume. Therefore, it was decided to stratify by employee size and select a sample from each strata. However, the sample was not random. Only seven firms employ more than 100 people. Two such firms were used to test the pilot questionnaire and so they were not available for the survey. It was, and is, believed that change and innovation among the wood turners and shapers will begin with the larger firms; they have whatever slack resources exist in the industry. Furthermore, it is widely believed that smaller firms follow their lead, a not too surprising state of affairs. For these reasons it was decided to include all five of these larger firms in the sample and choose the remainder randomly.

Table 1 compares the distribution of firms in the industry (as given in the Maine Buyer's Guide) with the distribution of firms in the sample. The larger firms are over-represented as explained

Table 1. Distribution of woodturning and shaping firms by size

Firm size (No. employees)	Maine Buyer's Guide	Survey Sample
More than 100	11% (7)	20% (5)
Between 51 and 100	21% (13)	28% (7)
Less than 51	68% (42)	52% (13)
Total No. Firms	100% (65)	100% (25)

above, while the smallest firms are under-represented. This should be kept in mind as the examination of the data proceeds. If anything, the survey sample is weighted in favor of the healthier, more viable firms.

General Observations

Originally, thirty-two firms were selected for the sample (i.e., about half the industry). After the interviewing began, it was discovered that four firms had since gone out of business altogether, and one was no longer producing turned and shaped products. One firm refused to participate in the survey. Still another was closed for vacation throughout the interview period. This left twenty-five firms.

It is noted that not only had four firms dissolved since the sixth edition of the Maine Buyer's Guide was compiled but that two other firms in the sample were in the process of dissolution. Both are relatively small firms, one with current sales of less than $100,000 and the other reporting sales of less than $500,000. Both claimed that they were victims of the Occupational Health and Safety Act. Apparently, they could not afford the purchase of additional safety-related equipment to comply with the requirements of the Act.

Another survey finding of some interest is that eight of the twenty-five sample firms are subsidiaries of larger organizations such as the Diamond Match Co. and American Home Products.

Twenty-two firms gave current sales volume data, including seven of the subsidiaries. Four of the five largest firms in the sample (in terms of current dollar sales) are subsidiaries.

Clearly, these subsidiaries cannot take independent action. Five of the eight deliver all of their output to the parent firm. The policies of these organizations must be coordinated with the policies of the parent. It is problematical at this point whether or not the proposed project can influence these subsidiaries in such a way as to contribute to growth of the Maine economy. In discussion of the survey data, there will be frequent separation between the subsidiaries and the seventeen independent firms and, where appropriate, consideration of the subsidiaries altogether.

Firm Age and Ownership

The survey confirmed that wood turning and shaping (WT&S) firms are relatively old, family businesses.

Seven of the seventeen independents were founded before 1900. The median founding date was 1930 (1932 including subsidiaries). What was not appreciated at the beginning of the survey was the number of newcomers in the industry. Six independents were founded in the post-World War II era. Why? What attracts new industry entrants? Unfortunately, the survey did not gather information to answer this question. It can be said though, that these firms are not noticeable successful. Not one of the five such firms for which sales data is available reported sales exceeding $500,000. These new entrants account for 5 out of 10 poorest sales performers in the entire sample. It is extremely doubtful that these new entrants were encouraged by knowledge of new processes, products, or markets.

With regard to ownership, clearly the industry is dominated by family owned firms. In the case of sixteen of the seventeen independents, one family owns at least 90% of the total company stock. All firms are corporations.

Financial Data

In order to innovate and grow, a firm needs two factors: (1) Knowledge of market demands and the means to satisfy them; and (2) the Resources, both financial and human, with which to implement an innovative idea. It is in order to analyze these factors in the WT&S industry and identify those project activities which must be undertaken to help the industry surmount obstacles to innovation.

Looking at the industry's financial resources, the obvious first question is - how large is this industry? What are its current sales? How profitable are its operations? Table 2 provides some rough answers to these questions.

Table 2. Sales and net profits after taxes, fiscal year 1972

Gross Sales	Net profits after taxes: unknown not disclosed	less than 5%	5-10%	Totals
Unknown, not disclosed	3(1)			3(1)
Less than $1 million	3(1)	8(1)	3(1)	14(3)
$1 million to $5 million	1(1)	2	2(1)	5(2)
Over $5 million	3(2)			3(2)
Total	10(5)	10(1)	5(2)	25(8)

Note: Figures in parentheses indicate number of subsidiaries included in adjoining figure.

It should be remembered that the smaller firms are under-represented in the sample. Clearly, most of the sample firms (14) sold less than one million dollars worth of goods during the last fiscal year. In fact, ten of the firms sold less than a half-million dollars worth of goods during that period.

The investigators had been told that the after-tax profit rate in the industry is about 6% on gross sales. Ten of the 25 respondents refused to divulge this figure. The data supplied by the remaining respondents indicate that the median rate may be less than 5%. Among the five respondents reporting a figure above 5%, one headed a company preparing to dissolve, and another volunteered the exact figure of 5.25%. Although the survey may show that average profit on sales is lower than the industry assumes, the absolute values may not have significance in judging industry profitability. In family-owned firms, the return to the owners is often largely in pre-tax dollars. Comparison among the firms is confused, because, for the smaller firms the corporate income tax may never reach the 50% rate. Hence, it is possible to characterize the WT&S industry of Maine as one composed mostly of small producers, operating at a very thin corporate profit margin.

Given this low volume, low profit situation it was not expected to find many firms carrying bank-supplied long-term debt. However, among the 17 independents, nine (9) respondents did report that their firms carried long-term debt; in seven of such instances, the debt was carried by Maine banks exclusively. The median age of this debt was four years, the oldest being 13 years. A quick comparison with the founding date indicated that in each instance the debt was incurred long after the firm was founded. This capital apparently was not used for initial acquisition of plant and equipment. Perhaps it was used to acquire additional equipment. The respondents were asked whether their firms had acquired new production equipment in the past three years, whether such equipment was purchased and how the purchases were financed.

In Table 3 it is seen that all but two independents did acquire new equipment recently. Twelve firms built at least some of this new equipment (not shown on table). Also, six out of the nine firms reporting long-term debt had to finance their recent capital acquisitions from company funds, five completely and one in part. This leads to the inference that all but three of the independents have exhausted their line of credit and must rely on their scanty profits (and the mechanical ingenuity of their personnel) to realize any future capital expansion. What about other sources of credit? Only two independents have approached the Small Business Administration in the past three years; one such loan application was rejected. Not one firm in our sample has received financing from the Maine Industrial Building Authority (Ref. Section 10).

Table 3. Use of long-term debt and means of financing recently acquired equipment

Means of Financing Equipment	Long-Term Debt			Total
	Carrier	Does Not	Unknown	
No equipment is acquired past three years		2		(2)
Purchased equipment financed internally, at least in past	6	4	1	(11)
Purchased equipment financed with bank loan only	3		1	(4)
TOTAL	(9)	(6)	(2)	(17)

Human Resources

Turn now to a consideration of the industry's personnel. The survey focused on the middle management. Top management may adopt innovative ideas and programs but middle management is usually left with the task of implementing them. Does the WT&S industry have these human resources to do the job?

Consider the foremen. There are 74 foremen employed by the seventeen independents, the median number employed by a single firm being three. Table 4 indicated the formal training received by these first line supervisors. Over three quarters (77%) of all foremen are

Table 4. Formal Training of Foremen (independent firms only)

Type of Training	No.	
High School Degree	57	(7 unknown)
Post High School Technical Training (Vocational Institute Certificates)	4	(5 unknown)
College Degree	3	
Job related training outside company in last three years (e.g., U. of Me. extension course)	14	(No information for 2 companies employing 4 foremen)

high school graduates but very few have received formal technical training in a degree program or an extension-type course. Only four independent firms reported that their foremen had attended seminars and extension courses offered by the University of Maine within the past three years. (These seminars and courses dealt with supervisory skills and dry kiln technology.) Three of these firms reported sales of between $1-$2.5 million, and so must be grouped among the larger independents.

Of course technical skills can be developed on the job. And a man with experience in several industries can be expected to be somewhat more receptive to change than his colleague who has spent his entire career in one industry, or worse yet, in only one firm. Fifteen respondents representing 70 foremen (independent firms) were able to supply this type of data. Exactly seven foremen had prior jobs in companies other than their present employer. Five of these seven came from other WT&S firms.

What about the foreman's supervisor? He is known by several titles: plant manager, production superintendent, production vice president, etc. Now focus exclusively on the independents. Fifteen firms supplied at least partial data on this manager, and it is summarized in Table 5. Two of the three firms which hired college graduates supplied sales data; not unexpectedly, both are in the one million-plus group.

Table 5. The foreman's supervisor: 15 independent firms, 17 supervisors

Median no. of yrs. with present employer	14 (1 unknown)
No. of High School Graduates	15 (1 unknown)
No. with formal business or technical training beyond secondary school level	6
No. with College Degree	3
No. with job related training outside company in last 3 yrs.	2 (1 unknown)

Just to complete the picture of middle managers, note that only two independent firms employ graduate engineers, as engineers (two of the foremen supervisors are graduate engineers). Only one subsidiary employs a graduate engineer, although presumably they can draw upon parent company staff.

Only two of the independents employ salesmen. Apparently the principal function of a salesman in this industry is to negotiate orders with middlemen such as brokers or manufacturers' representatives. They do not actively solicit business. There will be more said on this score when examining the markets and the marketing conventions of the industry.

Summarizing the foregoing discussion, the independent segment of the WT&S industry is characterized by small, family owned firms operating at thin profit margins. They apparently find it difficult to raise capital, at least at rates that are profitable. There is little mobility into the industry, at least at the supervisory level. Most moddle managers start their careers in a particular company, and they stay there. These managers have little formal training in technical matters and do not widely participate in extension-type programs.

In contrast to all this, the industry continues to replace and add to its capital stock, and most firms which do acquire new equipment build at least some of it themselves. If this industry has one resource in relative abundance, it is a pool of empirical knowledge about its conventional machinery.

Exposure to diverse sources of information

It was stated above that an innovative firm requires both (a) resources with which to implement innovative ideas and (b) information about marketing, technical, and investment opportunities. Our findings regarding the industry's resources have been discussed. Turning to the second question -- the industry's information seeking and information using patterns.

It is believed that innovation springs most vigorously from the wedding of a market demand, a felt need, with some technical means for satisfying that need. Before the entrepreneur or manager can effect this union, he must be aware that an opportunity exists -- that he can satisfy some demand better, cheaper or faster than anyone else. How then does the entrepreneur or manager in this industry find out about his market? How does he keep abreast of technical advances affecting his industry?

A reasonable point of departure is this question of equipment procurement. In the last section it was mentioned that fifteen of the seventeen independents have acquired new equipment in the past three years. The respondents were asked why this equipment was sought and what information sources were used in the procurement decision.

Table 6a includes twenty-four reasons for installing new equipment. In exactly two-thirds of these instances, the firm was only trying to meet the current needs of its business (reasons 1 through 4). It was either seeking improved efficiency, increased capacity or mere replacement of existing items. In one instance, a firm was required by the authorities to install safety-related equipment. Three firms acquired equipment related to the problem of wood waste disposal. This also probably reflects environmental pressure and the current concern for air pollution control.

Only four companies reported that they acquired equipment in the past three years in order to do things they had not done before -- either the production of a new product or some new downstream operation such as finishing or parts assembly.

Table 6a. Reasons for new equipment procurement (15 independents)

Reason cited for new equipment	No.
1. Production & materials handling efficiency	8
2. Increased capacity	5
3. Requirements of the Occupational Safety and Health Act	1
4. Replacement	2
5. Upgrade wastes for sale, more efficient handling of wastes	3
6. For new operations:	
a. secondary operations (finishing, subassembly, etc.)	3
b. new product or product line	2

The data about information sources was very spotty. Table 6b underscores, however, (a) the overriding importance of local and interpersonal sources of information. Only two firms reported getting equipment ideas from such "cosmopolitan" sources as trade journals and trade fairs.

Table 6b. Sources of information used in equipment procurement decision (15 independents)

Source	No. instances reported
1. Undesignated discussion partner	4
2. Equipment vendor, salesman, promotion literature	5
3. Standard items acquired, no extensive search necessary	1
4. Occupational Safety and Health Act requirement	1
5. Journal, trade fair	2

This immediately raises the question: to what extent are industry decision-makers exposed to these "cosmopolitan" sources? Some simple tabulations bearing on this question are presented in Table 7.

Table 7. Exposure to various information channels (17 independents only)

1.	No. respondents reporting at least occasional reading of trade journals		11
	(a) Median No. read	3	
2.	No. firms sending representatives to trade shows in past five years		5
3.	No. firms ever using services of the Maine Forest Products Council		9
	(a) for seminars (e.g., dry kiln technology)	3	
	(b) for purposes too vague or unimportant to be recalled by respondent	6	
4.	No. firms ever using services of the USDA Forestry Service		6
	(a) for advice re wood supply	3	
	(b) for advice re waste disposal	1	
	(c) for unspecified seminars	1	
	(d) for personnel recruiting	1	
5.	No. firms belonging to at least one industry association		10
	(a) to the Wood Turners and Shapers Association (WT&SA)	10	
	(b) to strictly local associations (e.g., Associated Industries of Maine, Maine Hardwood Association)	6	
	(c) to national or regional associations other than the WT&SA (e.g., National Association of Manufacturers New England Dry Kiln Association)	2	
6.	No. of firms sending personnel on visits to other WT&S plants		10
	(a) Median No. of such visits within the past year	4	
7.	No. of firms sending personnel on visits to plants outside WT&S industry		10
	(a) Median No. of such visits within past year	4	
8.	Reasons for plant visits outwide WT&S industry:		
	(a) customer relations including technical assistance from	5	
	(b) general observation	2	
	(c) searching for new business opportunities	1	

Of the eleven respondents who reported reading one or more trade journals at least occasionally, only six were able to attribute some practical business value to them. Five firms sent representatives to trade shows in the past five years. All attented shows exhibiting production machinery, but only three attended customer-industry shows. This indicates a certain sensitivity to the markets as evidenced by the fact that all three of these firms reported acquiring machinery in the past three years for new secondary operations or new products. As suspected, there is a (weak) association between size -- and therefore resources -- and innovativeness; two of these three firms reported sales in excess of $1 million; one reported better than $5 million.

About one-half the independent firms have had some contact with the Maine Forest Products Council (MFPC) and one-third have had occasion to consult with the U. S. Department of Agriculture Forestry Service (USDA-FS). However, the reasons for these contacts (Table 7, items 3 and 4) show that these two organizations are not now being used as sources of innovative ideas. Two thirds of the respondents reporting contact with the MFPC could not even specify or remember the reason for the contact. Half the respondents reporting contact with the USDA-FS indicated that the firm was seeking referrals to wood suppliers.

Other firms can also act as important channels of information. Ten of the independents belong to the Wood Turners and Shapers Association, an industry group composed principally of Maine-based firms. The executive director of this Association was interviewed by the investigators. The Association engages in no formal activity to promote information exchange of any type among its members. It doesn't regularly conduct marketing surveys or undertake promotional work. The one marketing study reported sought to investigate the perceptions and attitudes of the industry's existing customers. No effort was made to identify new markets for the industry. It appears that the industry does not act in concert on any issue of mutual concern: distribution, promotion, prices, wood procurement, waste disposal, etc. Only recently have industry leaders tried to forge some collective position on the issue of air pollution regulation.

Again referring to Table 7, item 5, only two independents belong to associations -- other than the WS&TS -- which are regional or national in scope. In no instance was a respondent even aware of forest product industries and their associations outside of Maine, for example, those in the Northwest.

Given the rather local orientation of the industry, it is appropriate to inquire next into the amount of information exchange that takes place informally among firms. One proxy measure of such informal

exchange is the number of visits made to a competitor's plant over the past year. Only ten of the independents sent personnel on such plant visits versus seven of the eight subsidiaries (not shown in Table 7).

What about extra-industry plant visits? Again, ten (independent) firms reported sending personnel to visit firms outside the wood turning and shaping industry. But note -- of the eight firms which indicated the purpose of such trips, five indicated that they were visiting customers, usually for technical assistance in meeting an order. Exactly one respondent reported that his company had made a plant visit for the purpose of soliciting new business. Only one such trip was made, so it is assumed that this is not the usual practice for the firm in question.

Thus it appears that the wood turning and shaping industry of Maine is not integrated with people and institutions outside its industry or outside its locality. Even within that industry and within that locality there is not as much interaction as might be expected.

Industry members are generally secretive and suspicious. They tend to regard other wood turners only as competitors and not as potential collaborators or resources. This attitude may be a consequence of the industry's relationship to its customers, the way it has defined itself vis-a-vis the marketplace.

The Marketing Dilemma

The wood turning and shaping industry in Maine is essentially a group of job shops producing wooden components for other industries, e.g., toys, furniture, and tools. Although many of these firms have the capability to assemble and finish complete wooden products none of those surveyed do so. Why? As a representative of one of the larger firms put it: "We're producers, not marketers."

Reluctance to enter the marketplace is nearly universal. Marketing is correctly perceived as an expensive and risky acitvity. The industry prefers to maintain its familiar relationships and to define itself as a custom jobbing activity. This is not surprising; adaptation to a low but certain level of satisfaction is often perceived as "safer", less threatening, than wholly novel departures which promise -- but do not guarantee -- greater satisfaction in the future.

However, a price must be paid. There is no more certain and stable relationship than that between master and slave. Dependence on other organizations for markets and product ideas implies a lack of autonomy. And this lack of autonomy acts as a barrier to innovation,

particularly product innovation. In the following paragraphs, the industry's dependent position is defined and this qualitative evaluation made more concrete.

Date were collected regarding each firm's product mix. More specifically, each firm was asked (a) which product class made the greatest contribution to gross sales in the last fiscal year (the "major product class") and (b) how large was this contribution (in terms of percent of gross sales)? The results are in Table 8.

Table 8. Percent of gross sales contributed by major product class

Major product class	Percent of gross sales				Totals
	unknown	less than 25%	26%%to 50%	over 50%	
Household goods:					
1. clothespins	1				1
2. handles				1(1)	1(1)
3. rolling pins				1	1
Furniture					
1. furniture			2	1	3
2. lamps			1		1
Toys and toy parts		1	1(1)	2	4(1)
Misc. components					
1. cores, plugs, rolls				1	1
2. dowels, dowel pins			2	3(2)	5(2)
3. novelty, variety turnings		1	1	1(1)	3(1)
Sports goods					
1. golf tees			1		1
2. sled parts				1(1)	1(1)
Specialized items					
1. bottle caps	1				1
2. spools				1(1)	1(1)
3. toothpicks			1(1)		1(1)
Totals	2	2	9(2)	12(6)	25(8)

Note: Bracketed numerals indicate number of subsidiaries included in adjacent figure. Example: 3(2) means two of the three firms are subsidiaries.

The marginal totals tell the story. One third of the independents (6) owe over 50% of their gross sales to a single product class; all but 2 of the 15 independents for which data is available owe at least a quarter of their gross sales to one product class. This indicates a rather low degree of product diversification. The majority of firms seem to be quite dependent on the manufacture of a limited range of turned products.

To what extent do the firms compete with each other? The column totals indicate a fair degree of specialization; no more than three independent firms dominated the same major product class (furniture, toys and toy parts, dowels and dowel pins).

Another issue to explore is that of dependence on specific marketing channels and on specific agents within these channels. There are two generic classes of marketing channel: direct selling or selling through some intermediary such as a broker or manufacturers' representative. Data was gathered on how each firm distributes its major product class. This channel accounting for more of the major product class than any other channel is called the firm's "principal marketing channel." Table 9 exhibits some of this data and indicates the relative use of various marketing channels.

Table 9. Relative use of marketing channels (based on data from 24 firms)

Principal marketing channel	Percent of major product class sold through principal marketing channel			Totals
	25%-50%	51%-75%	75% +	
1. Direct sales to manufacturers	1	2	6	9
2. Sales to an intermediary				
a. brokers	2	1	3	6
b. mfr. rep.		1	2	3
c. wholesalers			1	1
3. Parent company				
a. as customer		1	3	4
b. as intermediary			1	1
Totals	3	5	16	

Again, the marginal totals are most informative. The bottom row indicates that the majority (21) of firms dispose of better than 50% of their major product through a single marketing channel. This conclusion remains valid even if we ignore firms which use a parent firm as their principal marketing channel.

The rightmost column in Table 9 shows that over half (10) of those firms which do not rely on a parent company as a principal marketing channel have designated an intermediary such as a broker. Intermediaries charge a commission; why do so many sample firms use them? There are two reasons: passivity and poverty. As stated above, the firms in this industry do not, as a rule, actively solicit business; they wait for customers to come to them. Hence, the need for these intermediaries. Comments from several respondents also lead to the suspicion that firms which are strapped for working capital prefer to deal with brokers who pay cash rather than with manufacturers who, all too often, present a collection problem. Note that eight of the ten firms nominating intermediaries as their principal marketing channel ship better than 50% of their major product class through such channels.

Taking a closer look at dependence on specific marketing channels another dimension of dependence might be the number of buyers in each marketing channel. A firm which deals exclusively with brokers may deal with many such individuals and be beholden to no one in particular. Table 10 sheds some light in this area. Seven of nine firms reporting direct sales as their principal marketing channel report dealing with over twenty-five customers for their major product class. But six of the ten firms relying on intermediaries deal with less than ten such agents. This tends to support the hypothesis that reliance on sales intermediaries is an index of dependence.

Table 10. Dependence on particular buyers (24 firms)

Principal marketing channel	No. of buyers in the principal marketing channel			
	less than 10	10-25	26-50	50+
1. Direct sales	1	1	3	4
2. Sales to an intermediary	6	3	-0-	1
3. Sales to or through a parent	4			

To summarize, firms which rely on sales intermediaries use them to distribute the lion's share of their output; firms which rely on sales intermediaries deal with relatively few of them. Now, to close the triangle, examine the relationship between the number of agents in a principal marketing channel and the proportion of the major product class sold through that channel.

It is clear from Table 11 that the principal marketing channel, as defined, turns out to be that channel carrying over 50% of the firm's output in its major product class. This is as true among firms having relatively few customers as it is among firms having relatively many.

Table 11. Use of principal marketing channel

No. buyers in the principal marketing channel	Percent of major product class sold through principal marketing channel	
	less than 50%	over 50%
Parent only	-0-	5
1-10	1	6
10-25	-0-	4
25 +	1	7

Two dimensions of dependence have been considered: dependence on particular products and dependence on particular marketing channels. Data combined along these two dimensions is presented in Table 12.

Table 12. Dependence on products and dependence on customers (n = 23)

Percent of gross sales contributed by major product class	Proportion of total production sold to three largest customers			
	less than 25%	25-50%	50% +	Parent only
less than 25%	0	0	2	
26-50%	4(1)	3(1)	2	
50% +	2(1)	2	6(3)	2(2)

Nine of fifteen independents for which complete data is available derive better than 25% of their total revenues from a single produce class and sell better than 25% of their total production to their three largest customers.

Which industries were represented by each firm's three largest customers? Table 13 indicates the relative frequency with which various industries were mentioned by the respondents.

Table 13. Industries represented by largest customers

Industry	Frequency of mention
Furniture	11
Toys	8
Variety and novelty items (incl. jewelry, trophies, etc.)	7
Household goods (rolling pins, etc.)	6
Tools (i.e., handles)	3
Cosmetics	2

Note: Three industries each received one mention: rubber and abrasive goods, sporting goods, coat hangers.

What is striking about Table 12 is that the industries most frequently mentioned are large consumers of wood. The wood turners and shapers are producing components for final products which probably use wood as the main material factor. Are the wood turners and shapers integrated into a larger wood products industry within Maine?

The respondents were asked to estimate the proportion of buyers in their principal marketing channel (as defined above) operating outside of Maine. All but two independents gave an estimate of 90% or higher. The pattern holds true even for firms dealing with relatively many buyers. It should also be mentioned at this point that only two subsidiaries are owned by Maine-based parents.

How do these firms find new business? Their customers are distant and they do not employ salesmen. Apparently customers seek out these firms either through their own efforts or via intermediaries (brokers, manufacturers representatives). To get a concrete picture of this situation, the respondents were asked to focus on their firm's newest customer and to explain how his order was obtained. The data is exhibited in Table 14.

Table 14. How wood turners and shapers get new business (independents only)

1. "How long has the firm been doing business with the newest customer?"	
median (n = 14)	between 2 weeks and 2 months
2. "How did this customer find out about your firm?"	
a. unknown	7
b. referral by another WT&S firm	3
c. other referrals	3
d. mail campaign	1
3. "How was the price set?"	
a. customer offered an "acceptable price"	6
b. customer asked for a bid	2
4. "Who set the specifications for the job?" (n = 11)	
a. customer mostly or entirely	8
b. firm and customer	2
c. firm	1

The respondents had difficulty supplying the information wanted. Several claimed that these questions were not relevant to their business. What they meant was that they do not actively seek new business. New customers come and go; they learn of WT&S firms through informal, third-party sources when they require their services. Specifications are typically set by the customers; WT&S firms make little effort to sell anything other than what the customer has in mind. Very little effort at product innovation was evident.

A Final Word

This ends the discussion of the wood turning and shaping industry in Maine. The picture drawn is not encouraging. It is a small industry, one characterized by a rather passive and limited conception of the marketplace. It is not integrated with other Maine industries and therefore is not stimulated by local developments. It probably provides a decent living for its owners but does not exhibit the growth needed to generate the high-paying skilled jobs, the sort of jobs which would attract Maine's educated youth.

In today's economy, growth implies innovation, and this industry does not innovate. The above discussion of the industry identifies at least one key reason for this failure. People in the industry do not perceive opportunities for innovation; they simply do not know what they can do to alter their situation. Even the more articulate industry representatives seem to associate progress with incremental improvements in their production technology. True growth will begin when the industry abandons its passive role vis-a-vis the marketplace and starts to produce and market complete products, products with a high "value added". As long as these firms continue to see themselves as job shops producing what are essentially commodities the industry will not grow in the desired manner.

Asking an industry's conception of itself is not a simple task. At least two distinct but related issues must be addressed:

1. The industry's perception of, or information about, the opportunities open to it, i.e., its options; and

2. The industry's perception of the risks which every innovation implies.

Perceptions are changed with information, information that is accepted. The research cited in Section 9 converges on this simple point: the most useful information, the information which is sought, accepted and applied in the process of innovation is information received from a trusted, interpersonal source. Authoritative sources cannot effectively direct change; innovation cannot be "programmed", for innovation is a complex, dynamic process. What can be done is create a highly integrated, interpersonal network among people and institutions in Maine; and this network will carry, process, and diffuse the information that will ultimately alter attitudes and perceptions.

PART III

APPENDICES

APPENDIX A

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Appendix A

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Maine Entrepreneurial Institute:

W.K. Kellogg Foundation

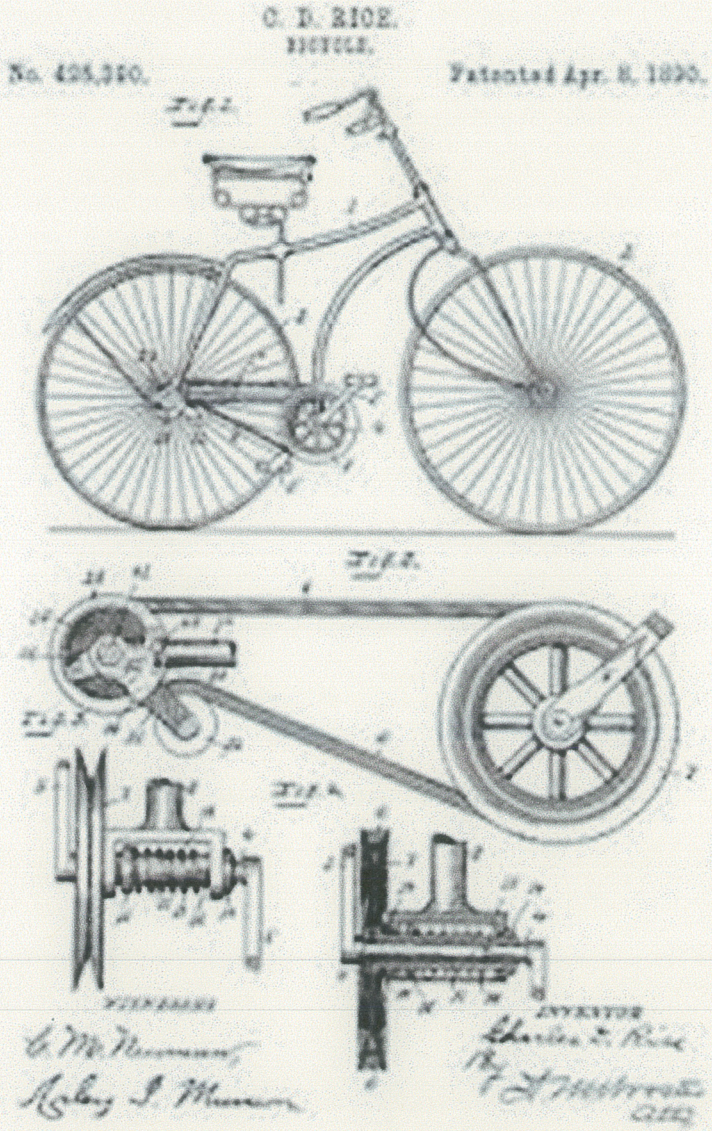
Challenge

"If anything imaginable is possible, if there are no constraints whatever, what would be the nature of a trustworthy organization to…

effectively facilitate the fair exchange of intellectual property

including trade secrets in a virtual world."

Dee Hock, VISA founder



- See link for InventureX's one page Lean-Canvas.
- Listen to Charlie Rose's 45 minute interview with Lee Kwan Yeu.
- READ Malcolm Gladwell's article on Intellectual Ventures.
- Read MIT Professor von Hippel's article on "Lead-User" research.
- IP Cloud-Based Software: rated highly https://www.appcoll.com/

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