THE ASSIMILATION AND IMPACT OF INFORMATION TECHNOLOGY ON LOGISTICS IN CANADA,

by

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BA(Hons), Wilfrid Laurier University, 1991

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN BUSINESS ADMINISTRATION in

THE FACULTY OF GRADUATE STUDIES Faculty of Commerce and Business Administration Department of Transportation and Logistics

We accept this thesis as conforming to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

May 1994

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Abstract

This thesis reports the findings of an examination of the logistics function within six Canadian Food manufacturers and the process they undergo to assimilate new logistics information technology (IT) into their organization. Specifically, this thesis postulates that there are four phases to the assimilation process:

1. The Initiation Phase
2. The Adoption and Implementation Phase
3. The Management and Control of Information Technology
4. The Impact of Information Technology

Within each phase, there were a number of steps that were examined. Since the sample of companies for this project was small, these recommendations can only be applicable to those in the sample. However, the findings could form the basis for a larger study.

Within the sample, one company was found to have closely followed the four phases outlined below with cost savings equivalent to four times their investment in IT. Another company in the sample was beginning to follow these same phases. The remaining four companies have yet to follow the four phases and thus successfully expand their IT base. Below is a summary of those steps that one company followed that lead to their success.

1. The Initiation Phase

The company began the search for IT with a plan or strategy derived from a centralized logistics function within their organization. This plan is based on what their needs are and the needs of their customer. A particular person who understands logistics is assigned to the task of finding the right technology for the organization. Technology that reduces costs and increases productivity is sought out. However, no special budget or allowance was set up to assist in the search.
2. The Adoption and Implementation Phase

Once the IT is chosen, the company begins to redesign their logistics flows to meet the demands of the new technology. They begin to introduce the IT to small selective groups within the logistics function. While senior management is involved with the process by providing the appropriate resources and maintaining the proper focus, users of the IT drive the process. Responsibility for the implementation of the technology is shared between the logistics and information systems functions rather than one centralized IT group. Benchmarks are set up to allow for a before and after analysis. Any barriers to adoption are dealt with on a daily basis.

3. The Management and Control Phase

The company also set up extensive logistics measures to indirectly monitor the performance of the IT within the logistics function. Tight controls are also set up within their organization to effectively manage the IT properly once it is put into place.

4. The Impact Analysis Phase

Once the IT was implemented and being used daily by the company's managers, a formal post implementation audit was performed to ascertain the effects the logistical IT is having on the company and the marketplace they compete in. The company took steps to gather information to learn from past mistakes to not only assist in improving the assimilation process but also to repeat it as well.

These steps are only a summary and the thesis provides the detailed findings from the case interviews of the six companies. A detailed set of recommendations is provided as well as further areas of research are defined in order to help in bringing new technology into logistics and to expand the body of knowledge on this increasingly important topic.
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Acknowledgments

I would like to thank the following people:

To Garland Chow who was the person who was the key for the successful completion of my degree, for my success at UBC and for getting my thesis done.

To thesis committee members Trevor Heaver and Chris Hane of UBC and Vincent Harel of United Parcel Service of Canada Ltd. for their insightful comments and assistance while I conducted my research.

To the people of United Parcel Service who gave me the financial support and the resources to complete my thesis and my degree while also teaching me how to balance the often overwhelming demands of graduate school with the high demands of work.

To Len Hendrickson for his always insightful comments during the entire process.

To David Gillen for telling me about the logistics program at UBC and helping me get into the program originally.

To the Social Sciences and Humanities Research Council of Canada whose research funding made this thesis possible.

Finally, and most importantly, to the Good Lord, the Lord of Hosts, who has given me all I have and who gives me my primary duty in life: to fear God and keep his commandments.
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Dedication:

I dedicated this thesis to the following:

First, to the Good Lord, the Lord of Hosts, who gives me wisdom and strength:

"Trust in the LORD with all your heart and lean not on your own understanding; in all your ways acknowledge him, and he will make your paths straight." Proverbs 3:5

Secondly, to my Parents, Wayne and Norma Anderson, and to my Uncle and Aunt, Dr. Harvey and Ethel Anderson, whose support during my university career has been unfailing.
1. Introduction

1.1 Background

Ever since the advent of the first computer, the information revolution has slowly gained momentum. Today, as Michael Porter so aptly put it:

"The information revolution is sweeping through our economy. No company can escape its effects. Dramatic reductions in the cost of obtaining, processing, and transmitting information are changing the way we do business. Most general managers know that the revolution is under way and few dispute its importance." (Porter and Miller, 1985)

With such a revolution, organizations, in order to survive, let alone profit, must learn how to deal with such change. The same is found within the logistics function. Not only must the logistics function look for ways to compete, the logistics function must also learn how to use information technology to implement those methods. As John Parker, Chief Information Officer of Sea-Land Service, Inc. stated in a speech in 1991:

"...Sealand is an information network on which we hang transportation assets such as ships, trucks, trains, warehouses, depots and offices... {We compete in a} global market [that] holds far too many variables and they change too rapidly to say with any real certainty. But we can say with certainty that information technology(IT) will be at the core of the world's strongest players. It will create some big winners in this decade - just as it has in the last.

Those winners will be the companies that understand the wiring of the business, and they will have injected the right technologies at the right points. They will have spread access to technology up, down and across the organization. And they will have carefully prepared people to lead and to use that technology. They will be lean, flexible and fast. They will sense change in their markets early, and they will have the agility to react in time to make a difference. They will be able to do that because when change comes - and we know it will - (they will be able to react appropriately). IT access means not reorganizing companies, it means reprogramming companies." (Parker, 1991)

Such statements are powerful. They create many questions as to what will happen in the future and what companies have to do to become successful.
1.2 Objectives

Such statements make it evident that IT is and will continue to play a very important role in logistics. However, as Parker indicated, logistics managers still have to figure out the role IT will play and when it will play it. The managers in the 1990's and beyond must have a plan in place to assimilate IT into the logistics chain efficiently and effectively to maximize positive impacts.

This study has two objectives: define a process Canadian companies can use to successfully initiate; adopt and implement; and manage IT; and then determine the effects IT has had and will have on the firm and the marketplace.

These objectives are based on two premises:

1. Firms successfully initiate, adopt and implement, and manage IT only through a preset plan.
2. Once this plan or strategy is carried out, there are positive benefits accrued to the firm and its marketplace.

There are three sets of questions that are asked within this study in order to fulfill both objectives; the first two fulfill the first objective, the third fulfills the second objective. The questions to be asked are the following:

1. What is information technology and what type of logistics technology does it include? What are the current trends emerging in the world of information systems/technology for logistics?

2. How do successful companies reprogram themselves to perform logistics functions and achieve their logistics objectives? How do they determine their competitive strengths and then successfully adopt, implement and manage information technology to leverage those competitive strengths into logistical advantages? How do they organize themselves in light of this new technology in order to perform the logistics function and achieve overall logistics objectives?

3. What are the effects of this new technology on both the firm and the marketplace after companies reprogram themselves to achieve logistical advantages? How are market interactions changed? What and when are the benefits obtained and where are they felt?
In order to answer these questions and to see if the above premises are correct, an interview program was used to test a number of hypotheses that are presented in Chapter 4 of the project.

1.3. Importance of the Topic

These questions are important from a research and management point of view for a number of reasons. First of all, Rogers, et. al.(1991) summed it up with the following quote "One important question . . . is how the deployment of information technologies fits into the decision making context of the firm, and how those technology selections fit into a firm's logistics strategy. Firms must determine the process that needs to be followed to ensure the acceptance and successful implementation of technology."

Current research in the field has led to some normative theories in the 1980's on ways companies can assimilate information technology but has failed to lead to a positive theory of what type of assimilation process is carried out in Canada today. Many authors in the logistics literature, management information systems (MIS) literature and even the general management literature have put forth various frameworks for companies to follow in order to successfully harness the power of IT and bring IT into their organizations. There have also been studies indicating some the things leading edge companies do to adopt IT. However, there is a lack of research on the assimilation process in logistics, in particular, how it is actually carried out and what steps are to be followed. No formal survey or exploratory research has been done to determine what occurs in practice or to explain the path companies are taking in their quest to harness the benefits IT is suppose to bring.

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1A normative statement is a statement about what should be done. A positive statement is a statement about what is (or was) or about how something works.
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Secondly, current research has yet to properly determine how beneficial information technology is. There have been studies indicating firm specific benefits but there has been limited research on the impact IT is having on today's logistics. What impact new technology makes is still under debate in the field. Thirdly, the research to date has yet to offer some insight on how information technology should be managed once it is implemented. Adoption suggestions abound that highlight some of the barriers that must be overcome to successfully assimilate IT. However, knowledge and ideas are missing that suggest ways companies should implement and adapt logistical IT to their organizations as well as how logistical IT should be managed once it is implemented. Finally, the literature today has failed to explore the full impact of information technology on both the companies that adopts IT as well as on the marketplace. While the MIS literature is only beginning to address this issue, the logistics research community is far behind in terms of identifying the impact and value IT really has.

1.4 Thesis Outline

The thesis is organized as follows:

1. Chapter two provides a review of the literature to date on the initiation, adoption and implementation, management and impact of information technology on logistics today.

2. Chapter three describes the theoretical framework to be used in the research.

3. Chapter four reviews the design of the research.

4. Chapter five provides a description of the companies and the industry.

5. Chapter six analyzes the findings from the interviews.

6. Chapter seven provides a summary of the project including recommendations and areas for further research.
2. Literature Review

Information technology is widely discussed in today's business literature. It is a subject that is vast and is growing larger with each passing day. The first step in surveying this literature is to properly define IT.

2.1. Information Technology Defined

The definition of information technology is typically comprehensive and includes different types of information related technology. Most people understand that logistics management is concerned with the planning, implementation and control of the movement of physical objects and associated information. (Droge and Germain, 1991) However, what makes up the information technology to move this information? Porter (1985) argues that

"...IT must be conceived of broadly to encompass the information that businesses create and use as well as a wide spectrum of increasingly convergent and linked technologies that process the information. In addition to computers, then, data recognition equipment, communications technologies, factory automation, and other hardware and services are involved."

While this definition does identify the general realm that information technology covers, it does not provide a specific enough base from which further research can be conducted. Fortunately, Droge and Germain (1991) as well as Geisler and Hoang (1992) offer definitions that do. Droge and Germain (1991) define IT as the following:

"Information technology consists of computer software, electronic data interchange (EDI) telecommunications and data-handling hardware. Software, EDI and hardware are the three pillars of the information revolution..."

Geisler and Hoang (1992) also offer a definition of IT. While somewhat similar to Droge and Germain (1991), it still offers differences that are considered appropriate. In their definition, they group IT into five categories:

1. Computer systems, hardware
2. Computer systems, new applications software
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3. Computer systems, maintenance software
4. Telecommunications systems
5. Emerging technologies, such as voice pattern recognition.

From the above, it can be seen that a definition is required that is broad enough while still not so all encompassing that it is too abstract.

The definitions for information technology and logistical information systems that are used in this thesis are ones that draw from a booklet written by Richard L. Dawe entitled *The Impact of Information Technology on Materials Logistics in the 1990's*. In his book, the term logistics information system (LIS) is used to describe the subset of the overall business management information system (MIS) that focuses on producing the information flow required to manage the logistics process. This is done by turning relevant data into logistics information. Data are defined as "facts or figures from which conclusions can be drawn." Information is defined as "data that has [sic] been endowed with relevance and purpose." A management information system is defined as "an interacting structure of people, equipment, methods and control, which is designed to create an information flow that is capable of providing an acceptable base for management decisions."

In terms of functions, MIS serves three basic purposes: 1) by transforming data into information, 2) by storing data until it is required and 3) by transferring data among users. Thus, by substitution, a definition for a logistical information system (LIS) would be an interacting structure of people, equipment, and controls involved in the logistics process, which creates both an internal and an external information flow capable of providing an acceptable base for logistics decisions.

Therefore, from these definitions, information technology can be defined as "the hardware and software that collects, transmits, processes and disseminates data in an organization" (Dawe, 1993). In turn, information technology in logistics (including both hardware and software) can be sub-divided into three categories, corresponding to the three
purposes and the three islands of technology referred to by the definitions of MIS and IT. These three categories are: (1) data collection and storage technologies, (2) data communications technologies, and (3) data processing technologies. These categories or "islands of technology" are a result from classification made in earlier years: data processing (i.e. data and processing), office systems (now viewed as departmental systems versus central information services) and telecommunications.

IT is one of the six basic building blocks of any information system that includes input, output, models, data bases, and controls. Furthermore, IT, probably the most evident of the blocks, is the "toolbox" of the information system that binds the system together. The overwhelming contemporary challenge for today's logistics manager is the need to integrate the abundance of information technologies available into the logistics chain. That is discussed in the following sections.

2.2. Information Technology: Beginnings, Trends and Outlooks

The concept of using information for competitive purposes has been widely recognized for years. However, the actual documentation of this concept can be traced to Michael Porter's works in the 1980's. In his groundbreaking works *Competitive Advantage: Creating and Sustaining Superior Performance* (Porter, 1985) and *Competitive Strategy* (Porter, 1980) Porter argues that technological change is one of the principal drivers of competition. It plays a major role in industry structural change, as well as in creating new industries. However, information technology is only important for competition if it affects a firm's competitive advantage or industry structure.

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2It is interesting to note that this challenge is primarily a management issue, not specifically a technical issue.
He argues that the basic tool for understanding the role of technology in competitive advantage is the value chain. As seen in figure 1, technology development is one of four interdependent support activities that bring a product or a service to the customer. IT can profoundly affect each primary activity in the value chain. IT can improve the company's effectiveness or it can add value by affecting the firm's competitive advantage. Since technology is embodied in every value activity and is involved in achieving linkages among activities, it can have a powerful effect on both cost and differentiation. Thus, by reviewing its value chain, each company determines how it can effectively compete within the marketplace by using IT.

Porter further postulates that information technology transforms not only the firm's competitive ability (i.e. low cost or differentiation) but also its value chain. This is because of the fact that information technology now makes plentiful something that was rare to executives in the past: information. This new resource, in turn, transforms not only the company's products but its processes as well. (Porter, 1985)

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3Porter's strategy for competition is based on the idea of competitive advantage whereby firms either lower their cost structure or employ some methods to differentiate themselves from their competitors.
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The change in products and processes leads to changes in the basis of competition. It not only changes industry structure but also provides a powerful levering tool for creating new competitive advantages and for spawning new businesses.

It is from these works by Porter that the research in information technology for competitive purposes began. Other authors began to study IT and its effects, offering insight into how trends were evolving as well as what was to come. Jeremy Shapiro at the Massachusetts Institute of Technology expanded on Porter's work by offering a summary of what was occurring in business in terms of information technology. In particular, he suggested that there is a dialectic of the information revolution emerging. The information revolution began with the thesis that the manager needed to acquire, store and organize large quantities of data quickly and accurately and that depending on the manager's responsibilities, the data required may refer to the company's operations, markets, the activities of its competitors or trends in the industry and the economy. (Shapiro, 1991)

As time progressed, however, the information revolution quickly reached a state that Shapiro calls the antithesis of the revolution that is characterized by the following:

1. There is an overabundance of data for the purposes of managerial decision making.
2. The manager does not know what the data in his corporate database imply about competitive strategies.
3. The firm is not organized to allow competitive strategies based on information and analysis to be easily communicated and implemented.4

Shapiro argues that with this state of antithesis, a new synthesis is required to allow managers to overcome the above deficiencies. The new syntheses that are emerging are many, according to Shapiro. However, he offers two. The first is to develop and use advanced decision support systems. The second is to adapt the firm's organizational structure to

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4 These competitive strategies are ones that allow the company to offer is products at lower costs than its competitors or to differentiate its products from those of its competitors. Shapiro argues that cost competition is the one most relevant to data collection and analysis and thus his presumed thesis.
promote identification, communication and implementation of competitive strategies based on integrated planning.

James Robeson(1988) built on this concept of the revolution by attempting to forecast, on the basis of a survey he performed, what might occur as this information revolution continues. In the future, Robeson concluded that with the rapid proliferation of information technology, servicing customers and supplying products would change dramatically as a result of firms increased ability to handle and control information captured by IT. Secondly, Robeson concluded that electronic data interchange would becoming increasingly important. Finally, Robeson foresaw that with emerging IT, there would be an improvement in the timeliness and completeness of the exchange of information between channel members.(Robeson, 1988)

With this concept of a revolution underway, Robert Neuschel (1988) provided a general outline of some of the general demands that would be placed on logistics management in the 1990's as the revolution continued. They were better carrier-shipper relationships, becoming a low-cost producer; using the computer; developing a total-cost approach to logistics; and re-orienting the organization to customer service. Neuschel theorized that these demands will subsequently change how companies formulate strategies and how they manage change. He also argued that the management that can truly harness the power of IT will gain a significant competitive edge. Neuschel concludes that no company involved in transportation or distribution can be a leader without such mastery of the computer.(Neuschel, 1988)

Bowersox(1989) put Neuschel's arguments to the test by examining what leading edge logistics organizations are doing. In his study of 695 companies, he found 117 leading edge firms that had similar traits in terms of IT. Each of them is characterized by a significant use of data processing technology and enjoys a high quality of information system support, each
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has a state of the art computer application and is planning more updates and expansions, and each is involved in new technology such as electronic data interchange (EDI) and artificial intelligence (AI). Furthermore, these organizations have formal planning processes and are strongly committed to IT deployment. They understand that information is the key to successful logistics management and that information that is specific, timely and high quality only comes from proper IT management. (Bowersox, 1989) As Bowersox states,

"Leading edge firms are closer to the cutting edge of technology. They view the use of information and technology as a way to gain competitive superiority. Leading edge respondents are early adopters of technology that offers cost reduction potential. They are also concerned with implementing technology to enhance revenue generation. Leading edge firms have learned to use information as a strategic resource (and)... they are ahead of the pack in all areas of technology adoption. It is safe to conclude that the leading edge firms are leaders in testing and adopting new technology." (Bowersox, 1989)

Bowersox found that leading firms report an average of two to three EDI applications, which is significantly greater than normal firms. (Bowersox, 1989) Furthermore, these firms continue to rank IT as the most important issue to firms today (Bowersox, et. al., 1993)

A report by Kurt Salmon Associates Inc. (1993) had similar findings to that of Bowersox. In their study of efficient customer response (ECR) programs in the grocery industry, Kurt Salmon Associates found that the leaders in the grocery industry had developed an IT investment program to support efficient customer response. Kurt Salmon Associates stated that the companies with the strongest IT capabilities will establish a clear competitive advantage over other companies. Those companies leading the way in ECR foresee an almost paperless, fully integrated business information system linking them to their business partner within five years. (Kurt Salmon Associates, 1993)

However, while IT might be widely accepted by some practitioners and companies as a key component for being competitive, there are still questions about how IT is being accepted throughout the entire logistics function.
Gustin, in his study in 1989, updated again in 1993 (1993b), provided a detailed examination of the status of logistics information systems in American business. In his study, Gustin found that the following had happened over a five and ten year period.

1. While progress continues in automating logistics data, the rate of computerization has slowed and numerous opportunities still exist for increasing automation.

2. Difficulty continues in implementing integrated logistics; in fact no significant progress in successful implementation was observed during 1982-1993.

3. Information needs remain substantial for most logistics areas, especially for customer service, sourcing/purchasing, logistics management and logistics control. Furthermore, the greatest need is for operational data (versus strategic) while more interfacing is required between marketing and manufacturing.

4. System support priorities are also relatively unchanged during the last ten years. For instance, support has improved for sales forecasting and the interfaces with marketing, manufacturing, and other logistics units within the company. While the greatest need is for operational data, the greatest gap exists in providing strategic level information.

5. Impediments to successful system implementation have remained similar during the last 10 years, most important are conflicting priorities, MIS and economic resource limitations, and lack of management support.

6. Information needs and system priorities differ significantly

7. Larger companies generally report higher levels of systems performance as compared to smaller firms.

8. Levels of system satisfaction depend more on the magnitude of systems budgets than on increased allocations from existing budgets...at least in the short term.

9. Companies with integrated logistics operations report higher levels of information availability and systems satisfaction than non-integrated firms; however, costs of logistics operations and associated systems are no different for these firms.

10. Companies with centralized logistics operations report higher levels of systems satisfaction and lower logistics costs than firms that are not centralized; however, logistics information system expenditures for both types of firms are comparable.

Dawes and Rogers (1993) found similar results to that of Gustin. The initiation, adoption and implementation of logistics information technologies today is still not complete and is, in fact, downright slow. They concluded that with this slow initiation, adoption and
implementation rate, an information gap was developing. This gap was the differential between installed and available IT. Furthermore, since logistics managers were sometimes reluctant to or unaware of new IT, this gap is growing wider. (Dawes and Rogers, 1993)

Dadzie and Johnston (1991) also found similar results in their study of corporate warehouse logistics. While overall automation in warehousing hovered around 30%, individual areas were wide ranging from horizontal movement within the warehouse at 64% to inspection at just 10% thus indicating a gap in the amount of IT being implemented throughout the organization. What was also of interest is that with the automation process came organizational change; adaptation programs had to be implemented, workers had to be re-trained and jobs re-structured. Furthermore, the authors found benefits were in line with expectations, especially in terms of accuracy, speed of service and service consistency. As well, the implementation decision came from top management and logistics professionals in these organizations with this decision being based on cost of acquisition and maintenance; and on potential benefits in customer service and operations. Finally, they found that factors that affect IT adaptation are the workers' attitude towards automation, inventory requirement under just in time (JIT) technology and concerns about cost and competition. (Dadzie and Johnson, 1991)

These results were not limited to the U.S. Canadian studies offer similar results. A study by Jamieson and Radford Consultants for Transport Canada indicated that while firms have adopted some information technology, their adoption has been slow and will continue at the same pace for the next 5 years. Current computer applications in Canada focus primarily to manage the availability and supply of goods while future plans focus on distribution activities per se. Nevertheless, technology within logistics in Canada is found mostly in internal administration rather than operations and services. EDI and routing/dispatch technologies are virtually non-existent.
A recent study by KPMG's Thomas and Lynch (1994) sheds further light on the Canadian situation. While IT is being initiated, it is being adopted and implemented in varying degrees. Warehouse management systems, distribution requirements planning (DRP) and EDI are well entrenched but bar coding and radio frequency is still slow to take hold. What is particular interest in this study is the reasons why IT was chosen and IT's particular benefits. Respondents indicated that IT was adopted primarily for better customer service, higher productivity, lower inventory and good payback. Furthermore, the study concluded that IT not only improved order accuracy and space utilization but also reduced labour costs. (Thomas and Lynch, 1994)

With such benefits and gaps arising and new trends emerging, one begins to beg the question of what is in store for the future.

A.T. Kearney (1992), in a recent study performed by them, suggests that companies are just starting to invest quite heavily in logistical IT. Over 60% of the companies surveyed indicated they are using or plan to develop EDI links with suppliers and customers, to put in bar coding technology and expand personal computer use. Furthermore, the same number plan to invest quite heavily into various planning and operational information systems. (Kearney, 1992)

Mentzer (1993), building on the research of past studies and insights, reviewed and researched the trend towards increased use of information technology. Noting that the rate of technological innovation in logistics shows no sign of decreasing, Mentzer concluded that technology has not only improved the effectiveness of many logistics functions, but has also helped make logistics a competitive tool. With the advent of powerful communication technology that makes available a wealth of information to all levels of managers, there will be a dramatic change in how management looks at the problem of managing the supply chain and channel relations.
James Perry (1991) makes a similar conclusion to Mentzer but sees some problems as well. Perry begins by noting that the advances in sophisticated information technologies that have marked the 1980's will expand and diversify in the next decade. However, he also notes that advances in microelectronics, telecommunications, materials and materials processes along with increased use of robotics and automation will have a dramatic effect on logistics in 2000. While technology improves, a gap is appearing between the technological development and the ability to translate such development into successful logistics applications. As technology changes the nature of logistics organizations, the fit between people and technology remains a major issue. (Perry, 1991)

Perry (1991) sees other implications arising from these technological trends. One is with the movement of more sophisticated products. As these product movements grow, the demands on the logistics support process will increase. Another is with the changes in materials technology and methods technology. Such changes will mean that logistics systems will be supporting products made from new materials as well as adopting automation and other new methods in order to improve productivity and to meet growing support responsibilities in an increasingly competitive market environment. Finally, the IT revolution will allow for substantial improvements in all elements of the logistics process.

Perry (1991) concludes with the observation that in order to understand, appreciate, and exploit IT, it will be extremely important that the logistics organizations of the year 2000 have individuals who are not only technically competent in the technology itself but who have the functional vision to develop those applications most appropriate to improving the firm's logistics systems. As he stated:

"The environment facing logistics managers in the next ten years will be more dynamic and explosive than the period of the 1970's and 1980's. Technological advances will continue the trend to more complex and more integrated products, systems, and equipment... the increasingly complex technology imbedded in systems and equipment will mandate greater co-ordination of supply, transportation, and maintenance planning, policies and activities. The global economy will be
characterized by increasing competition, based not only on costs but, increasingly, on customer service. The logistics systems and managers of 2000 will be asked to do more with less in this more challenging customer-support environment. These customer-service requirements will mandate a more flexible, more responsive logistics structure and will require logistics managers with the vision and breadth of systems knowledge to exploit available technology. (Perry, 1991)

This literature review indicates the general consensus between both scholars and practitioners that there is a dominant trend towards more information technology and the increasingly important role information technology will play in the logistics field. IT usage is expanding at an ever increasing rate. However, as Dawes and many others indicated, there is an information gap emerging between what is being developed and what is being implemented. In order to bridge that gap, companies must learn how to effectively assimilate IT into their organizations.

The above trends only emphasis the growing importance of IT in logistics. The key issue now for logistics managers is how to bridge the information gap being created in their companies. The next section will review what has been suggested by various scholars as an effective strategy for information technology assimilation.

2.3. The Initiation Process

The initiation of new technology is of constant interest to management. While some may call adoption the first step in company re-programming, others may consider it the first stride required to remain competitive in the fast paced business world. As Bowersox (1989) has stated,

"The utilization of advanced information technology is firmly ingrained in leading edge firms. Leading edge firms have more data processing applications than less advanced firms and plan to significantly enhance their capabilities in the future. They are also more deeply committed to the future use of EDI and to the research and development of knowledge based/artificial intelligence.

A distinctive feature of leading edge adoption of new information technology is the manner in which advancements are implemented. Leading edge firms seek to exploit
new technology by undertaking systematic change. This normally means the reconfiguration of policy, procedure and the process to take maximum advantage of new technology. This innovative technology application is contrast to the more typical approach of putting new technology into a pre-established and somewhat restrictive process. To illustrate, whereas a typical firm may adopt some feature of EDI to improve speed or accuracy of a phase of order cycle management, a leading edge firm is far more likely to totally revamp their entire order cycle to exploit linkage technology. While North American firms tend overall to be slow adopters of new technology, leading edge firms are head and shoulders ahead of the pack."

With this idea in mind, many authors in the literature have offered advice as to how a company should begin to successful initiate information technology into an organization. A few of the more well known methods are discussed below.

Porter(1985) suggests five steps executives can take in order to profit from information technology. They are:

1. Assess information intensity: evaluate the existing and potential information intensity of the products and logistic processes of its business units.
2. Determine the role of IT in industry structure: examine how IT might effect each of the five competitive forces.
3. Identify and rank the ways in which IT might create competitive advantage: identify the value activities that are likely to be most affected in terms of cost and differentiation.
4. Investigate how information technology might spawn new businesses: consider opportunities to create new businesses from existing ones.
5. Develop a plan for taking advantage of IT: use the above four steps to create an action plan to capitalize on the information revolution.

While these steps are quite valid and offer a way one can determine a company's competitive strengths, Porter's framework still does not offer detailed steps to initiate information technology. What is required is to first determine how a company's initiation process is formed before determining an appropriate adoption and implementation path to take.
Droge and Germain (1991) suggest that the initiation of IT by an organization is influenced by whether the mission and strategic plan of logistics are formalized. In particular, this means that:

"... Management has thoughtfully designed appropriate goals for logistical operations and designed a method by which to achieve such goals. This may translate into the funneling of financial and human resources into logistics MIS to meet approved objectives. Both formalisation and participation by the senior logistics executives in business unit strategic planning may mean that an effort is made by senior management to integrate logistical concerns into the broader strategic context of the business unit."

Neuschel (1988) makes a similar suggestion, although more tactical in nature. He recommends that when initiating IT, managerial leaders must first think fundamentally about the nature and characteristics of the operation to be planned, managed and controlled before moving to the adoption and implementation phase. Questions that need to be answered include what is the end purpose of the activity, what are the key factors for success that need to be managed and controlled, what is the basic kind and amount of data necessary to plan, control and evaluate the operation; and, finally, what are the simplest and most direct process techniques for managing the activity?

One suggestion that is of particular interest is made by Cash, McFarlan and McKenney (1992). They suggest that to succeed in the initiation phase, companies need an informal management structure that allows for considerable flexibility. This hints of an almost decentralized structure for IT, something that may be contrary to that suggested by Gustin (1989, 1993b).

Lucas Introna (1991) suggests that IT is something that must be carefully integrated into the business. This means that IT must be designed to add value to the firm and must be designed on a pre-determined set of IT requirements outlining how the IT should be structured and integrated. Again, this is similar to Bowersox (1988) and Gustin (1993) that a formalized planning system for IT assimilation is required.
Finally, Dawe and Rogers (1993), as other scholars mentioned above, suggest that successful initiation of IT begins with an imaginative understanding of its customer needs (i.e. through surveys), its competitors' products and competitors' service offerings (i.e. through benchmarking). This continues with a key understanding of the firm's goals and priorities. Finally, a firm understanding of current logistics processes completes the phase.

In summary, there is some consensus but also some disagreement on what is required for successful initiation of IT into a firm. It is from the above discussion that the following research questions arise:

1. Does the rate of IT initiation in logistics increases with the formality of a logistics mission and strategic plan as suggested above?

2. Does a better understanding of a firm's logistics environment assist in the initiation of IT?

3. Does a particular type of logistics structure affect successful IT initiation?

4. Who is in charge of such a initiation process for logistics?

5. Does size play a role in such initiation?

While this list is not exhaustive and comprehensive, it does raise some basic questions that need to be answered in the initiation phase of IT.

2.4. The Adoption and Implementation Phase

Once IT is initiated, it must be adopted and implemented throughout the organization. This adoption and implementation process is often complicated and very difficult to complete. However, some authors have created adoption and implementation methods while at the same time highlighting some of the barriers that may arise during this phase of the assimilation process.
Geisler and Hoang (1992) identify five decision points in the adoption and implementation of IT:

1. Establish or articulate the need for information technology
2. Establish or determine which unit(s) will receive the new or modified IT
3. Select the technology
4. Select the suppliers
5. Authorize and sign off.

Donald Burke (1993) suggests that if one is considering to adopt and implement IT, there are a certain number of "do's" and "don't's" to follow. The "do's" including the following:

1. Get a consensus of your goals after you've discussed your needs.
2. Flow chart the current process
3. Postpone automation until you redesign your current processes where necessary.
4. Start by fixing a small but annoying problem to win friends.
5. Structure the project so there are visible payoffs along the way.
6. Try out rough prototypes of new systems to get early feedback from the people who will use them.
7. Settle for 80 percent solutions.

The "don't's" include:

1. Set vague objectives
2. Design the project to minimize internal conflict
3. Giving project management to a technically skilled person that is a poor negotiator
4. Leaving technology for last since you will then overlook opportunities to use it.

Lucas Introna (1991) also points out that while adoption and implementation of IT to optimize the total system maybe better with a top down approach, successful integration of new IT might make more sense to implement from the bottom up since the corner stones of the process are learning and adapting. The people thus involved can learn from implementing less complex processes and then make a "technology transfer" to the next higher level.
Furthermore, Introna suggests that commitment to the implementation process by all parties involved is critical for its success. As he concludes, "IT is not a coincidental add-on ... the process of integrating IT into business systems... (as well as) the degree to which operational people support and accept IT will determine its success."

Dawe and Rogers (1993) suggest that once the initiation (where competitive position and customer needs are determined) phase is complete, an adoption and implementation team must be set up that understands the organization's priorities in order for IT implementation to be successful. In particular, a clear understanding of the business's vision is required to ensure that each adoption and implementation step is a building block to the future as opposed to being a change in direction. As well, various barriers must be overcome including the cost of IT, the lack of personal resources, IT complexity, lack of technical expertise and lack of financial resources.

Closs and Frankel (1992) made similar observations in their research to Introna (1991) and Dawe and Rogers (1993). They concluded that a senior level management committee to "champion" the implementation was required along with a person with a strong user background who could solicit user communication and could provide adequate training. Furthermore, they indicated that impediments that will occur during the implementation process would be cultural (where people can't easily change to a system that requires more planning on their part or where people don't understand the new process the technology creates and thus don't trust it), perceived benefits (users don't understand how it will help the firm) or technology base (incompatibility of current systems to new systems).

Like the initiation phase, there are many suggestions as to how the adoption and implementation phase should be carried out. While some offer specific steps, others offer some general guidelines. They give rise to some basic research questions:

1. Are logistics processes redesigned and if so, how?
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2. Who drives the adoption and implementation process in logistics?

3. Does a particular type of logistics structure affect successful IT implementation?

4. How is new IT implemented?

5. How is the adoption and implementation process managed?

Again, while this list is not exhaustive and comprehensive, it does bring to light some to basic questions that need to be answered in the adoption and implementation phase of IT.

2.5. The Management of Information Technology

Once IT is adopted and implemented, the company must determine how it will manage this new IT. Many authors suggest many paths for such a process.

Cash, McFarlan and McKenney(1992) recommend that firms must not only have a proper plan to adopt and implement IT but also ways to manage IT as well. As they state, "different organizations must adopt quite different control approaches, which then must evolve over time to deal with a changing corporate environment, changing strategic role of IT and changing technologies." This means that changes in the organization structure must occur; that evolution of the uses of IT to ones not originally considered begin; and, most importantly, that the development of precise controls to guide the design and management of systems that use IT (to ensure that later applications can be done more cost efficiently than earlier ones) are put into place.

Ballou(1992) makes the same argument. He states "Logistics plans may be made and implemented, but that alone does not ensure accomplishment of their intended goals. It is necessary to think in terms of another primary function of management. This function is control - the process where planned performance is brought into line, or kept in line, with desired objectives. The control process is one of comparing actual performance to planned performance and initiating corrective action to bring the two more closely together, if required."

Johnson and Wood(1993) build on this by stating the following:
"In the process of designing a logistics system, the need to control the system must not be overlooked. Indeed, the control mechanisms must be built into the system, and their effectiveness must be continually monitored...they must be employed to keep a firm's position from worsening. In a competitive world with small and sometimes shrinking profit margins, applications of tight controls may allow a firm to maintain its position while competitors fall behind."

Johnson and Wood(1993) thus, emphasize the need for logistics managers to implement tight controls to allow for the proper management of logistics technology and to ensure success in the marketplace. According to these authors, tight day to day controls play a vital role in the short term survival of the firm.

However, the level of control is one that is still debated. As Earl(1989) has indicated, Tom Peters and Bob Waterman(1982), in their book In Search of Excellence, popularized the notion of tight-loose balances in management. Therefore, according the Earl, in pursuing controls for logistical IT, the emphasis should be on loose before tight. Performance measures as also a concern. As Lois Tullo(1992) stated, "IT is a business within a business and it must be managed in much the same way as any asset that has an impact on a organization's process. To do this properly, it is essential to develop a chart of accounts for IT investment and to have reliable, consistent rations, measures and benchmarking comparison."  

Carlson and McNurlin(1992) make a similar argument. They state "not only is top management giving measurement increased attention, but I/S management needs to respond by understanding how to quantify I/S value." Mahmood and Soon(1991) also state the same: "As technology continues to grow and IT becomes a vital survival factor within industries, strategic managers need to understand and manage IT as a competitive weapon."

In fact, Mahmood and Mann(1993) make a statement that summarizes the importance of measurement:

"Senior managers responsible for determining the level of IT expenditure are in a quandary. They perceive that appropriate IT investment may significantly improve a firm's profit potential, but they do not know how to measure this performance nor do
they know precisely how much should be invested in IT. Much of the investment that is made is based on hunch or intuition, on the assumption that real returns will result. Also, managers generally lack an understanding of which IT investments are most appropriate for support of the various types of decisions that must be made by organizational management.

However, Carlson and McNurlin(1992) did find out

"that while nearly every large organization had some sort of measurement system in place, each had developed its own, home-grown methodology. In most firms the measurements were tied solely to the management of the I/S operation. In many firms, there were different value systems in different business units, each tailored to agreements between line executives and the I/S management."

Overall, Mentzer and Firman(1994) do a excellent job of summarizing the fine line management must walk in this area and the job they must do in the future. As they state,

"Logistics has evolved over the last few decades from a seemingly minor and fragmented area of management into a coordinated activity with strategic implications for the organization. As this has occurred, the systems to control logistics activities have lagged behind. However, with the strategic mission of logistics increasing in the last 20th century, the need for more accurate, comprehensive, and timely control systems will be more pronounced."

In this article, an attempt was made to delineate the broad needs of such systems, but this only touches the surface. Customer satisfaction and resource management will not be achieved with performance feedback. Therefore, logistics organizations will require great strides in this area to keep pace with the logistics competitive edge. ... This will be a process of starting with a rudimentary control systems and continuing to add and improve to stay abreast of competition. The systems must evolve new measures and new ways to control logistics as logistics evolves.

The logistics systems of the 21st century and the next ten years of the 20th century will increasingly become a competitive tool for the corporation. However, companies that do not adequately measure logistics activities within and outside the organization will not achieve this competitive advantage."

The management of IT and logistics will always be a concern and both the controls and measurements required to properly manage logistical IT will be debated more and more. While this phase is still very exploratory in nature, there are two basic questions that need to be answered in the management and control phase:

1. What measures are systems set up to monitor the performance of IT?
2. What type of controls are implemented to manage the IT?

These are two fundamental questions that will allow the researcher to understand the type of control and measurement structure being implemented in the logistics function.

2.6. The Impact of Information Technology

With any investment in logistics IT, the question that is constantly being asked is what impact is it having? While numerous authors have identified how IT may impact the manager, the firm and the industry itself, most of the discussion is still conjecture throughout the literature.

2.6.1. Effects on the Manager and the Firm

Determining how investments in IT will effect the logistics organization, both operationally and financially, is still an issue that is being widely discussed.

Schary and Coakley (1991) conjecture as to how IT might affect the long term management of the logistical organization also. Acknowledging the fact that management itself is an information processing system, they argue that IT is changing how information is processed and thus will change the logistics organization in the future. Using transaction cost models and network design theory, they argue that current institutional arrangements will evolve in a number of ways ranging from full organizationally integrated approaches to complete outsourcing. As they state,

"The trend in information systems is clearly towards greater capacity to process information, which favours market-oriented as opposed to internally-oriented transactions. This favours organizations which do not integrate within a logistics department but which provide a logistics information connection. It also favours continuation of the movement towards partnerships and alliances to perform logistics activities.

The path of evolution depends not on IT but on the future characteristics of logistics transactions. If logistics processes become standardized, market solutions will prevail. Trends in logistics management, however, depend on more than information systems alone. A common theme in the current discussions on information systems is that organizations must exchange goals, operations, and
relationships with outsiders in order to seize the strategic benefits. Within logistics, the task of implementing (and managing) change falls upon the logistics manager. This requires understanding both the process of inter organizational management and the implications of new technology." (Schary and Coakley, 1991)

What Schary and Coakley suggest is that as a firm begins to gain better management and control over existing IT, this can lead to re-organization and help facilitate such relationships such as partnerships, alliances and the like. The key is how to re-organize successfully and how to set up successful management structures and controls that will facilitate partnerships, alliances, etc.

Max Hopper, Chief Information Officer of American Airlines only confirms this:

"We are entering a new era, one in which the thinking that 'best practice' as recently as five years ago is actually counterproductive. In this new era, information technology will be at once more pervasive and less potent - table stakes for competition, but no trump card for competitive success. As astute managers maneuver against rivals, they will focus less on being the first to build proprietary electronic tools than on being the best at using and improving generally available tools to enhance what their organizations already do well. Within their companies, they will focus less on developing stand-alone applications than on building electronic platforms that can transform their organizational structures and support new ways of making decisions" (Hopper, 1990)

This statement confirms what has been stated by many authors previously. As organizations bring technology into the logistics chain, structures will be modified and decision making processes altered. As Earl(1989) states, "As IT becomes embedded in {logistics} operations and pervasive in business thinking, IT activities now take on more complex organizational forms. Neat and tidy functional responsibility and authority gives way to all sorts of hybrid arrangements as business units and users begin to drive and develop information systems."

The financial impact on the logistics firm is also one of debate. One study by Dos Santos, Peffers and Mauer(1993) offers the following observation:

"Financial theory suggests that managers should make investment decisions that maximize the value of the firm. Using event-study methodology, we provide empirical evidence on the effect of announcements of IT investments on the market"
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value of the firm for a sample of 97 IT investments from the finance and manufacturing industries from 1981 to 1988. Over the announcement period, we find no excess returns for either the full sample or for any one of the industry sub samples. However, cross-sectional analysis reveals that the market reacts differently to announcements of innovative IT investments than to follow-up, or non innovative investments in IT. Innovative IT investments increase firm value, while non innovative investment do not. Furthermore, the market's reaction to announcements of innovative and non innovative IT investments is independent of industry classification. These results indicate that, on average, IT investments are zero net present value (NPV) investments; they are worth as much as they cost. Innovative IT investments, however, increase the value of the firm."

While increasing overall value of the firm is one important benefit from investing in logistical IT, other more specific benefits are important as well. Lambert(1992) highlights this point

"...the notion that a firm's total logistics costs could be reduced, customer service improved, and interdepartmental conflicts substantially reduced by the coordination of logistics activities has been accepted by many major corporations. Computers . . . brought high-speed processing and the logic of mathematics to the field of logistics and led not only to changes in transportation strategy, inventory control techniques, warehousing location policy, order processing systems, and logistics communication, but also to the desire to manage the costs associated with these functions in an integrated format."

The benefits from such technology are, according to these authors, great. They include reduced costs including inventory costs(Koselka, 1992), asset management, productivity, customer service and service quality(Droge and Germain, 1991). Studies such as the KPMG(1993) study mentioned earlier in this study to suggest some of the benefits companies can accrue. However, what benefits the firms accrue and what impact technology makes is still to be ascertained. As Huff (1990) stated,

"It is not yet clear how interactive computer-based tools affect basic missions and task processes in white collar work groups, and how these in turn can affect organizational performance. Although examples of dramatic technology related benefits have appeared, we are still unable to define the relationship between the capabilities of computer systems and the performance of organizations in the information economy. {In fact}, it is beginning to appear as if we may never have a complete understanding of the entire range of costs and benefits of information technology."
With such a statement, this researcher can only cautiously ask what companies have done to determine the impact IT has had on their logistics function. With even experienced academics still grappling with the impact IT has on the firm and the manager, only the basic of exploratory research can be conducted at this time.

2.6.2. Effects on the Marketplace

Impacts on a firm's industry are also still uncertain. While authors have suggested that firms will reorganize themselves, the exact impact on the market itself is still uncertain. While there may be ongoing consolidation or further de-segregation as firms pursue some sort of market based organizational structure that leads to further levels of outsourcing, only further research can confirm or deny such trends. Furthermore, once IT is brought into a market or into a firm, what new issues must be dealt with is also uncertain. Nevertheless, some authors, do offer some insight as to the effects IT might have.

Stern and Kaufmann(1985), in limiting their focus to EDI, postulate that the following propositions are possible and require further research. They include the following:

1. Information available will become more complete and accurate than previous information.

2. Increased inter organizational contact will lead to effective and efficient modes of conflict management.

3. Relationships between organizations will become more formal leading to less flexibility for dealing with disputes or changes in the environment.

4. More and more data will be amassed which will lead to information overload, thus requiring more data analysis.

5. The more powerful party will dictate standards but as power is divested, the industry will begin to create standards.

6. The more technologically sophisticated the company is internally will lead to increased cost advantages by developing EDI links with its suppliers or customers.

7. As EDI become synonymous with file and record-keeping, decision support systems will be developed to increase the positive relational effects found between organizations.
Clemons and Row (1993), however, go one step farther. They state,

"...IT can have a significant impact on the efficiency of product flow in the distribution channel. However, despite nearly universal agreement on the net economic benefits to the channel as a whole, we find that the necessary technological and organizational changes to improve co-ordination of product flow are not widely or rapidly adopted. These situations can be explained in terms of the relationship between bargaining power and the two dimensions of coordination structure: information flows and pricing structure."

This statement only confirms what potential impacts IT can have on logistics. However, how great this impact will be is still uncertain. Even Clemons and Row acknowledge that their work was exploratory, aimed at developing frameworks and propositions drawn from empirical experience. They concluded that the concepts and relationships they presented must be refined and more formally tested through additional empirical and conceptual work.

With such exploratory research that is well beyond the scope of this thesis still being conducted, only limited questions pertaining to market impacts can be asked. Questions such as whether or not a post implementation audit are performed on the IT or what impacts have companies seen on their market can only be asked.

2.7 Summary

The assimilation of IT into the logistics chain is one that has been and continues to be widely discussed. While extensive research has been performed in the U.S. on the initiation and the adoption and implementation phases, only recently is work being performed to better understand the management and impact phases of the assimilation process. For Canada, the project will reflect the research pattern found currently in the U.S. In particular, more descriptive research will be performed on the first two phases of the assimilation process while more exploratory research will be conducted on the last two.
3. Research Framework

The above literature review provides a brief understanding of some of the questions being raised in the field of Logistical Information Systems and Technologies. While trends and current technology have been identified in the literature, the literature still begs the question of whether or not firms have a successful method in assimilating new technology and what are some of the effects of technology, especially in the Canadian context.

The concept of information technology being assimilated in phases has been around for over 20 years. The framework used in this thesis was originally put forth by Nolan and Gibson(1974) and later modified or adapted by Cash, McFarlan and McKenney(1992), Johnson and Wood(1993) and Rogers(1990). This framework provides a solid methodological foundation upon which to base research on the assimilation of IT into a logistics organization. It was decided to use their work to identify whether or not Canadian companies are actually using a framework to successfully bring new technology into their organizations. However, before proceeding, a number of additions and changes were made to clarify and enhance the original research framework.

Table 1 is a technology management phase model modified for the assimilation of information technology in logistics (it was originally put forth by Earl(1989)). In the challenge section, a summary of the overall process companies might follow, as discussed in the review of the literature, is offered. In the goals section, some of the specific steps of assimilating technology into logistics are highlighted. The management section offers a review of the type of management each phase may bring as technology is assimilated.

The model put forth by Cash, McFarlan and McKenney(1992) originally had four phases: investment/project initiation, technology learning and adaptation, rationalization/management control, and maturity/widespread technology transfer. However, this was modified as seen in Figure 2 to tailor the model to the logistics function.
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Modifications were made using models put forth by Rogers(1990), Rogers, Dawe and Guerra(1991).

| Table 1 - Technology Assimilation and Management Model |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Phase/Factor        | Initiation | Adoption and Implementation | Management and Control | Technology Impact |
| Challenge           |             |                       |                       |                  |
| Identify technology of potential interest and fund a pilot | Encourage user experimentation, start training | Develop tools and techniques for efficient use of technology | Review impact of technology, spread to rest of firm, marketplace |
| Goals               |             |                       |                       |                  |
| Technical expertise, early applications cut | User insight on application potential, User awareness of technology | Value for money, reliability and longevity | Diffusion and integration |
| Management          | Lax planning and control | Encouragement and observation | Standards, analyses and studies | Organizational processes |

Table 1 provides a brief summary of the literature for each phase of the assimilation process. One can see how the challenges, goals and management approaches change as one passes through each phase.

Figure 2 is an outline of the assimilation process IT goes through in logistics. By providing a visual diagram, one can better understand the assimilation process logistical IT might follow within the firm.
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Figure 2 - The Assimilation Process of IT into Logistics

The Assimilation Process of IT in Logistics

- Initiation/Identification of New Technology
- Impact Analysis of New Technology
- Adoption and Implementation of New Technology
- Management and Control of New Technology
4. Research Design

4.1 Introduction

As mentioned earlier, the primary focus of this research is to determine the process that Canadian companies follow to help them assimilate information technology into their logistics function. As evidenced by the critique of the previous research, there are a number of hypothesis that can be tested. However, due to the limits placed on this research, only a number can be dealt with at this time.

In performing the research, a number of exploratory and descriptive hypotheses needed to be formulated to achieve the goals set out earlier in this project. Descriptive hypotheses were created to define some of the problems that Canadian companies face in bringing IT into the logistics channel and to define what state Canadian logistics is in. Exploratory hypotheses were made to determine if there is some type of relationship between what companies do and their success in bringing information technology into the logistics organization.

In creating these hypotheses, however, the definition of a "successful" company in the assimilation process needed to be clarified. A review of the literature and the work of Bowersox (1989) on leading edge companies allowed the researchers to fashion a number of characteristics to make up this definition. By combining these characteristics, a understanding of "successful" can be obtained.

First, a "successful" company must use technology in its daily logistics activities. Without technology, a company can not be considered successful. Secondly, there must be some basic technology that the company draws upon. While this "basic technology" is somewhat subjective, it can be understood as a number of basic computer applications such as purchasing, order entry and inventory control. Third, a "successful" company must have gone through some sort of process to bring IT into the organization.
These above characteristics do not mean that one company can not be more successful than others. What these characteristics provide is a threshold from which further evaluations could be made. "Successful" was considered a minimum in order to be considered a "leading edge" competitor. However, within this tier, companies could be "more successful" or "less successful" when compared to one another. What makes one "more successful" is the amount of information technology they use in comparison to others and where that technology is being used in the logistics function. This comparison to determine "how successful" a company is in comparison to others is based on three criteria, the number of computer applications they have, the amount of logistical information technologies they have and the size of their information gap. While these criteria do not lead themselves to the concept of success financially or performance wise, they do lean more towards the concept of the success in terms of the implementation of technology within the firm. Thus, success is a concept of reviewing the process each company undergoes and comparing the different processes to determine which is more successful than the other in terms of assimilating IT.

With this in mind, one can thus begin to list the hypotheses put forth within this thesis.

4.1.1 The Initiation Phase

The initiation phase in the assimilation process is one that has particular interest, especially since it is from this phase that all IT begins from.

Init H1: Successful initiation of information technology in logistics is a result of a well-defined logistics plan and strategy.

Init H2: Companies that have an understanding of their customer logistics needs can better identify IT opportunities.

Init H3: Successful initiation of IT begins with a particular person being assigned the task of looking for ways IT can be used in logistics.

Init H4: Companies begin the initiation phase by looking for technology that will provide them with a competitive advantage for their industry.
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Init H5: A centralized logistics function within the organization will facilitate successful initiation of IT for logistics.

Init H6: Logistical IT is budgeted for separately within the organization.

4.1.2 The Adoption and Implementation Phase

AI H1: IT forces the redesign of the logistics processes within the company.

AI H2: Successful adoption and implementation is a result of IT being selectively introduced to potential logistics users in small groups.

AI H3: Successful implementation of processes and priorities are driven from the top of the organization down.

AI H4: A centralized IT group within the logistics function ensures successful adoption and implementation in logistics.

AI H5: Extensive training is given to users to ensure successful adoption and implementation in logistics.

AI H6: User feedback is collected to fine tune the IT to ensure successful adoption and implementation.

AI H7: Successful adoption and implementation is ensured by formal plans being made to overcome potential barriers to adoption and implementation.

4.1.3 The Management and Control Phase

MCH1: Specific measures are set up within the logistics function to monitor the performance of IT.

MCH2: Specific controls are set up within the logistics function to manage the IT.

4.1.4 The Impact Analysis Phase

IH1: A post implementation audit is conducted to review the impact of the IT on the company.

IH2: A post implementation audit is conducted to review the impact of the IT on the marketplace.

IH3: Information is gathered by the company to help it repeat the cycle.
4.2 Research Methodology

There are two ways to structure the research project to test the above questions. The first is a case interview in which a descriptive and exploratory approach is taken. Data analysis would combine both the perceptions of the researcher and the subjects. The second is a field survey with a large sample and an emphasis on quantitative results. Data analysis in this method would consist of the perceptions of the respondents. For this project, the case research method was chosen for a number of reasons, as outlined below.

McCutcheon and Meredith (1993) argue that

"the gap between what academics were assuming and the real conditions of operations led to growing disparities between [logistics management] research's prescriptive advice and workable answers for managers. Sensing this gap, a growing number of [logistics management] researchers have seen the need to gather better information about the realities of operations systems and to develop better, more complete theories about them. A prime means of developing well-grounded theories is through empirical, field-base research ... case study research."

Furthermore, these authors point out that

"Case studies may also be used to support, expand, or raise doubts about existing theories, and can do so just as effectively as other methodologies that are often viewed as more rigorous or powerful. Yin (1989) refers to case studies designed to determine "how" or "why" events occur as explanatory studies. An example of the explanatory role is a study that compared the introduction of a new technology in each of two firms which used radically different approaches (McLoughlin, et. al., 1984). Since both implementations were successful, the commonalities and differences of the two could be compared to indicate factors that did or did not appear to influence implementation success."

Finally, these authors point out that

"Explanatory case studies involve hypothesis testing. Although case study research may not be viewed as a powerful theory-testing method, it can serve this purpose in several ways. First, testing hypotheses may involve demonstrating a theory's applicability under circumstances or in general. Here, sites might be selected to provide extreme examples of outcomes (e.g., highly successful projects versus highly unsuccessful ones). Since only one well-documented contrary instance can disprove a hypothesis, a case study can be a powerful tool to delimit a theory's generalizability or to discount it altogether. {Furthermore} case studies may be the best way to examine highly varied implementation situations."
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Bonoma (1985) was also of the opinion that case research methods were "useful when a phenomenon is broad and complex, where the existing body of knowledge is insufficient to permit the posing of causal questions and when a phenomenon cannot be studied outside the context in which it occurs."

However, the question still lingers about strong the data analysis may be. McCutcheon and Meredith (1993) reply as the role logic plays in what case researchers can do for data analysis.

"The most important tools are those of logical analysis. The case researcher seeks to find logical connections among the observed events, relying on knowledge of how systems, organizations and individuals work. An interpretative approach might be taken, wherein the researcher attempts to explain results by developing an understanding of the perceptions and reactions of individuals or groups. The theory must not only be logical but must also fit the observed 'facts', at least as accurately as rival theories.

Those who customarily use mathematical analysis may view this reliance on the researcher's logical reasoning to deduce relationships as a highly subjective practice, since such deductions cannot be verified with the ease or precision afforded by mathematics. However, in advocating the use of case research for theory testing in management information systems (MIS), Lee (1989) points out that 'mathematics is a subset of formal logic, not vice versa. Logical deductions in the general case do not require mathematics. An MIS case study that performs its deductions with verbal propositions (i.e. qualitative analysis) therefore only deprives itself of the convenience of the rules of algebra; it does not deprive itself of the rules of formal logic... (emphasis in original). The case study's reader must judge the researcher's reasoning, based on the provided data. In fact, this subjectivity is a property shared with virtually all forms of empirical research. However, the case's subjective portion tends to be very obvious, while other empirical methods may have similarly subjective elements (such as a survey respondent's interpretation of questionnaire items) that are cloaked in objectivity through their reduction to numerical data."

The above statements emphasize the importance of case research for a project such as the one covered in this thesis and one can thus conclude that case interview research would be an appropriate method of research.

As previously discussed, little empirical work has been done to discover the actual process IT is assimilated into logistics or the phases that firms must go through to ensure
success. Furthermore, Cash, et. al.'s research relied heavily on the case study method to study the phases in the assimilation of IT into an organization. Finally, as McCutcheon and Meredith (1993) suggest, case research may be the best way to examine highly varied implementation situations. However, since measurement theory has not been developed for the major phases in the process, it is difficult to use survey techniques with any assurance that the results have validity.

The stage of development of the research into the assimilation of IT into the logistics function (using the Bonoma (1985) continuum of "drift", "design", "prediction" and "disconfirmation"), seems to be just past the design stage. As he states, "in the design stage, the object of data collection is to assess and refine major areas of inquiry suggested by the preliminary model ... to provide a sufficient (not statistically so) body of observations with which to 'flesh out' the model and permit the development of some generalizations to account for the divergence in observation." Since the model put forth within this thesis for the assimilation and impact of IT on logistics was based on work done over the past twenty years in the MIS field but something that had yet to be empirically tested in the logistics field, it was decided to employ a case research strategy to clarify its contents.

Choosing the case approach meant that the project could be treated as a reformulation and testing of the assimilation model found in Cash, et. al. Modifications were made using works of Rogers (1990) in order to properly adapt the model to the logistics function. Company participation would have to be solicited, an interview guide would have to be drawn up and the interviews conducted.

4.2.1 Sample

The number of companies that have successfully gone through the assimilation cycle is unknown and discovering it was beyond the resources of the project. It was decided to use a
convenience sample generated from a key faculty member, from Dun and Bradstreet and from the membership of the Canadian Association of Logistics Management. The criteria for including a company in the study were:

1. The company had to be profit-oriented.
   Since Canada has so many co-operatives and government agencies involved in the marketplace, it was decided that only private companies would be focused upon.

2. The company was a part of the food industry.
   After reading the literature and surveying various industries, the food industry, and in particular, the grocery industry, is considered to have large amounts of information technology at its disposal. Therefore, it was decided that this industry would be one to be focused upon.

3. The company was familiar with information technology.
   A company must understand what is available in the marketplace for its use. In particular, a company must have a small "information gap" thus allowing the researcher to minimize his time from explaining logistical IT applications and determine where the company was along the assimilation process.

4. The company was a major player in the industry
   Quite often, larger companies have the resources and formal abilities to assimilate the latest IT into their organization. Since companies had to be somewhere along the assimilation process, only those companies that were significant in size were considered.

5. The company was a food manufacturer
   In the food industry, one could consider four areas to study in the distribution channel, manufacturers, wholesalers, retailers and third party logistics providers. Due to the limited scope of the project, manufacturers were concentrated on due to their large internal logistics chain as well as their inbound and outbound logistics flows.

With these criteria in mind, a number of telephone calls were made to perform a preliminary screening of potential companies. Using a list of food manufacturers from Dun and Bradstreet, the research asked four basic questions. The first was to determine if the company had brought some sort of information technology into their logistics function within
the past three years. The second was to find out if they were in the process of or had recently completed assimilating IT into the logistics function. Finally, the company was asked if they were available for an interview. Before the questions were asked, the researcher ensured that the proper logistics executive was approached to ensure the questions could be adequately answered.

The decision was made to find firms at various phases in bringing information technology into logistics in order to investigate the actual processes and steps associated with the assimilation of IT into logistics. Thus, if a company was in the midst of assimilating IT, a question was asked to determine where they were in the process (i.e. initiation IT, adopting IT, managing IT or determining its impact.)

A convenience sample of 10 companies located within the geographical region of Toronto (in order not to exceed the limits on the resources available to the researcher) was chosen at random from the sources listed earlier.

These 10 companies were then contacted and asked the questions mentioned earlier. While all companies seemed to meet the first two criteria, four declined an interview and thus, only six could interviewed.

As a result of these steps, a resulting sample of 6 companies located in the Toronto region who were in various phases of bringing logistical information technology into the organization was created. (See chapter 5 for details.)

4.2.2 Interview Guide Contents

Although Cash, et. al.'s(1992) book had no formal interview, heavy reliance was placed on other interview guides that dealt with IT issues (Reich(1988), Gustin(1989), Rogers(1990), Rogers, Dawe and Guerra(1991), AT Kearney(1992)) Additions and
alterations were made as follows (Appendix A contains the full text of the resulting interview guide):

1. Questions were rearranged into a format patterned after the assimilation process of IT. (i.e. initiation, adoption and implementation, management and control, impact analysis).

2. Additions were made to investigate specific issues within each phase. For example, questions were added to probe for qualitative issues such as the amount of formal planning done and the amount of centralization or decentralization within the organization.

3. Extensive modifications were made to tailor the interview guide to the logistics function.

4. A mixture of questions were used to prevent any leading by the interviewer and to reduce observer bias as well as observer caused effects.

Limitations

Although the theoretical frameworks have been designed to be complete, the resources and design of the actual research project limited the project's ability to fully test each phase. For example, since the buyers from the food manufacturers' were not interviewed, it was not possible to measure the impact on the food industry or the company. Furthermore, since the material taken from each company was verbal in nature only, variables such as cost impact could not be widely determined.

4.2.3 Interviews

The interviews were held at the interviewee's place of business and were 45 minutes to 75 minutes in length. Due to the fact that all of the companies interviewed felt that their logistical information technology was of strategic importance to them, the interviews could not be taped, written material could not be collected and only those notes collected during the interview could be used. However, after each interview, the researcher thoroughly reviewed the interview guide to make sure any gaps were filled in that were not recorded during the
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interview or to clarify any notes made during the interview. The researcher made taped comments of observations that came to mind immediately after the interview concluded. Furthermore, any questions that arose while reviewing the interview guide were followed up with additional phone calls to others in the company to clarify responses.
4.2.4. Data Analysis

There were several steps taken in the analysis of the raw data.

a. Organizing and condensing the data

Worksheets were made up for each of the four phases of the assimilation process as well as a worksheet to summarize the backgrounds of each company. The interview questions that pertained to each of these areas were then transferred onto the sheets. The researcher then, using the interview notes and supplemented by the tape recordings, filled out the worksheets for each company. If answers given were unclear, calls were made back to the interviewees or to others known within the organization to clarify responses given.

b. Summarizing the data to match the hypothesis

The researcher then made up sheets with the hypothesis listed for each phase. Using the companies as headings, he summarized, from the worksheets, the information which the interviewees provided to the questions. This was done to enable the testing of each hypothesis.

c. Review the data and analyze results

After summarizing the data (Appendix B), the research was able to review the data and make comments on trends he saw and how the observations made from the interviews compared or contrasted to the results found in the literature.

d. Conclusion - accepting or rejecting hypothesis postulated

Based on the analysis performed above, the researcher was able to then reject or accept each hypothesis put forth.
4.3 Measurement Issues

Before reading the findings of a piece of research, it is reasonable to ask just how good an answer the research provides. Two concepts used to judge how good the answer is are validity and reliability.

4.3.1 Validity

In order to ensure that the interview guides provided the right "answer" - that is, they revealed what they were supposed to, two ways to assess whether what was observed and measured was satisfactory representations of the assimilation process were content validity and construct validity.

Content or face validity was simple. Using the researcher's logic and previous research by others, the overall assimilation process was specified. Once this was done, specific questions were formulated to test each phase of the process.

Construct validity posed more of a problem. For those hypotheses that scales could be used, ordinal scales were created or used from other interview guides. For example, ordinal scales were used to determine the characteristics of information required to manage logistics or the impact logistical IT has had on the firm. For those hypotheses that theory had suggested no adequate scales existed, reliance on the researcher's skill and an independent party to interpret answers given to the questions asked was required. For example, this skill was used to determine the ranking of the companies interviewed.

The independent party that assisted in reviewing the coding of the results was a researcher at the university who was from outside the logistics field and one who would not bring any bias into the evaluations. To determine the objectivity of the coding, this party was

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5Ordinal is defined as a method to rank as in a sequence of first, second, etc. This is opposed to cardinal which is defined as simply using a method to count items with no rank involved.
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given the interview guides, the tapes to accompany the interview guides and the summary sheets (Appendix B) and then asked to determine if the coding on the interview guides and the summary sheets (See Appendix B) matched the comments made immediately after each interview. As a result of this, only minor modifications needed to be made to the summary sheets.

As mentioned earlier in this section, it became obvious that being "successful" is a relative term. Several interpretations are possible, all based on different criteria. For example, one could define successful companies based on a preset number of characteristics, based on a company having a definite plan for obtaining IT or based on how successful a company was in adopting new technology.

Basing the concept on the success the company had on adopting new technology is not appropriate since the company may have already adopted a very simple technology but a technology that does not make such an impact as to redefine the company. Having a plan for obtaining IT is also not appropriate since while a plan might be in place, it may never get executed thus making no difference to the logistics processes found in the company. Therefore, a set of characteristics is used to obtain a measure of "successful." By using those characteristics outlined earlier, the factors contributing to success and the comparative success of companies can be determined.

However, ensuring one could test for those characteristics posed a problem. To overcome this problem, a simple approach was used. Each interviewee was provided a list of technologies and asked what technology their company used and where their company used it. By asking the interviewee to list the IT their company used, the researcher would be able to firmly determine if indeed the company interviewed met a minimum threshold of IT in order to be considered successful. Secondly, by asking each interviewee to indicate where IT was used, the researcher was able to compare the progress each company had made in assimilating
IT into logistics and thus how successful the company was in comparison to others. This approach, thus allowed the researcher not only to ensure a company could be considered successful but also it allowed him to compare the success of each company to one another.

Determining the steps within the initiation phase was based on extensive work done in the literature on the subject. Various questions were drawn from a number of studies that had similar hypotheses about initiation IT into any area of an organization. This project simply drew upon that question base and tailored the questions in order to adequately test each hypothesis put forth within the initiation phase.

The adoption and implementation phase, like that of the initiation phase, had a large enough body of research to draw upon in order to test the hypotheses postulated. Again, questions were drawn from other studies and simply tailored to test each hypothesis put forth.

Since the management and control of IT is still under debate within the literature, it was felt that an attempt to determine what companies do to effectively manage their IT investment would be at least beneficial to the body of knowledge. Since the definitions for effective management and controls have yet to be determined, open ended questions were used to prevent any leading by the researcher. The first question asked was to determine the characteristics of information required to manage logistics effectively. This would thus allow the researcher to understand what was required by the logistics manager in order to properly perform his assignment. Once an understand of the what the logistics manager required in terms of information characteristics, the concept of management was broken down into two areas, the management of logistics and the management of IT. This was to ensure that the interviewee did not consider the two ideas the same. Questions were then asked to determine what tools were used to manage each. A list of management tools for logistics was provided to allow for some company comparisons to be performed. Finally, questions were asked to determine the types of controls found within the organization. The concept of controls was
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drawn from accounting and logistics theory. These questions would provide the researcher
with a number of things. First, they would provide him with an ordinal way to determine what
characteristics information must have in order to help in managing logistics. Secondly, he
would be able to ascertain what tools, if any, were used by the company to manage logistics
and its IT. Finally, the questions would allow the research to see if any controls were put into
place within the company once the IT was installed and being used.

The impact of IT is also one concept that is under debate in the research community.
Underlying any notion of success in a business context is the idea of contribution to the
bottom line. This contribution, however is often indirect and hard to measure. Thus, the
perceptions of the respondents may be the most important measurement rather than numbers
in the accounting system. Thus, the interview was structured to gather a set of data about the
impact of logistical IT adopted by the company. Furthermore, more general questions were
asked to gauge the respondent's opinion on the IT's impact on the industry and on
relationships outside the company.

In summary, the researcher understands that while some of the phases have a vast
body of findings to draw upon, others are still under debate and he must use various methods
to confirm or reject the hypotheses he put forth.

4.3.2 Reliability
Reliability is another concern that needed to be addressed. If one can not show that
the data obtained has some stability, then any conclusions made from the data are cast into
doubt. In this research project, the data were taken from interviews in which the participants
in a process (the assimilation of IT into logistics) were asked questions about the process they
underwent. This data collection method posed problems such as:
- Did the interviewees shade the truth to make themselves look better?
- Were their answers influenced by the interviewer?
- Did the interviewer record the answers correctly?
- Were the results coded and interpreted properly?
- Were conflicting responses resolved correctly?

These problems were alleviated in several ways:

- By using the interviewer's logistics experience in the interview and by asking the same question in different ways.
- By asking open ended questions
- By reviewing the coding with the taped comments made after the interview
- By having an independent party review the coding and interpretation of the data
- By making follow up calls to different people in the organization

Each of these steps taken to increase the validity of the data is discussed in the following paragraphs.

The interviewer has a number of years of experience from working in the Industrial Engineering group of United Parcel Service and in the public accounting industry. This experience gave him a body of empirical data to take into each interview against which to test the interview for significant deviation. This background personalized the interviews with the logistics managers and gave the interviewer the credibility needed to question the answers given.

The interview guide (See Appendix A) was designed to ask for information in several ways. Each hypothesis was introduced by first asking an open ended question. On the basis of the answer, another question was asked to obtain some sort of quantification or to further explain the answer. In this manner, the interviewee was led into a subject, first by general
discussion and then by more specific questions. He/she was given the opportunity to re-evaluate answers given as more detail emerged.

In all cases, the interviewer attempted to speak to the most senior logistics manager about IT. The objective was to question the person who had an overall view of the logistics system found in the company and where IT was being applied. In two of the cases, this attempt failed and the researcher had to interview different parties in the logistics or IS functions.

In light of the fact that only one person was being interviewed, questions were set up in the interview guide to ask selected questions in different ways. This not only allowed the interviewer to check the responses given and determine the accuracy of the respondents but to also deal with selected issues in different ways. In two of the cases, conflicting answers were given. In this case, the interviewer either made follow up calls to different parties within the company to clarify the conflict or applied information obtained from other responses given during the interview in order to make a judgment about the final answer.

Since all interviewees expressed concern about confidentiality and two of the interviewees expressly refused to have the interview taped, the researcher instead made appropriate notes during the interview and then reviewed the entire interview guide immediately after the interview. This review proved invaluable during the data analysis to clarify notes made on the interview guides.

In order to check on the objectivity of the researcher's coding of the responses, an independent party who was well versed in logistics and logistics research methods was given some of the interview guides and was asked to check the researcher's interpretation of the data. This procedure resulted in a few changes in how the data was coded but did not alter the data content or conclusions.
5. **Description of the Companies and the Industry**

In this section, each of the companies involved in the research and the industry they are in are briefly described. Because an assurance was given to the interviewees that total confidentiality would be provided, their names and locations have been coded. This section is included to give the reader an idea of the types of manufacturers that formed the sample and their outlook on their industry.

All of the companies in this sample are very large. In this study, however, our concern was not solely on size but with the companies use of logistical information technology. For example, at each manufacturer, the technology planned to be used or used currently along with the areas in which it was being used where explored. Due to the manufacturing and population base found in Southwestern Ontario, all companies interviewed were concentrated in the Greater Toronto region.

Company A sells $150 million of pastas, oils, tomato products and specialty foods in the Canadian market. It is owned by a $5 Billion parent located in the U.S. Its market is growing in volume but their revenues are flat.

Company B sells $300 million of canned fruits, vegetables and pet snacks. It is a division of a $700 million Canadian firm that is, in turn, owned by a $15 Billion American parent. Its market in volume and revenues are either flat or declining.

Company C sells nearly $400 million of soups, juices and frozen dinners. It is owned by a $6.7 Billion U.S. parent. Like others, its market is flat in volume and in revenues.

Company D sells $1.2 Billion of coffee, beverages, culinary products, canned pastas and frozen products. It is owned by a $45 Billion European parent and face a flat market but expect their market share to grow by 8% to 10%.
Company E sells $500 million of processed meats and is part of a $3 Billion Canadian company that in turn is owned by a $15 Billion European parent. Like the others, its market is flat.

Finally, Company F sells approximately $250 million of various food products and is owned by a $8 Billion American parent. Its overall market is growing at approximately 1% per year.

All six of these companies indicated that the most competitive force in their industry was the buyers such as A & P, Oshawa Foods, Loblaw's or Canada Safeway. Each company indicated that the number of food buyers is quite concentrated in Canada and their buyers' sizes are large. Therefore, each buyer's power to influence not only the interviewees' investments but their cost structure and ultimately their prices is substantial. However, Company D elaborated on the issue by stating that with the slow market growth, shifting rivalries, and increasing amount of technology being implemented in the food manufacturing industry, rivalry among firms was becoming a force of equal importance in the industry.

Another item discovered was the variation in each company's information gap. While the researcher was able to qualitatively determine if each company could be considered "successful", he could also see the size of the "information gap" within each company as defined by Dawe(1990). While all met the threshold in terms of computer applications and thus virtually no gap (i.e. each company used over 70% of the applications listed) the gap in technology was wide ranging.

As the table titled "Company Background" in Appendix B and Table 2 below indicate, the gap in technology was wide ranging from large (thirteen of the twenty technologies listed not being used) to small (eight of the twenty). The leader in this area was Company A and was considered very successful in closing the information gap. Company A was followed by D, C, E, F and B.
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Table 2 - Ranking of the Companies Interviewed

<table>
<thead>
<tr>
<th>Company</th>
<th>Application Base (out of 16)</th>
<th>Technology (out of 18)</th>
<th>Information Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12</td>
<td>10 (+2)</td>
<td>8</td>
</tr>
<tr>
<td>D</td>
<td>12</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>C</td>
<td>12</td>
<td>8.5 (+2)</td>
<td>9.5</td>
</tr>
<tr>
<td>E</td>
<td>11</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>F</td>
<td>9</td>
<td>5.5</td>
<td>13</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>5</td>
<td>13</td>
</tr>
</tbody>
</table>

Note: The +2 indicates that those companies plan to implement additional technologies in the short term. See Appendix B - Company Background Chart for details.

The number of technologies (out of 16 and out of 18) simply refers to the number of the technologies each company had of the 16 and 18 listed in questions 5 and 6 of the interview guide.

This finding was quite interesting since it revealed that while companies may have been successful in the administration of logistics and assimilating the required computer applications, the assimilation of logistical information technology was different, ranging from very successful (i.e. small gap) to little success (i.e. large gap).

When initially contacting these companies and later on during the interview, the researcher was able to make preliminary conclusions on the status of each company in the assimilation process. Companies A and C had already implemented some technology and were well on their way into phase four of the cycle (the impact analysis phase). Companies B and E, however, had just started the process and were still in the first phase of identifying the technology they would require (the initiation phase). Company F was bringing technology into the organization (the adoption and implementation phase) while Company D had just finished bringing new technology into their organization and was now determining how to manage it effectively (the management and control phase).
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6. **Findings**

6.1 **Introduction**

In the following four sections, results from the interviews are presented. For each hypothesis posed, a qualitative and/or quantitative analysis is performed. The entire model will be evaluated to determine if there is evidence that it is useful in describing the assimilation process. Each of the phases put forth by Cash, et al. (1992) is discussed according to the hypothesis put forth in each phase.

Five spreadsheets of source data are presented in Appendix B. Each shows responses to each of the questions posed in the interview guide according to:

1. Company Background
2. Initiation and Identification Phase
3. Adoption and Implementation Phase
4. Management and Control Phase
5. Impact Analysis Phase

For each spreadsheet, the order of the companies simply relates to when they were interviewed. In addition, a summary table outlining the conclusions reacted for each hypothesis (entitled Hypothesis Results) is also found in Appendix B. Once again, all companies have been coded, to protect their identity and their responses.

As mentioned earlier, the purpose of this research project was to set out and test a number of hypothesis about the steps and factors are involved within the assimilation process. By evaluating and analyzing the responses from the interviewees, the researcher could decide whether to accept or reject each hypothesis put forth. For ease of analysis, all responses were summarized into tables according to each phase they belonged to. Appendix B contains these tables that are labeled according to each phase.
6.2 Initiation and Identification

Within the interview guide, a number of questions were asked to test each hypothesis postulated for the initiation phase. By looking at each question individually as well as a group, a number of observations and conclusions are made.

6.2.1 Init H1: The First Hypothesis

Successful initiation of information technology in logistics is a result of a well-defined logistics plan and strategy.

Based on the definition provided earlier, all the companies interviewed met a minimum threshold of computer applications (not including logistical IT) and could thus be considered successful since all had been able to build up their computer application base. However, in evaluating their technology, the size of their information gap, and how that related to their logistics planning provided some interesting findings from which further conclusions could be drawn as to which were more successful.

Droge and Germain (1991) along with Bowersox (1988) and Gustin (1993a) all suggested that successful initiation began with a plan. In all the companies interviewed, it was noted that a mission statement did not seem related to the amount of technology within the logistics function. However, those companies that did have a logistics plan, specifically Companies A and D, did have more technology than those who had no plan or were in the process of devising a plan. (Appendix B - Initiation Phase.)

Thus, this observation does support the results found in the literature, particularly those suggested by the above authors. Thus, one could conclude that Init H1 could be accepted. That is, a logistics plan facilitates a quicker and more successful initiation of IT into logistics.
6.2.2 Init H2: The Second Hypothesis

Companies that have an understanding of their customer logistics needs can better identify IT opportunities.

As suggested by Dawe and Rogers (1993), identifying IT opportunities comes through the better understand of customer needs. Of the six companies, five used various methods to survey their customers and then use this information to initiate IT. This is confirmed by observing the similarity of computer applications amongst companies. However, due to the nature of the food manufacturing industry, it is not perfectly clear if the survey results were used to look for ways to identify new opportunities or simply a way to ensure they maintained their link to the customers.

Nevertheless, one can still accept this hypothesis based on the observation that five of the six companies did attempt to find out ways to serve their customers better through new opportunities that were presented to them.

6.2.3 Init H3: The Third Hypothesis

Successful initiation of IT begins with a particular person being assigned the task of looking for ways IT can be used in logistics.

It has been suggested in the literature that a "champion" is important in the initiation phase. As Droge and Germain (1991) suggest, a company should funnel the appropriate human resources into the initiation phase in order to begin the IT initiation phase. Thus, what would be expected is a person assigned from logistics who would be responsible for "scanning the business horizon" for IT applicable to logistics.

This was found to be true in all cases examined in the project. However, only five of the six derived their "champion(s)" from the logistics function. While this person usually has a high amount of status and authority, his/her awareness of IT was not always the same. Furthermore, while this person did have moderate to high
amounts of diversity of managerial experience, this diversity was related more to his/her exposure to the logistics function and not necessarily to the overall business. Finally, the role this person played was in developing the plan for the adoption and implementation of technology as well as getting the idea accepted and funded within the company. Other possible roles were more situation specific for each company.

As a result, it can be concluded that this hypothesis is true and the observations were consistent with those suggested in the literature.

6.2.4 Init H4: The Fourth Hypothesis

Companies begin the initiation phase by looking for technology that will provide them with a competitive advantage for their industry.

Porter (1985) was the first to suggest that IT should be seen as a way to create a competitive advantage. However, while Porter offers a strategic approach, others such as Neuschel (1988) and Bowersox (1989) suggest that a more tactical approach is appropriate to look for ways that technology would improve the management of logistics.

What was thus expected is that companies will look for ways that technology would improve the firm's logistics and thus allow it to obtain some sort of strategic competitive advantage in the marketplace. What was observed was that the majority of companies look for ways to cut costs within their value chain (Porter, 1985). Concern was not so much competitive advantage that a company could exploit, it was more a concern for ways to reduce costs and improve the performance in logistics cost control, customer service and productivity. For example, Company A looked for technology that would translate into direct savings, increased productivity and better customer service as opposed to providing them with something similar to Porter's competitive advantage.
Thus, one can cautiously accept this hypothesis. However, while one could argue that the companies are looking to exploit a low cost competitive advantage as put forth by Porter (1985), the results confirm more of the concepts put forth by Bowersox (1989) and Neuschel (1988) that companies look to IT as a way to improve logistics management.

6.2.5 Init H5: The Fifth hypothesis.

A centralized logistics function within the organization will facilitate successful initiation of IT for logistics

While Cash, McFarlan and McKenney (1992) hint at an informal, decentralized management structure for the initiation phase, Gustin (1987, 1993b) suggests that a formal logistics structure is required that has a centralized IT group within it. Thus, since Cash, et. al. dealt more with MIS and Gustin dealt strictly with logistics, what was expected was that findings similar to those of Gustin's would be confirmed in Canada.

This was exactly the case. Four of the six companies indicated that logistics and information systems were being centralized within their organizations (Of the two remaining companies, one was being decentralized and the other was not being changed from its existing structure.) Furthermore, the two companies that were ranked first and second in chapter 5 were two companies that had centrally consolidated logistics responsibilities and high levels of technology assimilated into their organization. (See Appendix B - Initiation Phase for detailed findings.)

Therefore, since these observations only confirm the observations made by Gustin, the hypothesis put forth can be accepted.
6.2.6 Init H6: The Sixth Hypothesis

Logistical IT is budgeted for separately within the organization

According to Dadzie and Johnson(1991), Bowersox(1989) and Droge and Germain(1991), companies will show their commitment to logistical IT by committing a certain percentage of their capital budget to logistical IT or by considering IT projects for logistics separate from others.

Unfortunately, when conducting the interviews, only two of the companies indicated the amount they spent on IT and both felt that the spending they did was below the industry norm. However, when looking at the prioritization process, five of the six companies indicated that IT was chosen according to a cost benefit analysis that was then compared to other projects within the firm.

Thus, due to the lack of response on this hypothesis, it is not certain whether or not companies set aside a portion of their budgets to acquire IT. Furthermore, it is not clear how the application for IT flows through the companies, whether it is through the IS group or through logistics. The responses seem to indicate that companies compare IT investments in logistics with other projects and investments available. As a result, this hypothesis has to be rejected since the evidence, be it limited, suggests that logistical IT is not treated in a special manner to other investments.

6.3 Adoption and Implementation

In the adoption and implementation phase, a successful completion of the phase was found to be when the company received positive feedback and users involvement increased as the technology was implemented throughout the logistics function.
6.3.1 AI H1: The First Hypothesis

IT forces the redesign of the logistics processes within the company

Bowersox(1989), Neuschel(1988), Dadzie and Johnson(1991), Burke(1993), Introna(1991) and Dawe and Rogers(1993) all suggest that a certain amount of process mapping and redesigning be carried out when adopting new IT for logistics.

Thus, it was not a surprise when this was actually observed in the companies interviewed. Five of the six companies reviewed their processes to determine the amount of modifications required to adopt and implement the IT. In fact, the interviewees seemed to indicate that the IT also lead to a re-organization of the logistics function as a whole.

All companies interviewed took a serious look at their processes when bringing in new technology. For those processes they were not satisfied with, they would adapt them to the technology being assimilated. For those processes they were satisfied with, they would adopt the technology. The organization of the logistics function in all the companies interviewed was re-organized within the last five years, however, this re-organization can not be directly attributed to new logistics information technology. Nevertheless, all companies indicated that a moderate to significant amount of change was required in the company to bring new technology in. As well, when changing processes or bringing in new technology, only three companies used outside parties, with only one of these being an actual consultant.

As a result of these observations, it can be concluded that when firms do adopt logistical IT, this does cause a redesign of not only the firm's logistical process but of the organizational set up as well.
6.3.2 AI H2: The Second Hypothesis

Successful adoption and implementation is a result of IT being selectively introduced to potential logistics users in small groups.

Geisler & Hoang (1992) along with Introna (1992) are two authors that suggest a selective introduction of IT, usually to user groups, is required to smooth the adoption of IT.

What was observed was slightly different. Most companies did practice selective introduction, either showing the technology to a management steering committee or to a small user group responsible for implementing the technology. Only two of the companies introduced technology to users or user groups. Two more introduced the IT solely to management while the remaining company that introduced technology to groups introduced the IT to a combination of management and users. Furthermore, most of the technology introduced seemed concentrated on the warehouse side of the logistics function.

As a result of these observations, one could accept the hypothesis put forth. However, one would have to qualify the statement that logistical users includes management.

6.3.3 AI H3: The Third Hypothesis

Successful implementation of processes and priorities are driven from the top of the organization down.

Introna (1991) and Dawe and Rogers (1991) have suggested that senior management play a key role in the adoption and implementation phase.

And as seen in the methods in which IT is introduced, senior management does play a role. In fact, all companies interviewed indicated that the role senior management plays is to either provide the proper resources or to provide direction to
the process. However, senior management might have also been involved because of the fact that the implementation phase the company was going through was unique and thus may have required either special resources or special direction.

Thus, while one can conclude that the implementation of processes and priorities are involves top management and thus accept the hypothesis, the question as to whether or not the involvement is because of the new IT or because of the unique implementation process is still unclear. Furthermore, whether or not top management drives the process or guides the process is also unclear. From the interviews, however, initial observations indicate that top management must still be involved, regardless of this.

6.3.4 AI H4: The Fourth Hypothesis

A centralized IT group within the logistics function ensures successful adoption and implementation in logistics

This hypothesis relates to that of Init H3 (Section 6.2.3) and the concept of a champion for IT. As Droge and Germain (1991) and Dawe and Rogers (1991) suggest, once the selection of IT is complete, a key person or group of people would be in charge of the implementation to ensure success.

All companies did ensure that a type of IT group, mostly made up of users, was used to ensure a successful adoption of the technology. While four of the six companies interviewed set up a group that was responsible for installing the technology, the membership in this group was evenly split between logistics and IS.

Thus, while one can say that there is an IT group responsible for implementing logistical IT within logistics, it is not necessarily made up completely of logistics personnel.
6.3.5 AI H5: The Fifth Hypothesis

Extensive training is given to users to ensure successful adoption and implementation in logistics

The concept of extensive training can be traced back to the work of Dawe and Rogers(1993) along with Introna(1991) who both suggested that in order to overcome potential rejection of the IT, a company must provide training for its users in order to achieve success in the implementation phase.

Of the six companies, three stated that they had extensive amounts of training but moderate acceptance, one had moderate amounts of training and moderate acceptance and three had limited training and had a wide range of acceptance from high to fair.

Unfortunately, these findings lead to uncertainty as to whether one could conclude that there is a link between training and successful adoption and implementation. While Introna(1991) and Dawe and Rogers(1993) recommend training, they do not specify the type or the amount that is required. Only after the study was begun did the researcher realize that user involvement and the concept of training is a complex subject to understand and is of a scope well beyond this project. Since no multi-faceted analysis was performed in this study and due to the complexity of this particular hypothesis, no conclusion can be made. Only through further research and detailed examination can one resolve this issue.
6.3.6 AI H6: The Sixth Hypothesis

User feedback is collected to fine tune the IT to ensure successful adoption and implementation

Burke(1993), Introna(1991), Dawe and Rogers(1993) and Closs and Frankel(1992) have all suggested that user involvement and feedback is an important component of the adoption phase.

In the interviews, all the companies indicated that while no special communications were set up during the adoption and implementation phase, feedback was solicited from the users, either in the form of meetings, surveys or newsletters. However, whether or not the feedback was used to fine tune the technology was unclear. Some companies indicated that the feedback was solicited mostly to find out how to get the users to adopt the system as opposed to how to fine tune the technology while others indicated that feedback was solicited in order to determine how the implementation was going within the company.

Thus, based on this observation, one can state the Burke(1993), Introna(1991), Dawe and Rogers(1993) and Closs and Frankel(1992) are correct in their observation that feedback is solicited during the adoption and implementation phase. However, in the studies, it was found that this feedback is used mostly to overcome barriers to the adoption and implementation of the technology as opposed to modifying the technology.
6.3.7 AI H7: The Seventh Hypothesis

Successful adoption and implementation is ensured by formal plans being made to overcome potential barriers to adoption and implementation.

Closs and Frankel (1992), Dawe and Rogers (1993), Introna (1991) also stressed that various barriers would arise to the IT being implemented and that in order to properly overcome those barriers, a predetermined plan should be available.

However, while the interviewees indicated that barriers did indeed arise during the implementation phase, especially the cultural and perceived benefits barriers suggested by Closs and Frankel (1992), a majority of the companies did not have a preset plan to deal with these barriers. In fact, only 2 companies had a plan or 'flowchart' to deal with these barriers. The rest dealt with these barriers as they arose on a daily basis. Furthermore, while planning may have possibly assisted in dealing with barriers, it does not necessarily improve acceptance. This, however, is based on qualitative comments obtained by the company as opposed to formal quantitative surveys.

Thus, even though the literature suggested that barriers would arise and those barriers were indeed confirmed, four of the six companies did not have a plan to deal with the barriers that arose. One must reject this hypothesis and conclude that through the use of user feedback, companies deal with barriers on a day to day basis as opposed to following a pre-set plan.

6.4 Management and Control

The management and control of logistical IT is a key part of the assimilation process. Ballou (1992), Johnson and Wood (1993) and Mentzer and Firman (1994) all stress the importance of proper measurements and controls. Again, while only exploratory research could be performed on this area at this time, some interesting results were uncovered.
After this information was ascertained, questions were asked to test the two hypotheses put forth earlier, namely:

MCH1: Specific measures are set up within the logistics function to monitor the performance of IT.

MCH2: Specific controls are set up within the logistics function to manage the IT.

During the interviews, it was observed that once the IT is installed and up and running, responsibility for it was placed in the hands of the logistics manager. However, while extensive measures were used to determine the logistics performance of the firm in terms of cost and quality, only three firms had enough measures to determine their performance for asset management (i.e. greater than six measures) and only two for productivity (i.e. greater than or equal to 4 measures). Thus, even though Mentzer and Firman(1994) stress the importance of new and better measures in order to determine the impact of IT's effect on logistics performance, all interviewees gave the impression that they would be able to determine the effect of the IT indirectly by making use of existing performance measures.

In fact, such an attitude has resulted in the failure by three of the companies to have enough measures in place to determine if the goals originally set out during the initiation phase were actually being achieved. For example, Company E indicated during the initiation phase that they wanted to improve their customer service. However, in the management and control phase, they indicated that they used only 5 of the 9 measures to determine how they were improving on customer service. The same is with Company B. They stated that they wanted to improve their productivity but in the management and control phase, they only used one of six measures available to determine if they were meeting that goal. Only Company A had a enough measures in place to determine if performance goals had been met.

This was the same with logistical IT. While Tullo(1992) and other authors (Carlson and McNurlin(1992), Mahmood and Mann(1993)) all stress the importance of having effective
measures to manage IT, this study found that all firms involved did not have an measurement
tools in place to monitor the performance or effectiveness of their IT investment.

A less dismal picture is found on the controls side. All companies did have some types
of controls in place (mostly preventive) to manage the IT that they install within the logistics
function. However, those controls are somewhat limited in the fact that they don't take
advantage of IT's ability to correct itself. For example, if the received amount of goods and
the billed amount of goods don't match the keyed in amount purchased amount of goods, the
technology must ask the operator to change the amount keyed in rather than changing it
automatically. Furthermore, all the controls are found in the accounting side of logistics, the
work supervision side or the security side. Only two companies (A and D) interviewed have
controls in place to control product flows that will allow them to actually perform product
recalls (i.e. reverse the logistics flow).

Thus, while companies strive to improve certain areas of logistics when first starting
out, preliminary findings suggest that not enough measures are in place to manage the IT
effectively. However, enough controls are in place that seem to compensate for this.

6.5 Impact Analysis

While many authors have stressed the impact of IT (Schary and Coakley(1991),
Lambert(1992), Clemons and Row(1993)), one must question if companies actual review this
impact and the process they underwent to bring IT into the logistics function.

Thus, three hypothesis were put forth,
IH1: A post implementation audit is conducted to review the impact of the IT on
the company.
IH2: A post implementation audit is conducted to review the impact of the IT on
the marketplace.
IH3: Information is gathered by the company to help it repeat the cycle.
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Of the six companies interviewed, only three conduct any formal post implementation audit. Nevertheless, the firms felt they were still able to determine the benefits of their IT investment, be it subjective in nature and even though they have limited measures in place to effectively determine the benefits. Again, while the firms did not have quantitative measures in place, qualitatively speaking, the interviewees felt they are still able to ascertain the benefits.

Of the benefits they felt were present, three said they saw or are seeing cost reductions, two say they have seen management improve and one said they are seeing or are expecting to see more productivity gains. Four expected these benefits to continue for more than one year, while the remaining two expected these benefits to last less than six months (i.e. one time only).

In regards to the impact of the IT, the firms felt, on average, the IT installed had a slight impact on sales force accuracy, computer support, communications with customers, suppliers (logistics services and other) and internal non-logistics groups, transportation costs, measurement tools and methods, inventory reduction, load leveling and workforce leveling. Only in providing timely information, cost reductions and reducing systems incompatibility did the interviewees feel that IT had made a significant impact.

While five of the six parties interviewed felt that IT in logistics was affecting other parts of the firm, the same five felt that no impact was being felt on the industry. Only one interviewee acknowledged that IT collectively is affecting the logistics function in the industry but even he acknowledged that most individual systems don't make a significant impact. Nevertheless, all 5 still indicated that they planned to develop closer ties with their customers and four of the six planned to develop closer ties with their carriers.

Finally, all indicated that all were trying to build upon the technology installed but only two actually brought up the concept of creating a type of supply chain management system.
within their organizations and how IT would be used to create that system. Thus, comments by Hopper(1990) seem to be emerging in Canada, be it ever so faint.

Based on these observations, one would have to reject all the hypotheses put forth that firms perform a review of any type to help them better manage for the future and to assist them to build future IT systems. In fact, based on the observations, more work is required to determine the impacts of logistics and clarify some of the issues being raised in the literature.

6.6 Additional Observations and Insights

When conducting the interviews, some additional information came to light that was not planned for earlier. This information is discussed below.

While companies took an inward focus to evaluate the logistical IT needs of their company, it was interesting to observe that all benchmarked themselves in various areas (especially on costs) to a standard unknown to the researcher but thought to be industry standards (See Appendix B - Initiation Phase). Obviously, cost has become the driving force behind the logistics assimilation process and one that will dominate decisions in the future. However, what effect this benchmarking process will have on logistics or IT performance is still unclear and requires further research.

Another observation is that while four of the six companies indicated that the value chain is an important to determine ways to reduce costs by using IT, only two suggested (unprompted) that they are trying to use IT to implement a process to manage the entire value chain.

As well, it was quite interesting to note the short time senior logistics people in these companies have been in their positions (all less than two years) even though logistics has been a part of the organization for greater than three years. This seems to confirm the notion that
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logistics is placing an increasingly important role in business today. (Mentzer and Firman, 1994)

What was also of interest was the role the information systems department continues to play. While some have talked about logistics taking control of its IT, the IS department is still involved and looks like will continue to play a partnership like role with logistics and its IT.

The amount of change found within each organization was also large and unexpected. IT in logistics is having a greater impact structurally than that initially suggested by all the interviewees. Furthermore, the number of companies who suggested that their implementation of IT was unique to their logistics was also somewhat surprising in light of their current technological base. Nonetheless, with this response, one would expect they would use some type of project management to help them monitor and manage the process during this "unique implementation."

What was also observed was the way the technology was introduced. All companies could introduce IT in five ways: Direct, in which they turned off their old system and started up their new IT; Parallel in which they would run their old system and new IT side by side for a period of time before shutting off their old system; Phase In is which parts of the old system would slowly be shut off as the new IT continued to operate; Modular in which old sections of their logistics function were discarded as new IT introduced and other, which would be a method not described or a hybrid of the above. Of the six companies, two used a direct method of implementation, one used a parallel approach, one a phase in approach and two a hybrid approach of either parallel/phase in or parallel/direct.

Finally, it is interesting to note that only the most successful company (Company A) was able to repeat the process time after time. By having a person being assigned to look for new technology (be it internal or external) and by implementing the right measures to monitor
The performance of IT, company A has been able to build upon its logistical IT successfully. The only other company to proceed in a similar path is Company F. Thus, by having a champion and the proper measurements in place, one can increase the ability to successfully repeat the assimilation process over and over again by learning which IT is having the greatest impact on their logistics function.
7. Summary

In this final chapter of the thesis, the findings will be summarized and recommendations for companies who wish to better manage the assimilation process for new logistics IT are presented. In addition, areas for future research are suggested.

It must be stressed, however, that recommendations made on such a small sample research, such as this project represents, must be viewed with caution. While some may say research proceeds slowly, the reality is that the assimilation of IT into logistics is increasing in speed. The researcher felt that with the increasing demands being placed on Canadian logistics managers, recommendations based on the type of qualitative observations developed in this project may serve a useful purpose in guiding Canadian managers towards successfully managing the assimilation process.

Furthermore, applying these recommendations across companies may not be applicable due to the unique nature of the food industry and thus, readers are cautioned when applying these recommendations elsewhere. However, it is reasonable that these recommendations could be applied to the food industry or those serving the food industry, especially those that are fairly "large" in nature and are similar in size to those found within this study.
7.1 Summary of Findings

Table 3 below summarizes the corresponding conclusion for each hypothesis put forth.

<table>
<thead>
<tr>
<th>Initiation Phase</th>
<th>Management and Control Phase</th>
<th>Adoption and Implementation Phase</th>
<th>Impact Analysis Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Init H1:</td>
<td>Accept</td>
<td>MCH1:</td>
<td>Reject</td>
</tr>
<tr>
<td>Init H2:</td>
<td>Accept</td>
<td>MCH2:</td>
<td>Accept</td>
</tr>
<tr>
<td>Init H3:</td>
<td>Accept</td>
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<tr>
<td>Init H4:</td>
<td>Accept</td>
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<tr>
<td>Init H5:</td>
<td>Accept</td>
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<tr>
<td>Init H6:</td>
<td>Reject</td>
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</tr>
<tr>
<td>AI H1:</td>
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<td>AI H2:</td>
<td>Accept</td>
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<tr>
<td>AI H3:</td>
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<tr>
<td>AI H7:</td>
<td>Reject</td>
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As a result of these findings, one could conclude that the first two phases of the assimilation process are well understood both in the literature and by management. However, the findings for the management and control phase along with the impact phase indicated that either more research is required in this area or the companies interviewed simply failed to properly deal with these phases of the assimilation process. In the eyes of the researcher, the former is a better indication than the latter due to the fact of small sample size in this project and due to the lack of literature on the area.

Furthermore, the observations on the lack of measurements to monitor both logistics and IT performance causes this researcher to seriously question the capabilities of these companies to justify and properly manage future IT investments, especially when no past or base information is available to compare future results to.

Finally, the questions first posed earlier in this project can finally be addressed.
that consists of data collection and storage technologies, data communication technologies and data processing technologies. Currently, IT is becoming more of a factor in logistics and will become even more important as time progresses. Advanced decision support technology that facilitates better communications within the entire logistics chain will be the norm in the future. To achieve this, companies must use IT as a catalyst for re-designing their processes that is driven by the users with the guidance of top management. Key concerns and goals in logistics today are being cost and service competitive. Only those technologies that achieved those goals are chosen and implemented in step like fashion that is directed from a well defined logistics plan. Once in place, measures and controls are set up in a centralized logistics function to facilitate effective management of the technology. While impacts and effects are unclear, lower costs, better management and better communication between the firm and its customer are perceived to be some of the benefits. However, when and where these benefits are felt is also uncertain.

While the project did answer some of the questions first posed, it also allowed the researcher to look over his findings and offer not only a number of recommendations to Canadian companies but also some suggestions as to what areas need further research.

### 7.2 Recommendations

When discussing the various phases within the assimilation process, it is important to review the findings of this study and relate them to real world applications. It must be noted that success in any one phase will strongly influence but not ensure success at the next. Unrelated changes in the economy, the industry or the legal system can influence one's destiny. Nevertheless, based on the observations made during the interviews, these recommendations should help in making a logistics function "more successful" in the assimilation of IT.
7.2.1 Initiation

In order to allow a company to successfully look for new IT for logistics, senior management must be aware that the IT for logistics should be handled differently from internal projects. They may already have a sense of urgency, created by intense competitive rivalry and high customer negotiating power. Top management support, consisting of a vice president of logistics or a "champion" with similar status and authority, is important at the initiation phase to provide the organizational power to bypass other projects and ensure that proper resources are dedicated. Companies with logistics manager well versed in technology will have an advantage in the fact that they will already understand the technology available to carry out specific logistics goals or strategies.

The recommendations that emerge from the project are as follows:

1. **Have a well defined logistics plan and strategy.**
   A logistics plan for a clearly defined logistics organization will provide focus to the search for new technology and a better understanding of the company's needs.

2. **Understand the needs of your company and your customer.**
   Ensure that you understand their needs in addition to your own in order to ensure that the technology desired will meet their demands as well. Watch what your competitors are doing to meet the customer's needs as well. This will ensure that you do not fall behind in the race to win the customer's business.

3. **Have a champion with the right resources.**
   Make sure that the person assigned the job of finding the technology to meet internal or external logistics needs have the resources available in order to
allow for innovation. As well, make sure they understand the logistics function. Lack of knowledge or lack of resources will only constrain the search.

4. **Ensure technology will meet preset goals.**

Understanding how technology will meet performance goals is critical. Technology is now becoming an enabler of strategy as opposed to a competitive advantage (Hopper, 1990). Ensuring you choose the right technology will only ensure the success of your strategy. Setting up a benchmark early on will also ensure you have something to compare with once the technology is in place.

### 7.2.2. Adoption and Implementation

After the IT has been chosen, it is brought into the organization for use. When adopting the IT, the company has the opportunity to redesign its processes and logistics structure to meet new demands in the marketplace. Companies must decide whether or not they are satisfied with the processes and structures they have in place before implementing the technology. Senior management must make this decision early to ensure any changes are carried out effectively.

Recommendations for companies adopting and implementing new IT are as follows:

1. **Decide if you want to keep your logistics processes and structures.**

   This decision will affect how and what technology is adopted in the future. Once you keep a process or structure, it might constrain future IT installations. As well, design changes have more long run promise of breakthrough than doing current processes better.
2. **Ensure top logistics management support the IT.**

Introduce the technology to management first to ensure they are comfortable with the technology before they begin to sell it to the users. Then begin to introduce the technology to small groups of users at a time.

3. **Set up a person or user group to manage the implementation process.**

By setting up an IT implementation person or user group, one ensures that adequate training is undertaken and that barriers are addressed to ensure the technology is implemented. That person or group can also solicit feedback in order to modify the implementation process as necessary to the needs of the users. However, ensure that the person or user group understands logistics and IT enough to manage the implementation effectively. Furthermore, the company should try to use some sort of project management to ensure a smooth implementation.

### 7.2.3 Management and Control

After the IT is set up in the logistics function, additional steps can be taken to maximize the benefits from IT and ensure positive impacts to logistics performance. Companies must realize that information that is timely, accurate and readily available is now possible with today's logistical IT. However, maintaining old measures before and after the IT is implemented may not help. Recommendations for companies entering into the daily management and control of the IT are as follows:

1. **Set up proper performance measures.**

   Continuing to use old measures may not provide management with the right information. Ensure that the methods and measures used with the new technology will allow assessment of the performance against original goals set.
for the IT. Set a benchmark yourself and a base from which future progress and accomplishments can be measured.

2. **Set up specific measures to determine the effectiveness of your IT investment.**

   Simply relying on indirect performance measures is not good enough. Setting up specific ratios and measures such as the Balanced Scorecard (Kaplan and Norton, 1992), financial option theory (Kambil, et al., 1991) and activity based costing offers ways to better measure IT in logistics.

3. **Set up tight controls.**

   In today's business environment, any slack can result in unprofitable failure. Thus, effective controls are required to ensure that once the technology is in place, it is properly managed by the company. (Mentzer and Firman, 1994)

### 7.2.4 Impact Analysis

After the company has implemented the technology and had time to adjust to the new technology, it is able to determine the impacts the technology has had both internally and externally; all barriers would have been overcome while effective measures and controls should have been put into place.

Recommendations for companies entering this final phase are as follows:

1. **Conduct a thorough review of the process.**

   Understanding the assimilation process the company underwent will allow past mistakes to be avoided.

2. **Determine the impacts.**

   Determine if the goals set during the initiation phase were (or were not) met as well as why. Understanding what effect which technology has had will also
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ensure the right technology is built upon. Just building upon technology because it is there will benefit no one.

3. Look for ways to build upon IT.

Understanding the impact of technology is not enough. Steps must be taken to repeat the process and thus improve the logistics chain not only within the company but throughout the industry as well.

7.3 Areas for Further Research

This research project set out to answer a number of questions to fulfill two objectives. What has been accomplished is a partial fulfillment of this goal. Phases of the assimilation process have been identified along with the steps within each phase.

However, there are several important topics that have not been addressed by this study and which could form the basis for further research. They include questions such as:

1. What IT performance measures are available to logistics managers?
As the findings show, current measures seem inadequate to measure IT investments. While many authors have suggested new measures, one must determine if indeed they are beneficial and useful. As well, new controls might be researched to find new ways to tighten up the control management has over its IT investment.

2. What are the bottom line impacts of IT on a firm and an industry?
The findings to date only offered subjective results on the impact of IT on both the firm and the industry. A wider study that would attempt to quantify the
impacts would be truly beneficial in determining whether or not the investment in logistical IT to date has been profitable.

3. What types of technology offer the most benefit?

Various parties have invented new technologies to serve the needs of the logistics function. However, in light of today's current economic situation and the cost benefit analysis required to justify IT investments, a study looking at the possible benefits new technologies offer would contribute greatly to the body of knowledge and would help management make better decisions. Dawe(1993) does seem to offer a glimmer of hope in this area.

This study lacks true generalizability because of the small sample size and the focus on food manufacturers. A larger study that could be shown to be representative of some population of logistics organizations would provide data that could be statistically manipulated. Such a study could test the findings of the current study.

As more companies assimilate logistical IT into their organizations, other avenues of exploration emerge, such as

1. How does IT affect supply chain management?

Some of the companies in the project began to talk about supply chain management. Obviously IT has brought this concept to the forefront but what it has accomplished and what role IT would play in such a management technique still needs to be fully explored.
2. What impact does IT have on strategic alliances and relationships?

Many authors have discussed the idea of alliances and relationships. Indeed, within this study, companies talked about developing closer ties with their customers. However, what role IT will play and what type of impact IT would give to such dealings also needs to be researched.

3. What effect does IT have on future logistics operations?

Mentzer and Firman (1994) brought up the importance of better controls. The companies in the study talked about what characteristics information must have as well the changes they have experienced in the logistics function. The question now at hand is what will be the future effects as IT continues to grow?

4. What phases need further research?

This project has shed some light on the assimilation process. While extensive research has been done on the assimilation phase and the adoption and implementation phase, the management and control phase along with the impact analysis phase both need some major work before a better understanding of these phases are obtained.

Using Bonoma's (1985) terms, this project attempted to move research on the assimilation of IT in logistics forward in the "design" stage by expanding the model and developing generalizations. Measurement issues were addressed, new cases added to the inventory and new hypotheses confirmed or rejected. What has begun here is an exploration of the process companies follow over time to obtain new logistical information technology.
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Perhaps a next step is to continue along this path and determine the detailed steps companies undertake in each phase.

Information technology will become a key component of the logistics process. IT not only affects logistics flows within firms but also affects logistics flows between firms and between industries. As a field of study, the circle of investigation continues to enlarge. The only inhibitors to successful exploration of these components are the resources and capabilities of logistics practitioners and researchers alike.
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Appendix A - Interview Guide

CODE: ____________________________

Section #1 - The Company:

1. What were the annual dollar sales of your business unit (division or subsidiary) and the total corporation (if different) during the most recent fiscal year?
   - Business Unit: $ ____________________
   - Total Corporation: $ ____________________

2. What are the primary products manufactured by your business unit?

   __________________________________________
   __________________________________________

3. How would you describe the current state of this market's growth?

   __________________________________________
   __________________________________________

4. According to Michael Porter's Competitive Advantage, which competitive forces operate most strongly in your industry?
   - Buyers
   - Rivals
   - Suppliers
   - New Entrants
   - Substitutes

5. Below is a list of several technologies. With respect to your business unit, please indicate whether each one, please indicate:
   - If it is used or is planned to be used
   - Where it is used

   Bar Codes                              Optical Scanning
   Robotics                              Artificial Intelligence, Knowledge Based Systems
   Automated Storage and Retrieval systems
   Automated Material Handling Equipment
   Local Area Networks
   Computer aided warehouse design
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6. Below is a list of logistic computer applications. Please indicate for each application whether it is:
   a) If it is used or is planned to be used
   b) Where it is used

   Freight Audit and Payment
   Sales Forecasting
   DRP
   Finished Goods Inventory Control
   Order Processing
   Vehicle Routing and Scheduling
   Outbound Freight Consolidation
   Performance Measurements
   Purchasing
   MRP
   Raw Material Inventory Control
   Warehousing
   Order Entry
   Inbound Freight Consolidation
   Supporting Financials
   Distribution Modeling

Section #2 - The Initiation Process (Project Initiation in New Technology):

7. Do you have a formal logistics mission statement? (y/n)
   If yes, please provide below or attach a separate sheet

8. Do you have a formal logistics strategic plan? (y/n)
   If yes, what is the time horizon of the plan?
   If yes, how often is your plan reviewed or updated?

9. Do logistics executives formally participate in overall strategic planning for your
   business unit? (y/n)
10. Which of the following statements provides the most accurate description of the primary strategy of your logistics organization.

(a) Process  A process based strategy is concerned with managing a broad group of logistics activities as a value added chain. Emphasis is on achieving efficiency from managing purchasing, manufacturing, scheduling and physical distribution as an integrated system.

(b) Market  A market based strategy is concerned with managing a limited group of logistics activities for a multidivision single business unit or across multiple business units. The logistics organization seeks to make joint product shipments to common customers for different product groups and seeks to facilitate sales and logistical coordination by a single order-invoice. Often the senior sales and logistics executives report to the same manager.

(c) Channel  A channel based strategy is concerned with managing logistics activities performed jointly with dealers and distributors. The strategic orientation places a great deal of attention on external control. Significant amounts of finished inventories are typically maintained forward or downstream in the distribution channel.

(d) Other  If your strategy does not fit into one of the above, please describe it.

11. To what degree is there alignment between IT and Logistics Plans?
   a. None (chance)
   b. Partial (some areas)
   c. Total

12. How do you achieve this alignment?
   a. Cross training of IT/logistics people
   b. Rotating people into IT from logistics business

13. How does business strategy affect the initiation of IT?

14. What is the first step initiating IT for logistics?

15. Do you do any external or internal analysis of your company in terms of identifying IT needs?
16. (a) Is IT developed in light of what other competitors are already doing or intending to do?

(b) Benchmarking is a management process used to monitor and measure performance against competitors. Do you use competitive benchmarking in any of the following areas?

- Cost Logistics Strategy
- Asset Management Technology Deployment
- Customer Service Transportation Operations
- Productivity Warehouse Operations
- Quality Order Processing Operations

17. Was the technology copied from one used in another market or industry?

18. Did you survey any of your customers? If so, how?

19. Did a particular individual play a critical role in the initiation of IT for the logistics function?
   If yes:
   a. Who was the individual?
   b. What department was this individual a member of?
   c. Describe his attributes: (high, medium, low)
      i. Status (informal)
      ii. Level of authority (formal)
      iii. Level of awareness of information technology
      iv. Diversity of work experience
   d. What specific role did this individual play?
      i. Creation of the idea
      ii. Developing the plan for adoption and implementation of technology?
      iii. Researching the technology
      iv. Getting the idea accepted and funded within the company
      v. other

20. Describe the company's IT prioritization process in looking for potential IT applications in logistics
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21. How do you scan for logistical IT opportunities?
   i. No systematic methods are used
   ii. Critical Success Factors for your industry (Low costs, etc.)
   iii. Porter - Competitive Forces (how to raise barriers within the five forces)
   iv. Porter - Value Chain (how to lower costs and where in the chain)
   v. Other - please specify

22. Did any of the below performance goals play a role in searching for IT for the logistics function? If so, how?
   i. Better Asset Management
   ii. Improved Logistics cost control
   iii. Better Customer service
   iv. Better Productivity
   v. Better Quality (i.e. less damages, returns, etc.)

23. (a) What is the title of your senior logistics executive?
     (b) How many years has this executive been in this position?
     (c) What was the senior logistics executive's previous assignment?

24. (a) What is the title of the person that senior logistics executive reports to?
     (b) What was this executive's previous assignment?

25. What type of description would best describe your current logistics organization
     (See List #1 for diagrams)
     i. Dispersed responsibilities for Logistics activities
     ii. Consolidated logistics responsibilities (i.e. formal dep't)
     iii. Logistics functions consolidated within business units
     iv. Centrally consolidated logistics responsibilities (separate bus unit)
     v. Corporate staff logistics function with line logistics functions in the business units
     vi. Other

26. How many years has logistics been a formal organization?

27. Are the logistics activities within your business unit
     i. completely centralized
     ii. somewhat centralized
     iii. combination
     iv. somewhat decentralized
     v. completely decentralized
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28. Has the trend over the last three years been towards
   i. centralization of logistics activities
   ii. decentralization of logistics activities
   iii. no change

29. Is the same true with IT in your organization?

30. Who is responsible for IT in logistics?

31. What percentage of revenue does the company spend on IT?

32. Is the above or below the industry norm?
   i. Don't know
   ii. Above
   iii. Below

33. Is this a deliberate policy?

Section #3 - The Adoption and Implementation Phase:

34. Within the last five years, how many times have all or parts of logistics been reorganized?

35. What parts of logistics have been reorganized?

36. How much change was needed in the logistics function to use the technology
   i. None
   ii. Slight
   iii. Moderate
   iv. Significant

37. Did you find technology to fit your logistics processes?

38. What amount of change was necessary to implement the system?

39. Did any outside parties redesign any of your workflows in light of the new IT?

40. Was there a key group of people or person that the technology was introduced to?
41. How did you implement the system?
   i. Direct
   ii. Parallel
   iii. Phase in
   iv. Modular
   v. Other

42. In what part of the logistics function was the new technology implemented?

43. How much was senior management involved?

44. What role did they play?

45. Was the implementation unique in any way? (y/n)
   In what ways?

46. Who was in charge of the implementation?

47. What department were they from?

48. Was there any involvement from the logistics function?

49. Were any outside parties involved in the implementation?
   i. None
   ii. A little
   iii. A lot

50. How much training did you provide?

51. What training did you provide?

52. How much user involvement was involved?

53. Was there any special communications set up?

54. Did you solicit feedback from the users and if so, how?

55. In implementing the IT, did you employ some type of project management technique?

56. Is this implementation process different from other implementation processes and if so, how?
59. What barriers to implementation did you observe?
   i. Cultural (planning and process focus)
   ii. Benefits (Didn't comprehend)
   iii. Technology Base (existing systems)
   iv. Cost
   v. People
   vi. Resources (What type as well)
   vii. Technology (planned system)

60. How did you deal with them?

61. How well has the system been accepted?

62. Can you quantify this?

Section #4 - Management and Control (Administration/Rationalization)

63. Please indicate the characteristics of information used to manage logistics. Use a five point scale where
   1= never
   2= not usually
   3= sometimes
   4= in most instances
   5= always

   Timely
   Accurate
   Readily Available
   Formatted on a Exception basis
   Appropriately Formatted to facilitate use

64. How do you measure the performance of the IT?

65. On the page accompanying this survey (List #1), please identify or list the primary performance measurements that the senior logistics management uses to monitor and identify problems in
   i. Cost
   ii. Asset Management
   iii. Customer Service
   iv. Productivity
   v. Quality

66. Have you created any tools to measure its efficiency?
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67. Who becomes responsible for the IT?

68. Have you set up controls to manage IT? (y/n)

69. What type of controls did you set up?
   i. Preventive (Deter problems)
   ii. Detective (Catch problems that arise)
   iii. Corrective (Correct problems)

70. Where did you set them up
   i. Accounting controls (Financial)
   ii. Work controls (supervision)
   iii. Product controls
   iv. Security controls

Section #5 - Impact (Maturity/Widespread Technology Transfer)

71. Do you perform any post-implementation reviews within the company?

72. Do you have one I can take with me?

73. What benefits, measurable or otherwise, have resulted from the IT within the firm?

74. How long did the benefits last
   i. < 6 months
   ii. > 6 months
   iii. > 1 year

75. What impact has it had on (using the five point scale below)
   1. Not applicable
   2. no impact
   3. slight impact
   4. high impact
   5. very high impact

   Sales forecast accuracy
   Computer support
   Excessive end of month or quarter surges
   Communications with customer
   Availability of trained logistics personnel
   Vehicle routing and scheduling
   Computer applications backlog
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Transportation cost
Communication with suppliers
Warehouse productivity
Measurement tools and methods
Communication with internal non-logistics organizational units
Timely information
Supplier logistical performance
Communication with logistical service supplier
Incompatibility of computer equipment and/or software
Inventory reduction programs
Cost reductions programs
Load leveling
Workforce leveling

76. Is the IT restructuring other parts of the firm?

77. In what ways did the system affect the Industry?
   i. Changed the nature/level of rivalry
   ii. Changed the structure
   iii. Increased/decreased transaction costs
   iv. Increased entry barriers
   v. Increased/decreased market size
   vi. Introduced new products
   vii. Other

78. In light of your current technological base and the technology you plan to or are currently develop closer ties to
   i. Raw Material Vendors
   ii. Copackers/Contractors
   iii. Public Warehouses
   iv. Carriers
   v. Customers/Brokers
   vi. Other (please specify)

79. Where there any other benefits accrued to your firm from the marketplace?

80. Have you try to build upon the IT now installed?
Five types of organizations are illustrated below. These organizations vary in the degree to which logistics activities are dispersed or consolidated. Consider which chart is most similar to your organization and then indicate your choice in the interview guide.

**Type A - Functional Organization:**
Dispersed Responsibilities for Logistics Activities

**Type B - Functional Organization:**
Consolidated Logistics Responsibilities
Type C - Divisional Organization:
Logistics Functions Consolidated within Business Units

Type D - Divisional Organization:
Centrally Consolidated Logistics Responsibilities

Type E - Divisionalized Organization:
Corporate Staff Logistics Function with Line Logistics Functions in the Business Units (essentially a combination of Type C and D)
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**List #2**

Possible performance measurements
to monitor and identify problems
(Please add any others as necessary)

<table>
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<tr>
<th>Category</th>
<th>Performance Measurements</th>
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<tbody>
<tr>
<td><strong>i. Cost</strong></td>
<td>Total cost analysis, Cost per unit, Cost as a % of sales, Inbound freight costs, Outbound freight costs, Administrative costs, Order processing costs, Direct labour costs, Comparison of actual vs. budget, Cost trend analysis, Direct product profitability</td>
</tr>
<tr>
<td><strong>ii. Asset Management</strong></td>
<td>Inventory turns, Inventory carrying costs, Inventory levels, Number of days supply, Obsolete inventory, Return on investment</td>
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<tr>
<td><strong>iii. Customer Service</strong></td>
<td>Fill rate, Stockouts, Shipping errors, On time delivery, Backorders, Cycle time, Customer feedback, Sales force feedback, Customer surveys</td>
</tr>
<tr>
<td><strong>iv. Productivity</strong></td>
<td>Units shipped per employee, Units per labor dollar, Orders per sales representative, Comparison to historical standards, Goal programs, Productivity index</td>
</tr>
<tr>
<td><strong>v. Quality</strong></td>
<td>Frequency of damage, Dollar amount of damage, Number of credit claims, Number of customer returns, Cost of returned goods</td>
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The following pages offer a summary of the responses collected for the questions posed in the interview guide. Each set of questions grouped according to what hypothesis it was to test. Each chart corresponds to the appropriate phase of the assimilation process. The six charts are:

Chart 1 - Company Background (one page)
Chart 2 - Initiation (two pages)
Chart 3 - Adoption and Implementation (one page)
Chart 4 - Management and Control (two pages)
Chart 5 - Impact Analysis (one page)
Chart 6 - Hypotheses Results (one page)

Blanks in the cells mean that the company either responded no to the question or that they do not make use of that technology.
## Company Background

### Technology

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### Computer Applications

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## Initiation

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