Technological Innovation Studies Program

Research Report

COMPARATIVE MANAGERIAL PROBLEMS IN EARLY VERSUS LATER ADOPTION OF INNOVATIVE MANUFACTURING TECHNOLOGIES

by

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and
R.P. Gillin

School of Business Administration,
University of Western Ontario.
February, 1973.

Rapport de recherche

Programme des études sur les innovations techniques

Industry, Trade and Commerce
Office of Science and Technology
Ottawa, Canada

Industrie et Commerce
Direction des sciences et de la technologie
Ottawa, Canada

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Six Case Studies

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February, 1973

CONFIDENTIAL
RESTRICTED CIRCULATION

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Comparative Managerial Problems in Early Versus Later Adoption of Innovative Manufacturing Technologies

by

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Executive Summary

The research involved a comparative examination of six companies in three industry sectors. In each sector one company was an early adopter of new processing machinery, while the other only purchased processing machinery which was well established on the market. The three pieces of machinery involved were an electronically controlled rip-saw, a continuous liquid packaging machine, and a mechanical grape harvester. The companies involved were located in Ontario or Quebec with sales ranging from less than $1 million up to $15 million, and from less than 50 and up to 200 employees.

With respect to the purchase decision, the research showed that:

- the early users tended not to have formal acquisition plans while the late users had such plans;
- the late users had a wider choice of alternative machinery;
- all users had active upper management participation in the evaluation, choice and implementation of new machine acquisition;
- all users assumed that the supplier would provide training, documents and instruction; and,
- with early users very little active preparation for installation of the equipment was carried out.

With respect to start-up problems it was found that:

- early adopters experienced a greater frequency and severity of start-up problems than did later adopters;

- the start-up period was longer for earlier adopters than for later adopters;

- the earlier adopters had less documentation (operating and maintenance manuals, circuit diagrams) from their suppliers than later adopters;

- earlier adopters had to develop more operating and maintenance techniques on the job than did later adopters; and,

- the start-up procedure was less structured for earlier adopters than for late adopters.

In all six cases the equipment was purchased from a manufacturer in the United States, usually through a Canadian supplier. All too often, the Canadian supplier did not know the equipment he was supplying, and was unable to provide the services the user expected.

A. Vanterpool
Office of Science and Technology
March 9, 1973.

CHAPTER I.

MANAGEMENT PROBLEMS IN EARLY ADOPTION OF MANUFACTURING INNOVATIONS

In the past productivity improvement in Canadian secondary manufacturing has been compared unfavourably to that of the United States. While the ways in which a firm may effectively compete extend beyond productivity improvement, eventually poor performance of this responsibility returns to haunt the executive.

Canadian manufacturers have several handicaps in improving productivity. Small markets, consumer demand for product variety and high transportation costs combine to seriously inhibit use of the two major approaches to productivity improvement - economies of scale and specialization. The small Canadian market and the demand for variety combine to reduce opportunities for specialization. Without specialization individual product volumes are kept low while the opportunity to achieve economies of scale is reduced.

One strategy that has been suggested for productivity and competitive improvement is that of rapidly adopting manufacturing innovations. Such a strategy would aim to achieve cost, volume or product performance advantages through quick utilization of new or improved manufacturing equipment. A new product may or may not be involved. Occasionally a company might choose to undertake process research and development as part of their strategy. The above actions are different from the more conventional decision approaches in which managers insist that operating installation of a new machine exist successfully before they will seriously consider an installation in their own plant.

For an individual manager the choice of strategy would not usually be easy. Predicting the performance of an untried technology is difficult. The risks inherent in early adoption may be considerable and could have adverse effects on costs, capacity and product quality. Early adopters may not obtain promised performances from new equipment. Changing organization, procedures and practices to capitalize on the new equipment may also be difficult. In the extreme case failure could result with the attendant costs of removing equipment and acquiring conventional replacements. On the other hand a successful installation could provide years of competitive advantage high productivity, reduced costs and higher profits.

Research into the consequences of early adoption of manufacturing innovation has not been extensive. The question of whether to be a "pioneering first or jack rabbit second"[1] has been raised but little more. More attention has been paid to this question in product innovation than in process innovation.

Our research addresses in part this strategy question. What are the managerial consequences of early versus later adoption of manufacturing innovation? Our hope is to shed some light on the problems and payoffs of early adoption so that individual managers will have a basis for assessing their strategy and for specific installations to better plan install and operate new equipment.

In Canada adoption of manufacturing innovations has been generally slower than in the United States. There are, of course, some exceptions to this statement but in general it seems to hold. Adoption of numerically controlled machining, for example was slower in Canada. There are some apparent explanations for this phenemenon. Since most machine tools are imported, information on innovations may be more difficult to obtain. Distribution is through manufacturer's representatives whose access to information and knowledge of their products may suffer from distance and lack of opportunity. The smaller size of many manufacturing firms will inhibit their ability to finance such capital acquisitions.

By examining the consequences of early adoption of manufacturing innovation some speed-up may be possible. Our research respresents an initial attempt to obtain knowledge of the structure and characteristics of the problem. We will describe what happened in 6 selected adoption situations, 3 are early installations while 3 are later.

Criteria For User Selection

To accomplish this goal we sought three pairs of Canadian companies. One of each pair would be an "early adopter". Since we were looking at Canadian Companies we searched for the first (or nearly first) Canadian

firm to adopt a particular manufacturing innovation. The second adopter chosen would have installed his machine a sufficient time later that several other intervening installations existed.

The innovation chosen for study had to meet several criteria:

1. The innovation should represent a significant change in the process either in its function or in its control or materials handling.
2. The equipment should be an important part of the production process. In other words failure of the machine would have significant effects on output. A peripheral device whose malfunction would be not affecting operations significantly would not be eligible.
3. The first installation should be reasonably recent. Preferably within the past 5 years.
4. The acquiring companies should be medium to small Canadian manufacturers or processors. It was felt that foreign owned subsidiaries or branches would contain a lack of autonomy sufficient to bias the sample. Consequently, such companies were not examined. Medium to small manufacturers were defined as having per annum revenues less than $15,000,000.
5. The innovation must be adopted rather than self developed by the user.
6. Where possible the equipment of early and later users would be obtained from the same supplier.

These criteria were selected to reduce the number of distorting variables in the sample. Our purpose was to examine the consequence of adopting early and the more similar our pairs of users, the more clearly significant comparisons could be made.

Approach

Each of the two adopters of each innovation was visited and interviewed. Their experiences with the machines, starting with the specifications of needs through choice of supplier, acquisition installation and start-up were studied. Information was collected through personal interviews with the involved management and summarized in case studies. These studies were later sent to the companies so they could be checked for accuracy. In each case the interviewers made every effort to cross-check information and to obtain the desired level of detail. This goal usually

resulted in multiple interviews, telephone conversations and correspondence until all parties were satisfied. Great care was taken to maintain the confidentiality of information received and any data were published only after receiving permission to do so. At the same time the supplier of the equipment was also visited and interviewed. The development of the machine and subsequent modifications were traced through from the beginning to the summer of 1972. This information was collected to determine for each user the "state of the art" at the time of machine acquisition and to check on the user's perception of the supplier (and vice versa).

Case studies were chosen as the vehicle most appropriate for our research. Since we expected each situation studied to have some unique characteristics a flexible approach was needed. As exploratory research our ability to predict all the important variables involved was limited. Finally, the time sequence characteristic of the situations examined made case studies appropriate for collecting and describing each firm's experiences.

After their collection the case studies were analyzed to determine:

1) whether any consistent differences in the experiences of late and early adopters appeared,
2) what factors affected those differences
3) whether any similarities existed and what factors appeared to affect them.

Selecting the Companies

In order to arrive at three innovations and nine case studies many more situations were reviewed. Our criteria of "significant innovation" and "an important part of the manufacturing process" eliminated several promising leads. Eventually, after studying various trade journals and periodicals, three acceptable innovations were found and the study started. The ones chosen were relatively small having, with one exception, annual sales of less than $15 million. Smaller firms were chosen for several reasons:

1. Smaller firms account for 60% of the employment in Canada.[2]

2. Because of relative lack of resources, problems tend to be highlighted and more easily identified.
3. Interviewing would be more effective since managerial decision and responsibility would be centred on a relatively small group of executives.

The situations we eventually found were in three distinct industries, namely woodworking, milk processing and agriculture. Most of our basic criteria were met. All companies were wholly Canadian owned, each innovation represented a technological advance in the industry, the installation was a significant change in each manufacturing facility, all adoptions took place after 1968, each innovation was adopted and not developed by the users and each pair of machines was supplied by the same company. The innovations chosen were:

1. An electronically controlled rip-saw. This machine was designed to cut stock lumber into prescribed widths automatically. The controls, operating features, and construction of this rip-saw were a major advance over conventional ripping systems. The supplier was Texas Woodworking Machine Co. Inc.* the first user was Woodbine Industries Ltd. and the later user was J.T. Meunier Inc.
2. A continuous liquid packaging machine. This machine originated in Europe but was sold exclusively in Canada by ChemCorp of Canada Ltd. The machine represented both a new product and a totally new process in the dairy industry. The first user in North America was Laiterie Quebec Ltee. The later user we chose was Northern Dairies Ltd. who adopted the process in 1971.
3. A Mechanical Grape Harvester. This self propelled unit represented a major shift from labour intensive hand picking method of grape harvesting to almost full automation. The supplier was Cedar Machinery Co. Inc. The first Canadian user of the machine was H.A. Simcoe Ltd. but was the seventieth machine sold. The late user we chose was Provincial Wines, a fully integrated wine producer.

Although most criteria were adequately met there were some exceptions. The Canadian supplier of the milk pouch machine had not historically been

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* All company names have been disguised.

a dairy industry machine supplier.

The timing of adoption of each of our users also is summarized in the following table:

Timing	Woodbine	Meunier	Simcoe	Provincial	Pierre	Northern
First User	X				X	
Early User		X	X			
Late User				X		X

Our record of the machine and supplier history was intended to mitigate the effects of variations in the timing of adoption.

Our sample contains companies of various sizes but all have revenues less then $15,000,000 p.a. The distribution is as follows:

Sales	Woodbine	Meunier	Simcoe	Provincial	Pierre	Northern
Less than $1,000,000			X			
$1,000,000 - $5,000,000		X				X
$5,000,000 - $15,000,000	X			X	X	
Employees						
Less than 50			X			
50-100	X	X				X
100-200				X	X	

The various sizes of the companies in our sample suggests differences in management depth and division of responsibility. Such characteristics are addressed later in this study.

ELECTRONICALLY CONTROLLED RIP-SAW

Texas Woodworking Machine Co. Inc.

The Texas Woodworking Machine Co. has a long history in the woodworking business. They manufacture several kinds of saws, jointing machines and materials handling equipment.

The preselect memory rip-saw had been under development for some time before 1969 and was a significant departure from conventional saws. The arbor configuration and the memory device were considered major innovations in rip-saw technology. Six concentric telescopic arbors positioned the six sawblades according to the instructions of an electronic control unit. Pre select saws, which involved the experimentation with various cut widths before sawing, had existed for several years. The Texas Woodworking Machine Co. saw contained a paper tape memory unit which stored both the board number and its corresponding cut selections for sawing. This configuration allowed the operator to create a buffer inventory of boards between the width selection station than the saw blades. The operational constraint before this developme[illegible]s the speed of the operator. With the memory device the operating [illegible]t became the machine's blade setting time.

The company development policy was to carry out machine debugging at a production installation. Further the management felt it was their obligation to spend as much time at each installation as was necessary to achieve reliable production. Woodbine Industries was such an installation.

J.T. Meunier was the second installation of the pre-select memory saw. One other machine of that particular design was installed at a woodworking plant in the U.S.A. By early 1971 the second generation saw had emerged and contained several improved features. The most notable among them were the arbor mounted edger blades. On the Woodbine machine the edger blades were mounted and driven independently from the saw blades. Three second generation machines were sold (all of them in the U.S.A.). In 1972 third generation machi[illegible]ere available and were even more significantly improved. Lubricat[illegible]waste removal and the electronic controls were improved. These new saws had chain feed (vs. roll feed at Woodbine) and provided improved lateral stability during cutting. This feature was expected to appeal to the furniture industry.

Woodbine Industries Limited

Woodbine Industries Ltd. is a manufacturer of wood windows and window frame products located near a medium sized western Ontario city.

The company had experienced rather dramatic growth in recent years with total sales increasing from approximately $5,000,000 in 1969 to an expected $10,000,000 in 1972. During this time the company had moved into a new and much larger plant and in the process acquired a new electronically controlled rip-saw.

The rip-saw station was the first department in the window making process and was followed by the cut-off station, for cutting prescribed lengths, the milling department for molding the wood into components and the final assembly department. The old plant contained an old company designed manually adjustable rip-saw which became a very serious bottleneck as the company's sales increased.

The President, aided by the general manager, surveyed the field of possible new saws and decided on a Texas Woodworking Machine Inc. preselect memory rip-saw. It represented the newest innovation in woodworking machinery largely because of its telescopic arbor configuration for blade settings and its string-shadow width selection device. Other less sophisticated machines were also available.

In November 1969 the machine arrived but was not fully debugged until 18 months later. The new rip-saw met production demands after the first three weeks but encountered bearing vibration, arbor alignment and control problems thereafter. The manufacturer worked very closely with Woodbine Industries in solving these problems.

Woodbine Industries was the first woodworking company to use the Texas Woodworking Machine Company's rip-saw.

J.T. Meunier Inc.

J.T. Meunier Inc., is a small window making and wood moulding concern in the Province of Quebec.

The company's sales increased from $2,000,000 in 1970 to $3,000,000 in 1971. In anticipation of this increase in demand the President and General Manager physically re-organized the manufacturing facility in early 1970. This re-organization included the acquisition of a Texas Woodworking Machine Co. Inc. preselect memory rip-saw. J.T. Meunier Inc. purchased the second preselect memory rip-saw manufactured.

The saw arrived in the spring of 1970 and although was operating within two weeks was not without its problems. As with the Woodbine saw the saw at the Meunier facility encountered persistent vibration. This condition led to several wiring breakdowns when the circuitry shook loose. Eventually by mid 1971 the saw was dismantled and examined. Two of the six arbors, it was discovered, had been machined in two pieces. This construction had caused them to vibrate. Only one was replaced because of the lead time needed to manufacture a replacement. The vibration diminished noticeably but was still present. During the summer of 1972 the other faulty arbor was replaced.

The manufacturer of the rip-saw worked closely with the J.T. Meunier personnel in the troubleshooting and problem solving.

THE CEDAR MACHINE CO. MECHANICAL GRAPE HARVESTER

Cedar Machinery Co. Inc.

Cedar Machinery Co. Inc., is a large supplier of harvesting and food processing equipment. The company's most notable farm machinery successes were a mechanical grape harvester and a bean harvester. The plant was located in a city in Western New York state but the company had representatives across the U.S.A. as well as in Canada, Europe and Australia.

Early development of the grape harvester occurred at Cornell University and was financed by the New York State Grape Production Research Fund Inc. The work was directly toward development of a vine variety which would be easier to harvest mechanically. In the early 1960's, Cedar Machinery was invited to participate. After a research expenditure of $1,000,000 and 5 years a prototype harvester was built.

The first mechanical harvester was sold in New York State in 1968. By 1970 when H.A. Simcoe purchased the machine seventy had been sold. The harvester had been modified for Canadian conditions (the bottom conveyor configuration was lowered). In 1969 however, the Canadian wineries wanted more time to study the effects of mechanical harvesting on grapes. This delayed adoption by the growers.

Since it was introduced in 1968, Cedar Machinery Co. Inc. has simplified and improved the basic harvester. Fundamentally the machine received at Provincial Wines was the same as the one H.A. Simcoe purchased.

The company provided start-up support and documentation to all users. In practice very little service support was needed.

Cedar Machinery Co. is the leader in the manufacture of grape harvesters. Only recently has any significant competition emerged.

H.A. SIMCOE LTD.

H.A Simcoe Ltd. is one of the largest independent grape growers in the Niagara peninsula. In 1972 the company worked 500 acres for total revenues of $250,000. In 1970 the company acquired a mechanical grape harvester from Cedar Machine Co. and thereby became the first Canadian user of the unit.

During the late sixties there was a significant decline in the availability and quality of grape picking labour. Hand picking personnel were usually transients who arrived for the harvest season in late September. Because of these labour problems H.A. Simcoe Ltd. purchased a mechanical harvester in 1970.

In September 1970 the machine was driven into the vineyard for the first time. Initially, minor problems arose with speed settings and support equipment co-ordination but on the whole the harvester functioned very well. Later a problem with excessive conveyor belt shrinkage became apparent but was never severe enough to interfere with production.

The harvester was more reliable and less weather sensitive than hand picking so the 1970 harvest was very successful. Mechanical harvesting necessitated several changes in the operation of both the grower and winery. H.A. Simcoe had to be more careful of cleaning techniques with the harvester than with his other machinery. The winery insisted on much faster vine to vat times because mechanical harvesting yielded individual grapes rather than the whole grape bunches received from hand picking. The harvester separated the individual grapes from the stems and a great deal more juice flowed into the container. Consequently fermentation began much earlier and required that the winery start processing sooner.

PROVINCIAL WINES LTD.

Provincial Wines is a large fully integrated wine producer with 1000 acres of vineyards located in the Niagara Peninsula. Total revenues in 1971 were $14,850,000. The company owned and harvested vineyards, produced a variety of wines and sold their products both through Provincial Liquor marketing boards and their own stores. In 1971 because of the declining availability and quality of transient help and an increase in the labour cost, the company purchased three mechanical grape harvesters from Cedar Machinery Co. Inc.

Much time and effort was devoted to planning and designing a bulk handling system which would accomodate both the growers and the winery and achieve reduced vine to vat time. Eventually the winery and vineyard managers developed a system of "tote-lift" bins for the field - 4 ton bins for the trucks. These bins were designed to feed into a new 120 ton/hr. continuous unloader at the winery. There were 200 independent growers which supplied the Provincial winery. They had to be educated in the new way their grapes were to be delivered. Thirteen independent growers also bought mechanical harvesters in the area in 1971.

Provincial's start-up experience was very smooth and only minor problems such as conveyor belt shrinkage occurred. Provincial followed the recommended cleaning procedures very closely, but some independent growers experienced severe breakdowns because they did not clean their machines properly.

The use of the mechanical harvesters and improved material handling at Provincial was a great success. Fully 60% of the original capital cost of $110,000 was repaid in the first year's savings.

THE PREPAC MILK POUCH MAKING MACHINE

ChemCorp of Canada Ltd.

ChemCorp of Canada is a large, international chemical company. During the early sixties the marketing department was looking for new polyethylene film markets. A machine known as Prepac was being developed in France to continuously package liquids. ChemCorp became the lisencee for Canada.

Early development of its machine took place at the ChemCorp Montreal office in 1964. In 1965 an experimental installation was set up at Canadairies Ltd. Significant machine modifications were made during and after this time and in 1967 a limited seals production installation was set-up at Laiterie Bon Chance Ltee. This experience offered its ChemCorp personnel the opportunity to develop their skills with the Prepac unit. There were only 4 ChemCorp technicians involved in the project at that time.

In 1968 Laiterie Pierre realized the market potential of the pouch-pack and became the first largescale user in North America. Further development took place at the installation and after particularly in the service area. The ChemCorp service department increased both in size and expertice. At Laiterie Pierre Ltee there were no major start-up problems except for some familiarization and packaging operation development.

By 1971 and the Northern Dairies Ltd. installations, 140 machines had been sold. The machine had been improved since 1968 particularly with improved maintenance features. The ChemCorp service department was well experienced and much larger than in 1968.

A new double spout unit was introduced in 1972 and had an output rate twice that of the previous model.

Laiterie Pierre Ltee.

Laiterie Pierre is a large diary located in the Province of Quebec. The company deals in fluid milk, ice cream, various fruit juices and other related products. Sales in 1972 were expected to exceed $13,000,000. In 1968, when the company acquired the Prepac pouch making machine sales amounted to $9,000,000. A significant proportion of this increase was due to the introduction of milk in pouch-packs.

Glass bottles, pure-pak cartons and plastic jugs existed in different sizes in the Quebec market. Plastic jugs were the only 3 quart containers available in 1968. The jugs were of poor quality and were subject to taste and volume variations. In an effort to maintain the 3 quart container market, Laiterie Pierre adopted the Prepac machine which packaged milk in single plastic pouches. These single quarts, however, were sold in packages of three.

The start-up was reasonably smooth but some time was necessary to find an efficient and economical technique for packaging the pouches. New maintenance skills also had to be learned on the job. Sales increased quickly and the machine met the production demands. The pouch-pack was such a sales success that the company ordered three additional machines within a month of the initial start-up.

The largest measure of success was a 15% increase in domestic consumption of fluid milk between 1968 and 1970. Currently pouch-packs supply almost 50% of the total milk market in the Province of Quebec.

Northern Dairies Ltd.

Northern Dairies is the only producing dairy in a medium sized Ontario city. Sales in 1970 were $3,663,000. Plastic milk jugs were prevelant but in 1970-71 were increasingly criticized for volume and taste variations. Since 3 quart plastic jugs were the only available container of that size Northern Dairies was compelled to find an alternative. In 1971 the company purchased a Prepac milk pouch making machine from ChemCorp of Canada.

After the installation, the company engineer spent three days in training at the ChemCorp Technical Services Office to learn the operating and maintenance characteristics of the machine. A ChemCorp representative was present at the time of installation to supervise start-up and debugging. Often one week of tests the machine was running at full production. No significant problems arose until 1 year later when the Prepac unit was placed on two shifts. The difficulties at that time were not severe and were attributed to an absence of daily maintenance.

The management at Northern Dairies felt the Prepac machine was a success. By December 1971, 11 months after start-up, pouch-packs represented 40% of the company's total milk volume.

CHAPTER II

EQUIPMENT ACQUISITION AND STARTUP.

A Conceptual Framework

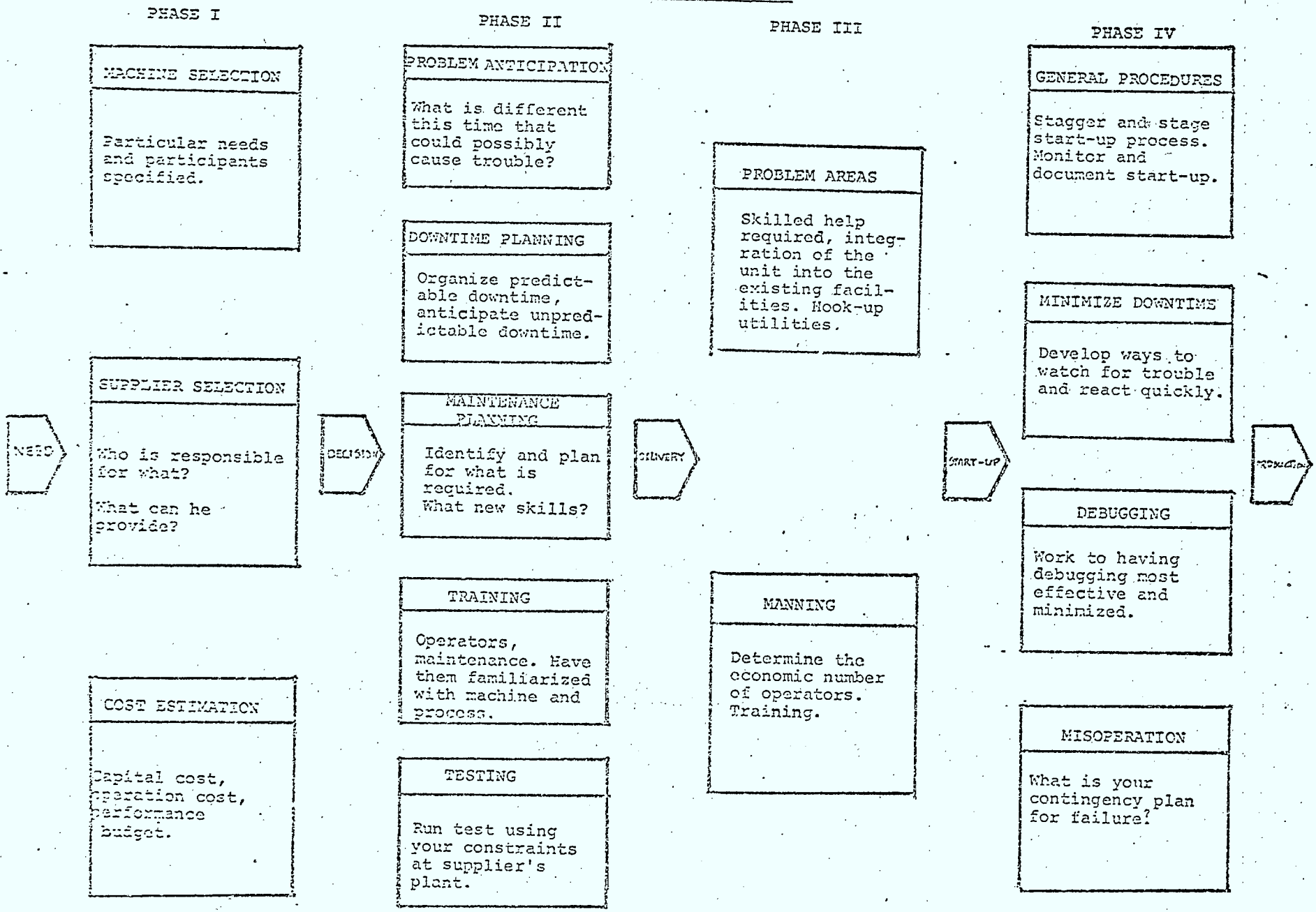
Whether a company's startup and operating experience with new manufacturing equipment is successful often depends upon decisions made and action taken months prior to installation. The user's specification of the equipment performance he desires is an obvious example. Thus in each instance our research covered the interval between the decision to acquire a machine to the time that startup was complete. To facilitate our study and analysis the activities involved were arbitrarily divided into four stages: equipment selection, pre-installation, installation and start-up.

Exhibit I illustrates the four phases in the acquisition and startup of manufacturing equipment and the major elements constituting each phase. At the beginning the user becomes aware of the need for new equipment. His motivation may arise from several sources - new products, need for additional capacity, equipment replacement and so forth. At that point he specifies his needs. His minimum specifications would define the desired functions and output rate. He might also specify other features such as adherence to National Machine Tool Builders Specifications, standardization electric drives, hydraulic fittings or tolerances to be held under production conditions. He may also undertake an evaluation of the characteristics necessary for the new equipment to integrate successfully into the rest of his manufacturing system. In other circumstances the opposite may hold - the user has to evaluate the potential changes in the rest of the manufacturing system to accomodate the new equipment. In any case there are opportunities at the time of specifying equipment and evaluating alternatives to avoid problems through analyses such as the above. Often the involved manager will consult with operating and maintenance personnel to ensure that the new equipment's specifications reflects their needs and circumstances.

In the second phase (after placing the order on the supplier) management usually has time to anticipate problems and prepare for installation, start-up and normal operations. During this time the equipment is being manufactured. In cases of new innovations the same users monitor the progress of the equipment and ensure that adequate testing of the machines

EXHIBIT I

A Conceptual Framework for the Acquisition and Start-up of Innovative Technologies



takes place prior to delivery. Some companies insist on tests using production materials, fixtures and tooling. Performance deficiencies thus identified can usually be remedied faster in the supplier's plant.

During this time also the user can organize pre-installation training of operators and maintenance personnel and develop methods and procedures for operating, trouble-shooting and maintenance of the equipment. All of these measures have been utilized at one time or another by manufacturers acquiring special equipment or introducing manufacturing innovations. As in Phase I management must evaluate in each case the potential usefulness of such checking and preparation. An alternative is to depend on the supplier to provide operational equipment, training and back-up services.

Phase III, installation, is mostly a technical affair. With innovations, however, special care may be needed. Managerial effort may be needed to ensure that adequate information is available, special siting requirements are met, appropriate skilled personnel are present and appropriate management controls are utilized.

In Phase IV, Start-Up, the equipment must be brought to acceptable operating performance. In large or complex installations a specific start-up procedure may be desirable. Elements of the machine could be operated and adjusted independently until the whole is checked out. Then full operations could be tried. During this time operator and maintenance training is important. Specific organization to ensure that this training takes place may be desirable. In complex equipment an information system to record system malfunctions for later diagnosis is sometimes used. Given that the new machine is an important part of the production system downtime for repairs could be costly in terms of lost output. In each of the installations studied this condition was obtained. In such circumstances methods and procedures designed to quickly diagnose problems and restore operation can have high utility. In those situations where a new installation requires significant debugging lack of the above organization, methods, and procedures may, in the extreme case, result in failure to achieve designed output levels.

The supplier's involvement starts close to the beginning of the acquisition process. His role varies from a passive response to requested tenders through to active promotion of the idea of utilizing his equipment.

Similarly in installation and start-up his participation depends on many factors.

Smaller companies depend heavily on their suppliers for technical advice and assistance. They usually do not have the trained personnel to be self sufficient in assessing equipment alternatives or developing plans to install and operate manufacturing equipment innovations.

In the study the actions taken by the user, his dependence on the supplier, and the help received from the supplier in each of the four phases were examined. In the following chapters wer describe first what the users did and second what their subsequent experiences were. Throughout, the interaction with the supplier is documented.

CHAPTER III

ACQUISITIONS OF MANUFACTURING INNOVATIONS

Summary of Findings

This chapter outlines some general observations about how the companies studied, aquired and started-up their new machinery acquisitions. We first compare all early adopters for common and differentiating features. Secondly we look at the later adopters within the same framework. Finally, we examine the similarities and differences of early adopters versus later adopters.

The Nature of Each Industry

It is worthwhile in order to gain an insight into the context of each company to examine the nature of each industry. None of the three woodworking, dairy products or agriculture is based on advanced technology. This characteristic has interesting attitudinal consequences which will become apparent in looking at their approaches to adoption.

Mechanical grape harvesting had very profound consequences on one fundamental characteristic of the industry. It shifted the user from what was formerly a high variable cost labour intensive operation to a high fixed cost and capital intensive operation. The nature of the end product changed with mechanical harvesting as well. Hand picked grapes were delivered in bunches while mechanically harvested grapes were delivered singlely. While evaluating the mechanical harvester the user then must take into account the change in the grapes as delivered. This characteristic delayed adoption of the harvester by one year and suggested the development of a new handling system in each case. The wineries wanted to study stemless grapes because they could lose more juice in transit then hand picked grapes. What had been a relatively unimportant consideration (delivery time) before, became very important with the use of mechanical harvesting.

The woodworking business is somewhat labour intensive because of the variability of the raw material. At the ripping station, for instance, a skilled operator was needed to select the best widths from a board with as little waste wood as possible. The electronic controlled rip-saw was a machine with the potential for both increased speed and improved width judgements. The presence of the new rip-saw had little or no effect on the surrounding operations or the operating characteristics of the plant. It was simply a better way to do the required operation.

A historical concern of the dairy industry has been to increase total sales volume. Milk consumption is more or less related to population and there have been few dramatic changes in total gallonage. Shelf life also has also been an important factor in the dairy business. Milk must always be fresh. This necessity in turn affected dairy delivery schedules. The pouch pack was a product innovation for the dairy industry and affected these fundamental industry operating characteristics. Laiterie Pierre Ltee increased their gallonage by 15% in the year after the introduction of the pouch-pack. They improved the delivery performance because pouches were easier to pack and the shelf life was doubled.

EARLY ADOPTERS

(Woodbine Industreis Ltd., Laiterie Pierre Ltee. H.A. Simcoe Lte.)

Size and Organizational Structure

Of the total sample of six firms the early user category contains both the smallest and the largest. H.A. Simcoe Ltd. has both the lowest revenues ($250,000) and the fewest number of employees (6) while Laiterie Pierre Ltee has the largest revenues ($13,000,000) and over 100 employees. Woodbine Industries is in between with $10,000,000 in sales and about 30 employees.

The organizational structure of each differs considerably. H.A. Simcoe Ltd. is a family operation with only three permanent non-family employees. Decision making at Simcoe is on a very informal basis. Howard Simcoe described the decision process concerning the harvester as "thinking about it for a period of time". There are no formal budgeting or control systems. The company harvests primarily grapes for sale to wineries and food processors, however, they do grow some barley and other grains.

Laiterie Pierre Ltee is more formally organized. There are two divisions within the company, ice cream and fluid milk. The decision process at Laiterie Pierre Ltee is more formal and structured than that at H.A. Simcoe.

The company organizational structure consisted of the President, Executive Vice President, Controller, Sales Manager and Production Manager. The Executive Vice President was the effective operating head. The President had final authority on major financial or marketing matters but relied heavily on his Sales Manager and Controller. The milk pouch decision was

ultimately made by the President but all the research and evaluation was performed by the company Controller and the Sales Manager. (Since that time - 1968 - the Sales Manager has been promoted to Vice President of Sales.)

Woodbine Industries Ltd. is functionally organized. There is a President, General Manager, Sales Manager and Production Manager. The President made the final decisions on major financial matters subject only to the approval of the principle shareholders. The company was growing rapidly in 1969 and organizational changes where taking place to handle this growth. After the rip-saw was acquired changes continued with the creation of an Industrial Engineering Department. At the time of the rip-saw acquisition a rigorous maintenance recording system did not exist. Recently one was developed. The study and evaluation of the ripping problem was undertaken primarily by the General Manager who was aided by the President.

Approach

In addition tothe organizational and industry features outlined above there are some notable observations in the way the early adopters addressed the issue of innovation adoption.

Similarities:

Some features of the approach to innovation among our sample of early users appear similar.

1. Although the operational problem which create the need for new machinery in each of our cases differed, in all cases the problem was fundamental to the continued success of the company. Woodbine Industries needed more capacity, Laiterie Pierre Ltee needed an increase in sales volume and H.A. Simcoe Ltd. needed a reduction in labour costs.
2. In all cases both the decision makers and project participants were one and the same. The participants in the decisions were those upper and top managers with significant operating responsibilities.
3. In all cases the existing "in-house" maintenance and operating skills were considered adequate with respect to the existing equipment.

4. No early user prepared any formal acquisition plan. Once the machine was ordered very little preparation was made other than some utilities set-up and plant layout changes. The users assumed that the suppliers would provide such things as training, testing, documentation and start-up procedure. The early users viewed the new machinery in the same way as part capital acquisitions.
5. There were other machines available at the time of each adoption. At Woodbine Industries Ltd. the management examined other available rip-saws and methodically eliminated the ones they felt to be unsuitable. At the time of the Laiterie Pierre Ltee Prepac installation, one other milk pouch machine was available but had not been developed or installed for Canadian conditions. Its function however was fundamentally the same. The Cedar Machine Co. Inc. grape harvester was the only self propelled machine available but there was another tractor-towed unit which was available in 1970. The innovation in each case had unique operating characteristics. All were covered by one or more patents. The other available machines performed a similar function in a more conventional manner. Each innovation offered significant advantages over conventional machinery.

Differences:

The differences in approach to acquisition of manufacturing innovation also provide insight.

1. Only Laiterie Pierre and H.A. Simcoe placed emphasis on good service and high machine reliability at the time they were evaluating possible machines. H.A. Simcoe knew that Cedar Machine Co. Inc. had historically built reliable machinery and trusted that reputation. Similarly Laiterie Pierre Ltee knew of and trusted the reputation of ChemCorp of Canada Ltd. As a borderline case Mr. Forbes, General Manager at Woodbine Industries, did view the close availability of Texas Machineries Canadian representative as a factor in service reliability. He also tried not to be the recipient of the first saw built although in the end he was not successful. Beyond the evaluation stage the users did very

to prepare themselves for the changes their new machines required.

2. Woodbine Industreis Ltd. was the only early adopter which did not have exposure to some production installation or test facility prior to delivery. The Laiterie Pierre Ltee people studied the Prepac machine at Laiterie Bon Chance Ltee. Howard Simcoe studied the harvester while it was being built at the Cedar Machine Company plant.

Summary:

From these general similarities and differences in approach by early users several points bear repeating.

1. In each case the choice of equipment was made by managers with operating responsibilities.
2. In general few preparations were made to develop the new operating and maintenance skills required prior to equipment installation.
3. No early user prepared a formal acquisition plan but one later adopter did.
4. All users depended on their suppliers for training, trouble-shooting and debugging services.

A summary of the approaches used by early users to the decision and preparation stage of the innovation acquisition appear in Exhibit II.

LATER ADOPTERS

The Nature of Each Industry

In each case, the nature of the industries did not change particularly between the time of adoption by early and later users. In the dairy industry there was no other electronically controlled machinery available in 1971. Similarly in the woodworking industry between the Woodbine installation of 1969 and the Meunier installation of 1970, no new alternatives came to the market. The woodworking industry, however, recently has seen more electronic machinery. Marcel Lalonde, General Manager at J.T. Meunier, said that there was a definite trend to electronically

EARLY ADOPTERS

Similarities and Differences in Machine Acquisition

Observation	Woodbine	Pierre	Simcoe	Similarities	Differences
Reason for acquiring manufacturing innovation	- needed increased capacity - had rip saw bottle neck	- gain competitive advantage and increase milk consumption	- declining labor quality - increasing labor costs	- situation in each case serious enough to necessitate action	- 2 production constraints - 1 market constraint
Decision Makers	President, General Manager	President, General Manager, Production Manager	Co-owners	- all high level decision and participation	
Machine Selection Criteria	- capacity to meet demand for next 5 years - emphasised specific needs (i.e., electronic skills)	- wanted reliability, good training and service - conducted test market of pouch-pack	- solve labor supply problem	- major criteria direct function of problem motivating the change -assumed supplier organized to supply training, start-up & troubleshooting skills.	- two users were concerned with maintenance & reliability, specifically in selection specifications
Maintenance and Operational Skills Available	- strong electrical and mechanical	- some mechanical - familiar with existing equipment	- mechanical with existing machinery	- all operated & maintained existing machinery effectively. - all felt supplier would provide addition skills needed	
Maintenance and Operational Skills Required	- modified operational - electronic	- new operational - electronic	- new operational	- all involved significant changes in the way things were done before - all aware of general needs but not specific - pro-acted on encouragement and direction of supplier	
Machines Available (including those chosen)	3 rip saws 1 was innovative 2 were fundamentally similar as existing	1 prover operational 1 other being developed	1 was self propelled and maintenance 1 other	In all cases potential performance of chosen machine appeared much better than existing alternatives.	

Similarities and Differences in Machine Accuisition

PRE-INSTALLATION:

Observation	Woodbine	Pierre	Simcoe	Similarities	Differences
Planning	- assumed any new techniques could be taught by supplier at installation	- depended on Chem Corp for installation and start-up	- relied on supplier for start-up guidance but knew machine was not particularly complex	- all made broad assumption about supplier based on the knowledge the user had of the supplier	-two knew of skill shortage, however did not act to alleviate it.
Lead Time	10 months	1 month for 1st unit 2 months for later 3 units	8 months		- long lead times because machines were built to order
Information provided	- layout drawings	-verbal communication - no manual	- verbal communication via visits to study machine being built - operation and maintenance manual	- all had absence of printed documentation - unavailable in all cases - more were insisted upon	- variable in need for such documents
Physical Preparations	- arranged utilities and plant lay-out	- set-up utilities and lay-out	- adjusted headlands - ordered 1 ton and 4 ton bins	- very little was done for training or start-up	- prepared for harvester because of nature of change in end product delivered to winery

controlled machines and that eventually he would need to hire an electronics maintenance specialist. In grape harvesting as in other forms of agriculture there is a distinct trend to mechanization. Although the mechanical grape harvesting is the most current grape industry innovation, Mr. R.L. Taylor, chief engineer at Cedar Machine Co. Inc., predicted that eventually grapes will be picked and crushed in the field. Right now, he added, it costs the grower more to remove grapes from the field than to pick them.

Size and Organizational Structure

Both Northern Dairies Ltd. and J.T. Meunier Inc. are small operations. Each have annual sales in the neighborhood of $3,000,000. Provincial Wines alternatively is a much larger company with annual sales of $15,000,000 in 1971.

Organizationally Provincial Wines Ltd. differs considerably from the other two. Provincial has two major operating divisions, grape growing and wine making. The grape harvester decision was made by the Director of Viticultural Research, the Vineyard Superintendent and the Winery manager jointly. On the basis of their evaluation and recommendation the Board of Directors gave final approval. The decision process was methodical with the three participants evaluating all aspects of the proposed acquisition and planning the change-over. The grape harvester was studied in the field before the order was placed, the participants corresponded with the manufacturer several times during construction and designed a built handling system. They worked both with the supplier and the independent grape growers to coordinate the acquisition of mechanical harvesters, tote bins, and the other hardware necessary for the changeover.

The organizational structure and decision process at J.T. Meunier and Northern dairies was less formal than at Provincial Wines Ltd. In both cases the principal owners of the company actively participated in the evaluation of machinery. They also made the final choice. Thomas Meunier, the company President and founder, accompanied by Marcel Lalande, the company treasurer, visited a woodworking machine show in New Orleans and there were first exposed to the rip-saw.

These two men consulted and visited a similar rip-saw installation together. Shortly thereafter Thomas Meunier decided to buy the Texas Woodworking Co. rip-saw. He was at the same time reorganizing the plant in order to achieve increased capacity. Thomas Meunier had in the past designed machinery for specific application, developed new window styles and examined proposed new machinery. Similarly at Northern Dairies Ltd. Mr Evens, the President, and Mr. Wilson its General Manager after having been exposed to various machine salesmen after the 12 months prior to 1971 discussed the available machinery and agreed that ChemCorp of Canada Ltd. offered the best alternative.

Approach

The way the late users approached the installation and start-up of particular machinery contains some worthwhile observations. The innovations had been installed in other plants to varying extents, however, they still represented a distinct and significant process change for the companies concerned. An exception to the definition of later adopters could be taken with the J.T. Meunier installation because that company took the second machine built ty Texas Woodworking Machine Co. Over one hundred of each machine had been installed when Northern Dairies Ltd. acquired the Prepac and Provincial Wines Ltd. acquired the grape harvester. For these users the machine represented new technologies to their respective businesses even though many other installations existed.

Similarities:

The late users all managed the acquisition of their new equipment in approximately the same way:

1. All decision makers were project participants and were principals of the companies or operating managers.
2. The skills available in each company were notably different than the skills required by the new machinery. This problem was overcome jointly with the supplier at the Provincial Wines Ltd. installation. On the recommendation of the Cedar Machine Co. Inc.

the management at Provincial Wines designed a new bulk handling system. Since many of the company's grape suppliers were independent the plan included training and educating the growers in the use of the harvesters and the changes in the ways grapes would be handled. The plan included visits and consultation with Cedar Machine Co. during the machine construction stage. At Northern Dairies Ltd. the company plant engineer attended at their invitation ChemCorp Technical Services Office for pre-installation training and familiarization. Note that in this case the training was proposed by the supplier.

3. In all cases physical preparation of the plant took place before delivery. For Northern Dairies Ltd. and J.T. Meunier Inc. this activity involved securing the space and setting up the tuilities. In the vineyards at Provincial Wines Ltd. some headlands* were adjusted and some trellis heights raised in preparation for mechanical harvesting. The equipment for the new handling system was also obtained (larger bins, tote-lift wagons, unloaders, etc).
4. All the late adopters had a choice of machines. Northern Dairies had four milk pouch making machines from which to select. The pouch produced by each was similar although the operating techniques varied. Three of the four were operating in Canadian installations. All but one had been installed in Canada with ChemCorp of Canada Ltd. had the most installed, more than any of the others. The Cedar Machine Co. Inc. harvester was the only available self propelled unit in 1971 but there was one other tractor-towed unit. Since 1971 another self-propelled harvester has become available. There were many rip-saws available at the time of the J.T. Meunier installation. None of the others offered the control features of the Texas Woodworking machine, however.

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* Land clearance at the end of the trellis rows to permit the harvester to turn.

Differences:

In each case the motivation for acquiring the new equipment differed. J.T. Meunier needed an increase in plant capacity, Northern Dairies Ltd. was under consumer pressure for an alternative to plastic jugs and Provincial Wines was interested in reducing the labour cost of the harvest. Otherwise the late users are noted for similarities in approach rather than differences.

Summary

In summary, several observations deserve emphasis. In the late user companies:

1. The decisions and preparations were controlled by the owners or the operating managers in each company.
2. Two of the three companies engaged in pre-installation planning and preparation. In one case both the user and supplier worked jointly. In the other the supplier initiated and carried out training of the plant engineer.
3. All companies engaged in some kind of physical preparation.
4. Only one user had a choice of available machines which operated in a similar way.

The approaches of the late users were similar. They all treated the machines as any other capital acquisition. A summary of these observations appear in Exhibit III.

EARLY VS. LATER ADOPTERS

We are examining the managerial decisions, planning and preparation for their new equipment made by the early and later adopters. In many ways the similarities in approach stand out.

All users, both early and late, used their normal policies and procedures for aquiring, installing and starting up manufacturing equipment. That the machines, in some cases, were newly developed and untested in their new environments did not alter the managers' approaches significantly. They were aware of the newness of the machine but depended on past success with their supplier's equipment or his reputation for service and reliable equipment to offset the risk.

LATE ADOPTERS

Similarities and Differences in Machine Acquisition

Observation	Meunier	Northern	Provincial	Similarities	Differences
Reason for Change	- rip saw bottleneck with increasing demand and limited capacity	- consumer pressure for alternate to jugs	- decline in availability and quality of hand labor - rise in labor costs	- situations sufficiently critical to warrant changes	- one production problem - one marketing problem - one labor problem
Decision Makers	President and General Manager	President and General Manager	Director of Viticultural Research, Vineyard Manager, Winery Manager	- all decisions and major participation came from high level management	
Machine Selection Criteria	- remove excessive personnel at bottlenecked rip-saw station - increased capacity	- reliable and swift service	- wanted to replace hand picking of grapes - insisted on special cowlings		- one true late user emphasised service (Northern) - one insisted on special features (Provincial)
Maintenance and Operational Skills Available	- strong mechanical skills	- stationary engineer with mechanical skills	- farm machinery mechanical skills	- all dealt effectively with existing equipment	
Maintenance and Operational Skills Required	- electronic - similar operational	- electronic - new operational	- new operational	- machines were a notable departure from the old or other ways of doing things	
Machines available	3 rip saws - all pre-select but only one innovation	4 - pouching machines, 3 with installations	1 self propelled 1 other not self-propelled		

LATE ADOPTERS

Similarities and Differences in Machine Acquisition

	Observation	Meunier	Northern	Provincial	Similarities	Differences
PRE-IMPLEMENTATION	Planning	- assumed problems could be handled at start-up - training would take place then because it always had been done that way	- stationary engineer went to supplier's office for 3 days of instruction - visited another installation	- prepare some vineyards to acceptable dimensions - developed bulk handling system (i.e. 3-1/2 ton tote lifts and 4 ton bins) - independent growers visited supplier for instruction		- two users engaged in preparatory training at supplier's plant - supplier originated
	Lead Time	10 months	1 month	8 months		- machines built to order had a longer lead time
	Information Provided	- communication with the supplier	- engineer went for instruction course with supplier	- frequent communication with supplier		
	Physical Preparation	- plant lay-out arranged to accommodate new saw	- utilities set-up	- implemented bulk handling system	- all prepared plant physically to some extent	

For the later adopters such dependence was more appropriate. For them training programs and service packages were better developed. We will enlarge upon this characteristic in the next chapter.

In all cases, both early and late, the decision makers and active participants were either the company owners or upper level managers. Although in some cases the ultimate authority was with a superior the effective selection rested with the operating managers. The absence of formal machine evaluation procedures and capital expenditure appropriations in the smaller companies is not unexpected and is characteristic.

Only Provincial wines had a formal acquisition plan. The change in the condition of the grapes when delivered necessitated closer scheduling and consequently improved materials handling. In addition, coordination with the independent growers was necessary. Northern dairies did not develop a plan as such although many of the training and familiarization functions in the pre-installation stage were initiated by ChemCorp of Canada. The preparatory efforts of all adopters suggests that there are two aspects to acquisition planning. Both the user and the supplier can each have a program for installation of new machines. The better the supplier's program the more reliance the user can place on him. In the cases of Woodbine Industries, Laiterie Pierre and J.T. Meunier Inc. Particularly the user assumed that supplier would provide many services (vis a vis documents, training, instruction). In fact these services did not materialize until after start-up.

One observation emerges about the availability of similar machines. The early users had only one choice. One later adopter had a variety of machines to choose from which performed similar tasks. The ostensible exceptions are all though the J.T. Meunier Inc. is an exception to our adopter definition there is evidence, according to the supplier, that alternative machines were available by 1972. The electronically controlled preselect rip-saw, although had no direct competition, was being offered in different models by Texas Woodworking Inc. for different performance requirements. Similarly by 1972 another self propelled grape harvester became available and was working in the vineyards of California.

Briefly for early and late adopters:

1. The early users tended not to have formal acquisition plans. The plans made by late users were both supplier and user originated.
2. The late users had a wider choice of alternatives.
3. All users had upper management participation in the evaluation, decision making and implementation of a new machine acquisition.
4. All users assumed the availability of service training, documents and instruction from the supplier.
5. With early users particularly very little active preparation was carried out for installation and start-up beyond arrangement of physical facilities.

This chapter has examined t[illegible] and preparation for the new equipment. The next chapter ex[illegible] experiences with start-up and debugging.

CHAPTER IV.

Start-Up and Operating Experiences

Summary of Findings

Depending upon the amount of pilot work, the nature of the innovation, the suppliers experience and policies and so forth, the early adopters of a manufacturing innovation starts his newly installed machine under a certain amount of uncertainty as to its initial performance. In Chapter III we noted the preparations made for start-up, operation and maintenance prior to installation by both customers and suppliers. In this chapter we examine their start-up and operating experiences. First we will examine early users, Woodbine Industries Ltd., Laiterie Pierre Ltee, and H.A. Simcoe Ltd., followed by late users, J.T. Meunier Inc., Northern Dairies Ltd. and Provincial Wines Ltd. Finally this chapter attempts to classify consequences according to early or late users and relate these consequences to the preparations made.

The task of equipment start-up ranges from simple turning on of a switch through to long complex procedures. A small standard drill press, for example, usually can be installed and operated successfully with no special effort or organization. On the other hand a steel rolling mill is usually started-up in stages with careful checking of individual control devices, conscious synchronization of related sections and several weeks of trial runs and operator training. Between these two extremes are many intermediate approaches which may be appropriate depending upon the characteristics of the specific installation.

The equipment in our sample represents by size and complexity a middle range. Each represents a manufacturing innovation with all its potential uncertainty of performance.

In chapter III we noted that all adopters, both early and later, for the most part prepared for the new equipments by preparing facilities to receive them. Little in the way of training or development of new operating and maintenance procedures took place. The managers in these companies tried to attain some assurance of good guidance in these matters through the selection of suppliers with good reputations. The subsequent experiences varied and in the following pages we describe in what ways they varied. First we examine the early adopter.

Some experiences were common to all adopters. In each case the supplying firm provided technicians at start-up to supervise and provide instruction in operation, maintenance and troubleshooting. The amount of time spent and kind of assistance provided varied, however, and will be discussed below. All users installed peripheral material handling equipment with the machine under study. In some instances the peripheral equipment also required subsequent development or improvement.

EARLY ADOPTERS

The length of start-up varied from one day for H.A. Simcoe Ltd. to several months for Woodbine Industries Ltd. In the latter case two years passed before we can say that all the initial debugging problems were completely resolved. In seeking factors that influence such experiences we looked to the service provided by the supplier, the amount of field testing, the equipment received prior to the installation and the procedures and organization utilized by the users to develop the expertise in operating and maintaining their new machine.

The start-up experiences of early adopters, unlike their pre-installation preparation, are more notable

for their differences than their similarities. Some reasons for the differences are apparent and will be discussed later. Five similarities stand out.

1. All early users installed some amount of peripheral equipment at the same time the innovation was being installed. At Woodbine Industries Ltd. special transfer conveyors and a unit called a "tilt-breakdown hoist" were needed. At the Laiterie Pierre installation tin-tieing machines were acquired for the pouch packaging process. H.A. Simcoe Ltd. acquired new grape bins to handle the increased production rates. These peripheral devices were ordered prior to the arrival of the main machines but were delivered at about the same time. All our early users needed additional equipment, particularly for materials handling, to support the new machine. In each cases there were no major difficulties with the peripheral equipment. The tilt-breakdown hoist was a widely used unit in the woodworking business, but at Dashwood Industries Ltd. a specially designed tier separator was also needed because of that company's particular raw materials storage system. Before the Laiterie Pierre installation the tin tieing units had been used on other packaging lines but not in dairies. After installation the company also discovered that milk pouches could not be packed in conventional wire cases because of the risk of puncture. Consequently, new plastic cases were acquired. For early users in general the peripheral equipment needed to make the new machine compatible with the existing operation

was specified early, usually by the supplier.

2. For all early adopters supplier technicians were present at the time of installation and remained through the initial start-up period. At Woodbine Industries Texas Woodworking Co. representative remained for three weeks. He adjusted and tested the rip-saw and gave company personnel operating and maintenance instructions. Similarly at Laiterie Pierre the ChemCorp people provided similar service for the initial two weeks. Perhaps because H.A. Simcoe was an early user only in Canada and his machine had extensive field tests prior to start-up, the supplier representative did not remain very long. He stayed only for the first day but was available on very short notice. At Woodbine Ltd. and Laiterre Pierre supplier representatives as well as ensuring their respective machine started adequately, also gave informal instruction to maintenance and operating personnel. Usually the plant maintenance crew worked closely with the technician. During start-up and debugging he pointed out possible troublespots and demonstrated methods of repair. At H.A. Sincoe such instruction was more limited. On the other hand the documentation of operating and maintenance instruction provided by Cedar Machine Co. was much more extensive than for the other early adopters. For these customers there was no formal instruction in electronics, for instance.

3. At our three early adopters most initial efforts at start-up were devoted to obtaining acceptable production rates. At the Laiterie Pierre installation much time was spent developing an effective way to package the quart pouches in threes. At the Woodbine plant the Texas Machine Co. technicians dealt predominantly with vibration and control problems. Although Cedar Machinery's technician emphasized operation of the grape harvester initially he specifically worked to achieve coordinated fan, conveyor and harvesting speeds for different grape varieties. The maintenance procedure and timing were also emphasized.

4. Many maintenance and operating techniques were developed on the job at the time of installation and start-up. As mentioned earlier the ChemCorp people dwelt at length on improving packaging techniques. An economic balance between Prepac output, tin-tieing machines and the number of operators had to be found. The skill at disassembling and adjusting the rip-saw was developed by the Woodbine Industries Ltd. personnel during and particularly after the start-up period. The self-development required of early users was necessary because many maintenance and operating techniques had not been firmly established by the suppliers at the time of installation. The degree to which this development takes place at an early installation depends, it seems, on the number of

previous installations experimental or otherwise of each machine. In our sample the number of previous installations varied from a low of zero for the rip-saw, to two for the Prepac machine to a high of seventy with the grape harvester. The degree of early user techniques development roughly corresponds to this spectrum.

5. In all cases there was evidence that the widespread expectations of the early adopters for start-up assistance and advice were not fully realized. There was no formal documentation provided until after the start-up at either Woodbine Industries Ltd. or Laiterie Pierre Ltee. In both those instances as at the H.A. Simcoe installation some operating and maintenance techniques were developed on the job. That is not to say that the user's assumptions were groundless, however. All the machinery suppliers sent skilled representatives to aid in the start-up phase but these representatives did not come as experienced as the users had expected. There is evidence that there is a noticeable gap between what the supplier feels the user can do and what the user thinks the supplier can do. This observation is similar in all early user cases. More pronounced is the difference in what the user expected and what in fact the supplier had. Laiterie Pierre Ltee. placed less emphasis on the technical state and the service package of the supplier than on the marketability of the product

because they felt such a large and reputable company as ChemCorp would be thorough and reliable. The management at Laiterie Pierre had not considered that ChemCorp was relatively unexperienced with the Prepac machine and that they had little exposure to the dairy business. Woodbine Industries Ltd. assumed they would get full documentation of the machine and that although the machine would be one of the first ones built it was a production model and not a prototype. At Cedar Machinery Inc. the engineers translated their awareness of user characteristics, gained from earlier experience with a previously developed bean harvester, into design improvements for operation, and maintainability. The Texas Woodworking personnel stated that the technical sophistication of their machines in some cases is several years ahead of the industries ability to operate and maintain them.

Early Adopters - Differences in Start-Up Experiences

The similarities in experience of early adopters are over-shadowed by the differences. The problems of start-up varied from very few to many. Given the similarity of approach we must look to other reasons for the differences.

1. The printed information (maintenance manuals, wiring diagrams etc.) available at the time of installation and start-up were limited for both Woodbine Industries and Laiterie Pierre. When H.A. Simcoe Ltd. took delivery on the other hand,

the maintenance and operation procedures were fully documented. Cedar Machinery had a policy of ensuring that operating and maintenance information in printed form was available for the first of any new machines they offer for sale. Over time, these instructions are improved as experience develops. Also, as we have pointed out, although H.A. Simcoe's installation was the first in Canada it was the seventieth grape harvester developed by Cedar Machine Co. over a period of three years. Thus the quality of the recommended procedures can be assumed to reflect this experience.

2. Each early adopter encountered a different degree of frequency and severity of start-up problems. At Woodbine the problems were many, varied and largely related to the machine's function. At Laiterie Pierre problems were fewer and were roughly an even mix between operating difficulties and maintenance problems. At H.A. Simcoe there were virtually no serious problems either in operation or maintenance. If we recall the two experimental installations prior to Laiterie Pierre's these experiences roughly correspond to the stages of development of each machine at the time of installation.

3. The extent and sophistication of the training given and required seems to be related to the stage of development of the machine also. The training required for the grape harvester was minimal but the machine itself was well

developed. At Woodbine and Laiterie Pierre the training needed was more extensive. Although all users recognized that significant training in some operational and maintenance areas was required non took upon themselves the development of specific training programs. They all assumed the supplier's technician would provide adequate training at delivery.

A summary of the installation and Start-up experiences of our early users appears in EXHIBIT IV.

LATE ADOPTERS

Like the early adopters the later adopters installed peripheral equipment and had the benefits of supplier technicians at start-up. Other similarities of experience occurred which were not shared with the early adopters. Specifically:

1. All late users had relatively smooth start-up experiences. All machines met required production schedules within reasonable lengths of time. At Northern Dairies the machine was running at full capacity by the end of the first week. The J.T. Meunier rip-saw was meeting production demands within the first three weeks. Among the later adopters J.T. Meunier's start-up took longer and had more functional problems to overcome. Written operating and maintenance instructions were not available to the same extent as for the other two. Relative to the other two later adopters, however, J.T. Meunier was early in the game. J.T. Meunier received the second rip-saw manufactured. Northern Dairies was about 100 on the list as was Provincial Wines. The grape harvester at

Early Adopters

INSTALLATION

Observation	Woodbine	Pierre	Simcoe	Similarities	Differences
Information Available for Assembly	- layout drawing - no manual or other documents - sub assembly drawings prepared internally - original layout drawings were inaccurate	- no drawings, no manual until several months later - supplier representatives on call	- complete operation/maintenance manual given at delivery - supplier representative available on call	- 2 had little support documentation	- only one with documentation because established technique and methodology had not been developed for the others.
Assembled by	- user initially with later supplier support	- supplier	- delivered assembled		
Peripheral Equipment	- tilt-breakdown hoist (standard piece) - tier separater (custom piece)	- tin-tier - standard piece not designed for such use	- new, bin sizes 1 ton and 4 ton	- all needed some additional equipment - process alterations required new materials handling or packaging or exhausting etc.	
Training and Re-training A) Operators	- width judgements fundamentally the same as before - supplier familiarized operator with width selection device - following station (cut-offs) no change but more of them	- performed by supplier at time of 1st and subsequent deliveries - spent time developing tin-tier technique	- supplier explained controls and delivery, also outlined in manual - had seen unit and been instructed at supplier's earlier during construction phase	- all suppliers provided some guidance - none gave formal instruction	- requirement and difficulty of training here depends on how much of a departure the operation is from what was done in the past.

Similarities and Differences in Machine Start-up

Early Adopters

	Observation	Woodbine	Pierre	Simcoe	Similarities	Differences
INSTALLATION	B) Maintenance	- initial outline of problem areas by supplier - most training on the job - no established technique	- by contract performed by supplier Quebec people monitored methods - no instruction on cleaning regularly and lubrication until later (steam cleaning problem)	- cleaning instructions emphasized - essential for reliable operation - designed for low complexity maintenance	- no formal instruction	- suppliers did not think of full range of possible problems - training done on the job and by exception
START UP	Supplier Guidance	- present for 1st 3 weeks to monitor operation. They instructed operation and maintenance personnel on use and troubleshooting. - suggested possible problem areas.	- present for first week for initial runs instructed operators and tested machine	- present for first day - no need to stay longer but always on call - could make limited recommendation on operating speeds	- supplier unable to give precise technique for maintenance (Woodbine, Quebec) or operating rate (Simcoe) because of information shortage (no historical information)	
	Problems and Modifications	1. vibration - severe and persistent - added legs to arbor support table 2. supplier replaced inadequate and faulty circuitry which was causing irratic performance 3. changed edger direction 4. bearing siezed - repaired by Woodbine people	1. Teflon wore out too quickly giving high leakage rate 2. developed means to package the pouches - experimented with different number of operators	1. Start-up co-ordination of various tractor and handling personnel 2. Co-ordinated paddle conveyor and fans speed to maximize yield - not described by manual because of variety and maturity conditions	- absence of specific operational procedures. - some methods had to be developed by users - debugging associated with problems with machinery itself vs. phasing machinery into existing operation - all suppliers expressed willingness to be called in event of any problems	

EXHIBIT IV (cont'd)

Similarities and Differences in Machine Start-Up

Early Adopters

	Observation	Woodbine	Pierre	Simcoe	Similarities	Differences
S T A R T U P	Problems and Modifications (Cont'd)	5. operating speeds reduced feed 250 ft/min to 200 ft/min blades 3500 rpm to 2400 rpm		3. Conveyor belt shrinkage Simcoe developed wetting method to solve problem supplier later changed belt fabric. 4. paddle breakage - changed to rods so then back to paddles 5. oil filter clogging - solved by removal	- predominantly functional problems arose	
	Repair and Trouble-shooting Technique Development	- learned by user on the job at start-up and in January 71 - taught by Texas Woodworking people during the 1st 3 weeks and subsequent visits - no general techniques were firmly established	- both supplier and user learned machine idiosyncrasies on the job - some outlined in manual which arrived later	- cleaning, adjusting and trouble-shooting methods described in manual - machine generally "rugged" - Simcoe ran to maximum then repaired if machine broke down	- technique learned on the job when problems arose	- harvester originally designed with maintainability in mind, thus not many new techniques were needed.
	Maintenance changes	- redesigned bearing housing, circuit boards, hydraulics for better maintenance - later changed circuitry to solid state	- started using water and steam cleaning then changed to dry methods because dampness affected circuits and seal quality	- cleaning critically important to effectiveness - outlined both by supplier and in manual - cost 50¢ per ton	- represent notable departure from past methods	- some methods are unproven and were developed because of problems - new skills not always needed but new methods were.

EXHIBIT IV (cont'd)

EXHIBIT IV (cont'd)

Similarities and Differences in Machine Start-up

Early Adopters

	Observation	Woodbine	Pierre	Simcoe	Similarities	Differences
START-UP	Maintenance Crew	- later re-organized around new director and	- remained the same	- remained the same		- management acknowledged at Quebec that high maintenance skills were needed -Woodbine felt they would need electronic personnel eventually
	Documentation: Provided Developed	not initially later with maintenance reorganization	not initially none	manual provided none		- an organization variable which the innovation acquisition did not affect
	Organizational Changes	- engineering department formed later	- none	- none		- organizational variable Woodbine was changing its organizational structure because of growth
	Duration of Start-Up	18 months	2 weeks	1 day		

Provincial Wines Ltd. was successfully harvesting by the end of the first day. Both Provincial Wines Ltd. and Northern Dairies had a few minor technical problems with the new machinery. On the other hand, J.T. Meunier had some significant difficulties with vibration and control circuitry. These problems were mitigated during 1970 when the machine was disassembled for repairs. During this time the plant was shutdown for five days. The problems experienced at the Meunier installation were less serious and persistent than at Woodbine. This apparent exception is more understandable when we remind ourselves that J.T. Meunier was the second user of the preselect rip-saw.

2. The supplier of the machinery in each case provided more specific assistance and advice on troubleshooting and repair procedures as well as operating techniques. The Provincial Wines installation illustrates the increase in operating information available. Howard Simcoe was present at the Provincial Wines Ltd. start-up to advise them on possible operating speed combinations for different varieties of grapes. The supplier representative had other experience with operating characteristics and was able to provide further suggestions. Reports were available on mechanical grape harvesting. By 1971 there was information available on other growers' experiences with the harvester both from the supplier himself and other users. ChemCorp explained more

clearly and emphatically to the Northern Dairy personnel the cleaning techniques for the Prepac machine. Since Laiterie Pierre's installation ChemCorp had acquired more experience in the dairy business. They realized that although more than one hundred Prepac machines had been installed by 1971, electronic controlled machinery was still new to dairies acquiring their equipment. The Texas Woodworking Co. technicians went into the J.T. Meunier installation with a greater awareness of possible problem areas. The Woodbine experience generated some modifications and changes in the machine.

3. Full printed documentation was provided to both Northern Dairies and Provincial Wines. J.T. Meunier did not receive an up-to-date manual installation. An operating/maintenance manual for the rip-saw was available by 1971 but cecame obsolete because of the frequent changes on the machine.

Late Adopters - Differences in Start-Up Experiences

Among the late adopters the most notable difference in start-up experience occurs when we compare J.T. Meunier Inc. to the others. J.T. Meunier Inc. encountered more difficulties and the start-up took longer. Since theirs was only the second rip-saw installed compared to about 100 for Provincials and Northern's installation these difficulties are understandable. The information available to Meunier at start-up, (eg. operating manuals, maintenance instructions) was less extensive than for the other later adopters.

In examining the experience of Northern Dairies and Provincial Wines it is interesting to note that both had organized start-up procedures. At Northern Dairies, the start-up was structured according to the supplier's recommendations. The ChemCorp representative ran water and milk tests while he gradually increased the production rate from 15 qts. per minute early in the first week to the recommended rate of 30 qts. per minute six days later. At Provincial Wines the activities of the first day of the harvest with the new mechanical harvester were coordinated by the winery not the supplier. Provincial's plan was important not only because mechanical harvesting was new to them but also because nineteen other machines were being started up at the same time and all supplied the Provincial Wines plant. It appears worthwhile for a user company to have a start-up plan but each particular situation dictates the extent to which the onus is on the user or the supplier. Either way a less successful result, according to participants in each situation, can be expected if there is no plan or procedure at all.

A summary of the experiences of late adopters appears in Exhibit V.

Early Versus Later Adopters

The most important experiences to compare are those of the early and later adopters. The previous analyses serve to assess the uniformity (or lack of it) of experience of early adopters and then later adopters. We have seen that the uniformities are not as general as one might originally expect. Some interesting differences occurred which eventually must serve to elaborate the conceptual framework for describing and evaluating technological strategies.

EXHIBIT V

Similarities and Differences in Machine Start-up

Late Adopters

	Observation	Meunier	Northern	Provincial	Similarities	Differences
INSTALLATION	Training (Cont'd) A) Operators: (Cont'd)		- used well established tin-tier technique	- familiarization to place earlier		
	B) Maintenance	- given on the job during start-up	- some instruction initially - preventive maintenance done by supplier (by contract)	- specifics verbally outlined but also explained in manual		- only one got solely "on the job" training - others had some form of formal instruction
	Manpower	2 supplier representatives 2 company personnel	1 supplier representative	1 supplier representative		
	Peripheral Equipment	- tilt breakdown hoist - planer - conveyors	- tin-tier machines (3)	- 3-1/2 ton tote lift bins - 4 ton winery bins - continuous unloader (at winery)	- all required some amount of handling and support equipment - none was new or complex	
START UP	Supplier Guidance	- 2 supplier representatives present for first 2 weeks - suggested possible problem areas - operator and maintenance instruction - tested system	- supplier representative for first week - ran water and milk tests to test system	- American representative present for first day but on call afterwards	- all had supplier representative for some length of time	- not all tested machine fully in user situation (at Provincial it was not necessary.)

EXHIBIT V
(cont'd)

Similarities and Differences in Machine Start-up

Late Adopters

	Observation	Meunier	Northern	Provincial	Similarities	Differences
S T A R T U P	Problems and Modifications	1. lamps, wiring were loose initially. 2. vibration initially present and got worse 3. Supplier changed edger-blades configuration 4. December 1971 changed arbor - plant down for 5 days	1. no major problems, start-up was phased in 2. after two shift operation began (1 yr later) quality problems arose	1. Conveyor belt shrinkage problem - developed roller adjustments to mitigate 2. paddle breakage - delivered with rod arms changed to paddles 3. minor problems with handling system 4. harvesting speeds developed on the job with advice from Simcoe	- all had relatively smooth start-up - problems did not arise until farther downstream and were maintenance related	
	Repair & Trouble-shooting Technique Development	- developed on the job in December 1971 when arbor was replaced - supplier guidance provided during 2 visits - used telephone extensively in finding and solving problems	- achieved familiarity quickly by studying supplier preventative maintenance and user's manual - sealing and control adjustments were well proven	- maintenance manual outlined major repair methods - machine designed to ease maintenance	- some techniques were well established so that they could be easily taught	- less development required on Northern and Provincial than with Meunier
	Maintenance Procedure	- circuitry changed to solid state at users' request and expense	- cleaned daily for first year but when the 2 shift operation began it was reduced to 1 day/week - performance problems arose.	- some minor improvements with accessability and protection, mud guards, cowlings etc.	- maintenance procedures were well established for Northern and Provincial	

Similarities and Differences in Machine Start-up

Late Adopters

	Observation	Meunier	Northern	Provincial	Similarities	Differences
START UP	Maintenance Procedure (Cont'd)	- major overhaul each year		- unit washed twice per day		
	Documentation	- maintenance manager maintained a diary on problems, parts and repairs	- no records kept before or after - user felt supplier was keeping records	- records contained number of parts replaced - recorded operating costs		- two users began documentation as a consequence
	Organizational changes	- none	- none	- none	- no changes made in organization (i.e. new people or systems)	
	Start-up duration	- 2 weeks	- 1 week	- 1 day		

EXHIBIT V (cont'd)

Start-Up

Generally, later adopters had quicker start-ups and fewer "bugs" with which to contend. J.T. Meunier did not experience the major breakdowns that Woodbine encountered. Northern Dairies took less time to reach trouble-free consistent operation than did Laiterie Pierre. Provincial Wines had fewer cleaning and adjusting problems than did H.A. Simcoe. These differences existed and should not be ignored even though the differences among the early adopters and among later adopters were in some instances sometimes greater than those observed above. We will discuss the implications of this apparent paradox in the following chapter.

Similarly the amount and quality of information on equipment operation and maintenance were better for the later adopters than the early adopters.

For some early adopters no printed instructions were available at all at the time of start-up. For the later users and particularly those who adopted more than two years after the first unit was sold (anywhere) the information available was much improved. The same conclusion holds for the number and quality of technical and service personnel available for the suppliers.

The design and construction of the individual machines were different for later adopters from those of the early adopters. Later in this chapter we will discuss the evolution of those changes. For the moment we will note that the changes took place and that a correlation existed with improved machine function and reliability.

In chapter III we noted that the preparations for installation and start-up made by our sample companies were in general, very similar and regardless of early or later adoption. After start-up some changes in company

organization, operating and maintenance methods and control procedures did take place. Some of these changes reflected direct experience. Others occurred at the advice of the supplier. The early adopters tended to make changes in the light of experience. Woodbine Industries hired more experienced maintenance personnel and enlarged their maintenance records. Whereas Laiterie Pierre revised their cleaning methods after the equipment developed problems, Northern did so on the advice of ChemCorp. Similarly Provincial Wines were able to use H.A. Simcoe's experience and Cedar Machineries advice to develop equipment cleaning and servicing techniques.

In general six observations can be made concerning the start-up experiences of our sample companies.

1. The frequency and severity of problems during start-up are notably higher with early adopters than with late. These problems seem to be more related to machine function than to machine maintenance. As the number of installations increased, the start-up problems became more maintenance oriented.

2. The start-up period was longer for early adopters than for later adopters. While start-up can be defined in many ways for our purposes it is the length of time required to achieve acceptable production rates.

3. There was significantly less printed documentation in the form of operating and maintenance manuals, wiring and circuitry diagrams available both before and at the time of early adoption.

4. Our early users had to develop more operating and maintenance techniques on the job than late users.

5. The start-up procedure (trial runs, testing, debugging, etc.) was less structured with early adopters than with later adopters.

6. Maintenance crew and operator training required seems to be the same in general for both early and late users. In our cases studies the machine was new to both the industry and the particular company. The opportunity for addition training other than with the supplier (vis a vis visiting other installations on their own) in the cases of late adopters is, of course, higher. The supplier originated training available seems to increase for later users as well as improve in quality because of the increase in supplier's experience with other installations.

These experiences indicate that the kinds of problems encountered by early adopters differ from those of the later adopters. Our investigation into the development and improvements to the innovation made by the manufacturers is consistent with this observation.

Manufacturer

In the innovations studied some similarities in the patterns of development stand out. The problems encountered in the beginning by the manufacturers and the early adopters centred on machine function. At Texas Woodworking problems of vibration and chip build-up led to changes in the design of the arbor, the edger

operation and the control circuits. At ChemCorp and their early installations problems of pouch sealing and of development of a "tear-away" spout existed.

As time passed and equipment function became more consistent machine improvement shifted toward improved reliability and ease of maintenance. Texas Machinery has moved to solid state electronic controls for improved performance reliability. ChemCorp is using more stainless steel for case of cleaning and has developed designs that allow quicker and easier access for servicing and adjustment. Cedar Machinery has made changes to reduce the probability of machine jamming and parts breakage. The nature and timing of machine and service modifications are outlined in Exhibit yI A, ß, and C. In Exhibit VII these changes have been classified and plotted. In each case the proportion of changes in the service package offered by the manufacturer plus improvements in machine reliability and maintainability improve over time.

Such trends are not difficult to understand. For a new machine containing substantial innovation one would expect that initial problems and efforts would center on machine function. This proportion can be influenced by the supplier's development policies, of course. Cedar machineries policy of having printed operating and maintenance instructions available for the first machine manufactured shows in Exhibit VII.

For Texas Woodworking and ChemCorp such policies were more difficult to achieve. Electronic controls were new for Texas Woodworking and devclopment of maintenance and operating procedures progressed with field experience. Similarly ChemCorp's experience with milk processing was limited at the time of their first installations. Development of machine maintenance

Texas Woodworking Machine Inc.

Changes in	Woodbine 1969	Meunier 1970	Post 1970
Function	1. changed & adjusted control circuits 2. arbor tolerances tightened 3. vibration problems, added legs to reinforce.	1. tolerances improved 2. right-hand feed saw 3. two piece arbor construction changed.	1. arbor mounted edgers- self storing blades - edge without ripping - improved exhaust system 2. chain feed saw to greater control of lateral shift, thus more precise cuts 3. 1971 - reservoir built into base - stability, thus less vibration 4. greater manufacturer in plant testing
Maintenance & Reliability		1. training emphasis on "why and where" troubleshooting vs. using established techniques (such techniques had not been developed)	1. new edger design simpler, less drive and sawduct hoods. Improved access of blades. 2. solid state circuitry - integrated and modular. 3. paper tape system replaced by electronic solid state 4. control panel indicated mismatch and source of trouble 5. 1971 oil mist lubrication system on all models.
Service	1. inventor spent as much time as was needed to get saw working satisfactorily	1. For the first two weeks the manufacturer's representative was present. 2. Maintenance and operation manual provided	1. group participation service package - 1972 - areas established and service visits cost $112.50 + expenses - number of participants would not be profitable but effective 2. representatives had improved knowledgeability (i) send customer installation diagrams and checklist (ii) when user ready he called Texas Co. and they sent a representative for the start-up (iii) stayed for as long as required (iv) recommended parts Future Plans: 1. more thorough training with some emphasis on electronics. 2. more manufacturer testing B-4 deliveries. 3. develop highly reliable and foolproof equipment. 4. spectrum analysis to test tolerance 5. new arbor configuration - simpler and more reliable, easy to service etc.

Equipment Design and Construction Changes
Cedar Machinery Inc.

Changes in	Before Simcoe	Simcoe	Provincial	After Provincial
Function	1. early prototypes for Geneva trellising 1966 cost $70,000 each. -spoked but rimless wheel, independent drives adjustable levels, 4 wheel steering. 2. Smith's paddle design for conventional trellising 1966. 3. bucket catching system - changed to collector leaves 4. change 2 piece to 1 piece lower conveyor.	1. rod beater introduced vs. flat paddle	1. new power plant (Ford to International) 2. hydrostatic transmission gave greater control of forward speeds.	1. change construction of conveyor belts. 2. hydraulic height control of lower conveyor. 3. hydraulic control of side conveyor 4. new paddle design and spring loaded harnesses
Maintenance and Reliability	1. developed some methods to deal with belt shrinkage- did not know why problem occurred. 2. removeable panels around fans and conveyors. 3. hydraulic motor relocated for serviceability.		1. mud guards and shields added.	1. new cowlings and shields. 2. change in paddle arm drives
Service Package	1. vineyard specification published 65. 2. manual revised annually. 3. parts depots set up. 4. guarantee 1 year.			1. developed more firm program for bulk handling system. 2. greater specification for operating characteristics because of greater experience with varieterial variation

EXHIBIT VI (B)

Equipment Design and Construction Changes
Chem Corp of Canada Ltd.

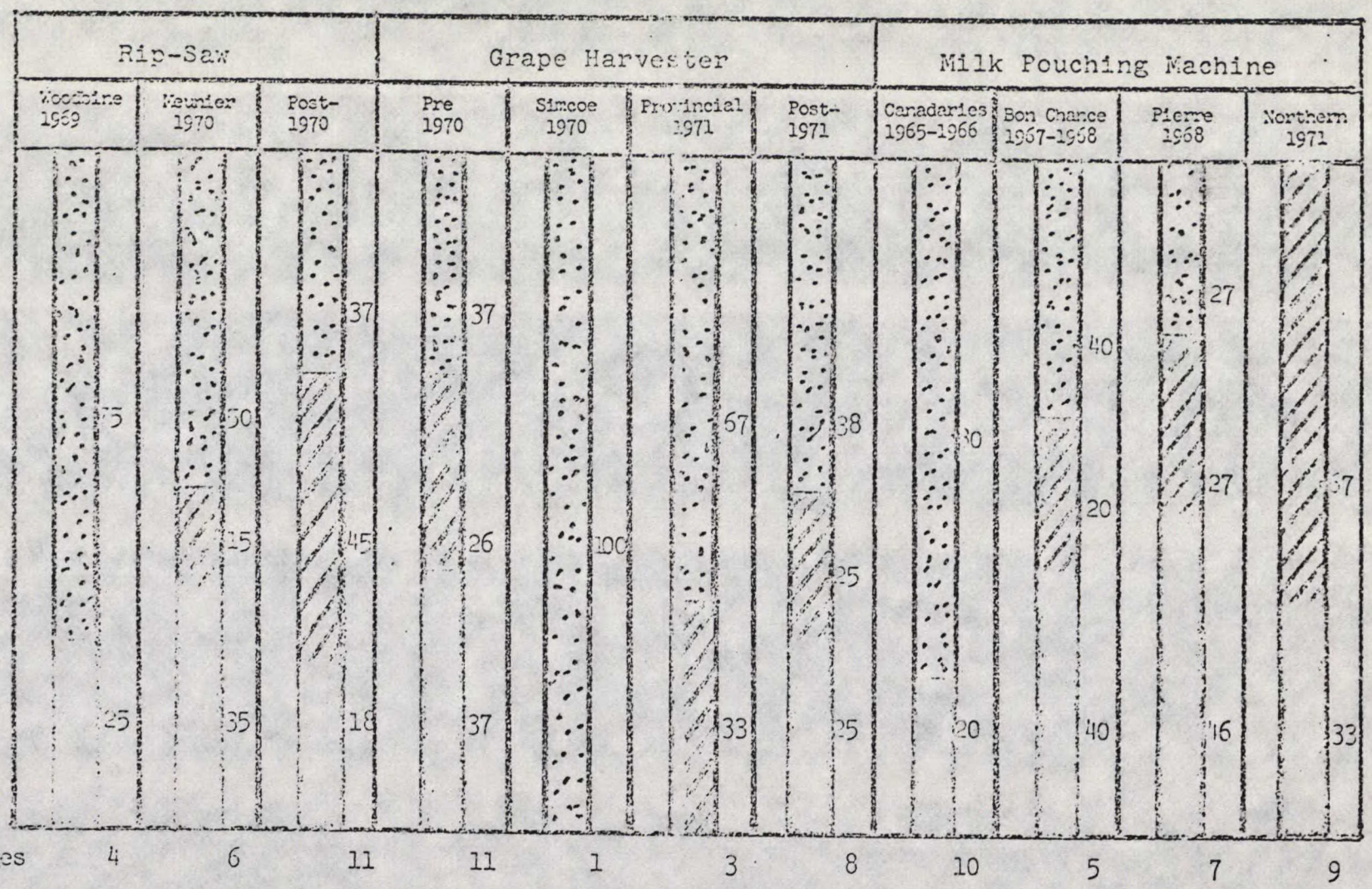
Changes in	Canadairies 1965 - 1966 9 months	Laiteric Bon Chance 1967 - 1968	Laiterie Pierre 1968	Northern Dairies 1971
Function	1. jaw cooling configuration changed 2. fly knife blade changed 3. sealing relay circuit. 4. film type 5. spout tab 6. pneumatic lubrication 7. packaging 8. achieved 150 qts/hr	1. removed spout on pouch 2. replaced jaw blade with heat wire arrangement.	1. developed packaging method. 2. studied building a packaging machine	
Maintenance and Reliability		1. change heat wire diameter for easy replacement.	1. first operation/ maintenance manual arrives late. 2. cleaning techniques and sensitivity to moisture established	1. recommended parts list available 2. hinged jaws 3. placement of film roll. 4. pneumatic lubrication changed 5. controls simplified 6. roll advance teflon tape
Service	1. representative there for 9 months. 2. total of 4 people on Prepac Project.	1. 4 people total in department at ChemCorp 2. little service needed.	1. user experience with electronic machinery improved 2. supplier's experience with the dairy business improved 3. 8 people involved (total) at ChemCorp.	1. start-up support includes ChemCorp training program and installation team. 2. service - on - call system - 7 days/24 hrs. 3. better knowledge of dairy business.

EXHIBIT VI (C)

EXHIBIT VII

Supplier Modifications made at/for each Installation

(Plotted %)



	Rip-Saw			Grape Harvester				Milk Pouching Machine			
	Woodbine 1969	Meunier 1970	Post-1970	Pre 1970	Simcoe 1970	Provincial 1971	Post-1971	Canadaries 1965-1966	Bon Chance 1967-1968	Pierre 1968	Northern 1971
Total Changes	4	6	11	11	1	3	8	10	5	7	9

Service Package Improvements

Machine Changes for Maintainability

Machine Changes for Function

features and customer service packages understandably were somewhat dependent upon the acquisition of such information.

This chapter raises a host of questions. We wonder could some of these characteristics have been anticipated? Could the users prepared better? Could some problems have been avoided? What effect did the nature of each organization have? Which strategy was more successful? Why? Could any have been more successful? We have examined what the early users did, what happened to each as a consequence and from this assembled some common factors. The following chapter will attempt to evaluate the significance of our observations.

CHAPTER V.

Interpretation of Results

The Question of Strategy

Should a company consider an "early adopter" strategy for manufacturing innovations? To some extent this question implies a choice which may not exist. For the manufacturer who needs additional capacity or who can wait no longer to replace equipment waiting for an innovation to prove itself may not be feasible. He must choose now and if he does not choose the innovation the opportunity to consider it again in the medium term will only occur if:

(i) future sales growth requires additional capacity.

(ii) the innovation is so profitable that the new machine chosen instead becomes economically obsolete.

(iii) existing equipment fails.

Outside of the above three conditions if the innovation is not adopted now the user will not have another opportunity to consider it for several years.

Thus the adopter is sometimes not able to substantially shift the timing of an acquisition and the early versus later choice of strategies is not a real one. Even within this restriction, however, manufacturers do have choices. We can therefore examine the implications for the early versus later adopters of specific manufacturing innovation.

The Equipment Cycle

In each instance the later adopter of each innovation studied received an improved machine compared to the early adopter. The amount of improvement varied, of course. The history of each innovation confirms that improvement had continued in each case up to the time of interview and gave every indication of continuing. Thus the later adopter of an innovation can expect to install a machine that is an

improvement on that which he would have installed if he had adopted earlier.

In chapter 4 we showed that the early design changes on an innovation emphasized improvement in function. Better sealing of milk pouches was an early concern of ChemCorp, for example. As time passes the emphasis shifted. Equipment reliability and maintainability were improved. Ease access, adjustment, cleaning, servicing, trouble-shooting and repair characterized the majority of later improvements. Thus in comparing the experience of early and later adopters of the three innovations studied the greater the time interval between early and later adoption the greater the number of differences in machine features were found.

The choice, therefore, is not between this machine now or later but between this machine now or a better machine later.[1] Generally, waiting will provide the user with a more reliable, more maintenance free, easier to service machine. In some instances he may expect different models from which to choose and an opportunity to select equipment more specific to his needs. Thus the decision to delay the adoption of a particular innovation usually offers more than uncertainty reduction to the user. He will often gain an improvement in machine function, reliability and maintainability also.

The results of chapters III and IV indicate other differences between the early and later adopters' experiences. The information, technical backup and training offered by the supplier is likely to be better for the later adopter than for the earlier. The pressures of developing, manufacturing and debugging the early versions of an innovation

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[1] This statement assumes no intervening development of a different machine with the potential to obsolete the one under consideration - sometimes a reasonable possibility.

may inhibit the ability of the supplier to commit resources to development of operating and maintenance manuals, service personnel and training courses. Later adopters are more likely to receive such services. This generality is not always true, however. The manufacturers whose policies include concurrent development of technical services will have them available for the first user as well as later ones.

The Early Adopter

The manager who chooses to be an early adopter of manufacturing innovations faces the possibility of particular problems not faced to the same degree by the later adopter. In any specific instance several factors influence what he may expect. They are:

1. The Technological Step. New technologies are likely to experience more start-up problems than extensions of existing technologies.
2. The experience of the supplier with a given technology influences the problems to be expected. If an innovation incorporates an existing technology but one new to the developer, initial problems may be more numerous. This generalization seems to be especially applicable if electronic controls are used for the first time.
3. Conversely the user's experience with the technology of the incoming equipment is a factor in start-up success. Again the first machine utilizing electronic controls could pose troubleshooting problems. An electrician without an electronics background does not usually cope effectively.
4. The experience of the supplier in the user's industry affect the expectations a user may reasonably use. Particularly if the innovation requires a change in user operating procedures the risk rises, lack of

supplier experience in the buyer's industry signals careful start-up management.

The preceeding factors suggests a selective approach to equipment acquisition. For the individual manager the decision to be an early adopter of a manufacturing innovation should depend on his assessment of (i) the machine. (ii) the supplier's policies. (iii) his own operating and maintenance policies, procedures, and organization.

ExhibitVIII illustrates the interaction of these factors. In general high supplies expertise in his product technology and the user's industry encourages early adoption. So does high user expertise in the equipment technology. When the opposite is true later adoption becomes more sensible.

Early Adoption as a Policy

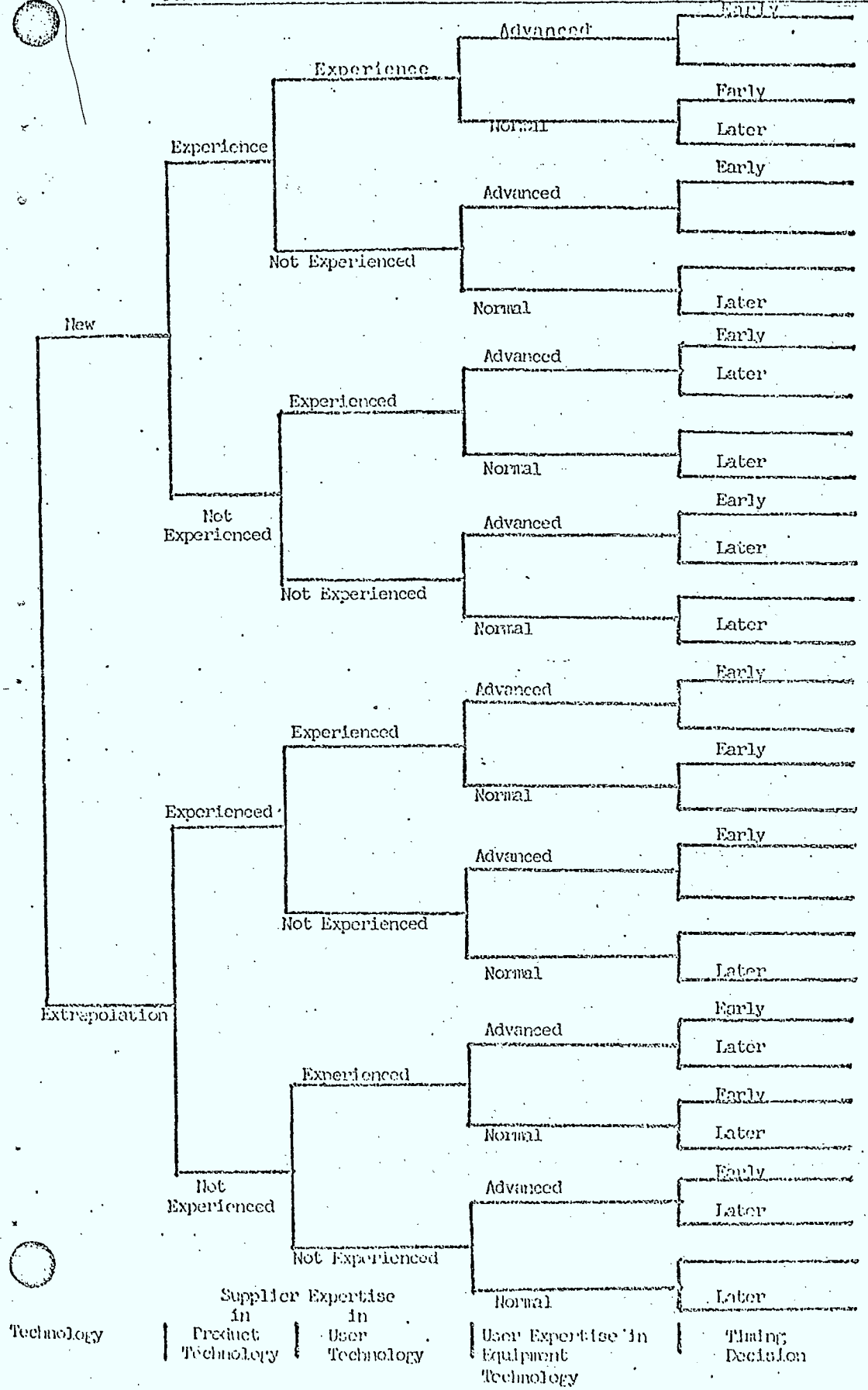
The preceeding analysis suggests that each company choose early or later adoption depending on evaluation of several factors. What are the implications of a consistent "early adopter" policy?

In this instance the risk of operating and maintenance problems depends on the specific circumstance. One can see, nevertheless, that in particular instances the risk of encountering significant problems would be high. Then the user must depend on his own abilities to start-up and debug equipment. Similarly he must assume a greater training responsibility.

Depending upon the frequency of equipment acquisition and the size of the individual installation such early adopters should carefully manage the whole acquisition and start-up process. At each of the following stages options are

EXHIBIT VIII

FACTORS AFFECTING THE TIMING OF THE DECISION TO ADOPT AN INNOVATION



Appropriate Decision Indicated. Where Both Early and Late Indicated Choice Will Depend On Analysis Of Specific Situation.

available which increase the likelihood of successful start-up and operation.

1. Equipment Specifications.
   Include details to reduce maintenance and increase reliability.
   Have operating and maintenance personnel participate in drawing up specifications.

2. Choice of Supplier.
   Check on availability of operating and maintenance manuels, training courses, experience with your operating procedures and problems.

3. Activities during Build Period.
   Chick for impact of acquisition on your operating procedures and organization.
   Monitor production of your machine.
   Consider use of tests in supplier's plant prior to shipment.

4. Installation and Start-up.
   Ensure that relevant information collection and analysis procedures exist. For example, data on breakdowns and their causes often useful in identifying chronic problem areas.
   Ensure that training is done. Avoid dependence on technical personnel who are machine rather than operation oriented.
   Look for problems that need equipment re-design for solution.

The late adopter can usually depend upon equipment improvements and supplier experience to aid in start-up and operation. For him less organization to anticipate or resolve equipment problems is necessary. To obtain the

competitive benefits from early adoption of manufacturing innovation as a policy, the user must consider development of organizational and procedural skills beyond those of the later adopter.

Canadian Aspects

None of the innovations studied are manufactured in Canada. Each is sold through a manufacturer's agent. The role of the agent in the process of acquisition and start-up varied substantially. ChemCorp, through field and laboratory trials, spearheaded development of the equipment to suit Canadian dairy operations. In the other two cases the Canadian representative provided little technical or service assistance. Our sample is too small to generalize but the ability of specific manufacturers' representatives in Canada to aid in adoption of new technologies should certainly be checked carefully by the prospective user before choosing a particular machine. Our results suggest that even for later adopters the manufacturer will be the prime source of technical assistance and service.

The Smaller Manufacturer

With one exception (Provincial Wines Ltd.) top management were actively involved in the assessment, acquisition and start-up of the innovations studied. In most instances they, at one time or another, operated and repaired their machines. These examples stress the relative lack of staff support in the smaller manufacturing company. Most companies are shallow in engineering and maintenance personnel. In several instances in the study acquisition of the manufacturing innovation lead to hiring of additional crafts or professional skills and/or expansion of information and reporting systems.

These conditions emphasize the need for thorough evaluation of adoption policies. All of our sample companies assumed that their suppliers would provide organized technical support and service. For earlier adopters such assumptions proved optimistic. Thus the small manufacturers who is one of the first to adopt a manufacturing innovation should first carefully assess his own technical resources. He may need to either expand his staff or to acquire technical services from consulting or engineering firms.

Summary

This study does not answer all the questions posed in Chapter I. The limits of sample size precludes generalization. The results do show that simple rules of thumb will not serve when significant manufacturing innovations are being adopted - even for the late user. At a minimum careful assessment of the suppliers' resources and policies for new product introductions is needed. Too often engineering and management expertise are incorrectly assumed. When the variable of user size is expanded to include larger firms the problem becomes more complex.

More research into the interface between users of manufacturing innovations, the Canadian representative (if imported) and the manufacturer is needed to establish the conditions under which the user must operate. If the generally accepted assumption holds that the pace of technological change is rising, then small users in particular will need advice and direction on ways to proceed. For him one particular machine may substantially influence his competitive stance. Without the large market and opportunities for specialization competent management of manufacturing facilities acquisition, start-up and maintenance will be an important factor in successful operations.

TECHNOLOGICAL INNOVATION STUDIES PROGRAM

PROGRAMME DES ETUDES SUR LES INNOVATIONS TECHNIQUES

REPORTS/RAPPORTS

	AUTHOR(S)/AUTEUR(S)	UNIVERSITY/UNIVERSITE	REPORT TITLE/TITRE DE L'OUVRAGE
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6.	F. Zabransky J. Legg	School of Business Administration, University of Western Ontario.	Information and Decision Systems Model for PAIT Program, October, 1971.
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9.	J.W.C. Tomlinson	Faculty of Commerce and Business Administration, University of British Columbia.	Foreign Trade and Investment Decisions of Canadian Companies, March, 1973.
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11.	I.A. Litvak C.J. Maule	Department of Economics, Carleton University.	A Study of Successful Technical Entrepreneurs in Canada, September, 1972.
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13.	Carl Prézeau	Faculté d'administration, Université de Sherbrooke.	The Portfolio Effect in Canadian Exports, May, 1973.
14.	M.R. Hecht J.P. Siegel	Faculty of Management Studies, University of Toronto.	A Study of Manufacturing Firms in Canada: With Special Emphasis on Small and Medium Sized Firms, December, 1973.
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