EXPLORING HOW INFORMATION TECHNOLOGY AFFECTS COMPETITIVE ADVANTAGE IN A CORE STABLE TECHNOLOGY MANUFACTURING FIRM

by

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To Tania María, Martín and Ana Verónica

Of Course, Dear Watson

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ABSTRACT

EXPLORING HOW INFORMATION TECHNOLOGY AFFECTS COMPETITIVE ADVANTAGE IN A CORE STABLE TECHNOLOGY MANUFACTURING FIRM

by

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Attention is increasilly being devoted to the importance of technology as a key resource of change and innovation to generate and sustain competitive advantage in any organization. Different types of technology have been identified: Base or Core technology, which is fundamental to the product or service being offered; Key Technology, that provides the technological basis for differentiation; and Pacing Technology, which is new technology, usually in its embrionic stage. The timing of the change provides the characteristic of *dynamic* to technology. Information Technology is an evidence of a widely applicable technology. These categorizations support the point that an organization may deal with different types of technology to enhance its competitiveness, and that technology strategy is the means to fit them all to the overall business objectives. This study investigates the phenomenon of the use of a dynamic technology to support the competitiveness of a core stable technological organization. Little is known about this phenomenon.

Current perspectives have little empirical substantation. To investigate this relationship, Information Technology (IT) is selected as the dynamic technology, due to its extensive use in service and manufacturing organizations as well.

The strategic role of IT and its consequences for the firm have been studied under diverse perspectives, such as IT and the competitive position of the firm and the changes in the strategic role of IT overtime. Upon these bases the phenomenon can be restated as the use of Information Technology to support the competitive advantage of a core stable manufacturing firm. The exploration of this phenomenon has clear implications for management during the technology planning process, especifically when the technology strategy is being defined. The point of interest is to understand *how* the use of IT affects competitive advantage. The scope is expanded to the disaggregate level using the value chain activities as a framework. Two research questions are addressed: Is the use of IT related to the firms competitive advantage? Are there differences in IT use within the different value chain activities of the firm? The test of causal relations is beyond the scope of this investigation.

The basic assumption is that technology must be *used* , not only acquired, to provide support to the competitive advantage, and that this support varies along the value chain activities. A case study research strategy is followed in order to explore the phenomenon as it was restated. To cope with the technically distinctive situation stated, this investigation is about the use of Information Technology in the MODELO Mexico Plant in order to support its competitiveness in the Mexican as well as International beer market. Preliminar data analysis lead to a third research question: How Information Technology is used in a firm with competitive advantage?

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CHAPTER I. INTRODUCTION

1.1 Research Objective

This study investigates a current phenomenon within a real life context: the phoenomenon of the use of a dynamic technology to support the competitiveness of a core stable technology organization. Little is known about this phenomenon. Current perspectives have little substantiation. Information Technology is selected as the dynamic technology, due to its extensive use in service and manufacturing organizations as well.

Upon these bases the phenomenon can be restated as the use of Information Technology to support the competitive advantage of a core stable technology manufacturing firm. This is a complex issue, as Information Technology use is only one of the many factors that affect firm performance.

The motivation for the study is to have a better understanding of how Information Technology (IT), the dynamic technology, affects a firm´s competitive advantage under the conditions given by technological environment dominated by a core stable manufacturing technology. The scope is expanded to explore this relationship disaggregating the use of Information Technology using the value chain activities as a framework. This perspective differs from the one that aims to asses the extent to which Information Technology provides competitive advantage to a firm.

The basic propositions are that Information Technology must be used, not only acquired, to provide some support to the firm´s competitive advantage, and that this support varies along the value chain activities. These propositions are different from the most generalized acceptation that

the position of the firm is improved, magically, by investments on Information Technology.

The main issues to know are: how Information Technology is *used* to support the firm´s competitive advantage and how it is *percieved* by administrators and users as a support of that competitiveness.

The exploration of this phenomenon has clear implications for management during the technology planning process, specifically when the technology strategy is being defined. The reason for this is that technology is now recognized as one of the fundamental core capabilities of a firm, and as such it is one of the central factors which enable the firm to act on strategy in order to utilize technology in favor.

1.2 Research Study Overview

Following the research strategy of a case study, the aim of this manuscript is to provide a theoretical perspective and empirical findings regarding how Information Technology is used in a core stable manufacturing technology firm, with a historical competitive advantage.

Chapter II. Development of the Research Questions and Proposed Model, begins with an understanding of the effects of technology on the firm´s performance. The two main blocks of such a relationship are discussed: Technology, its importance, its nature and different categories as a source of competitive advantage, and Competitive Advantage.

Some issues about technology strategy are included to incorporate a view of the common tool which matches technology with the overall business strategy. This general view leads to an intense literature review of the importance of Information Technology and its relationship with business and technology strategies.

The conceptual framework of the investigation, explaining the key factors, constructs and variables, as well as the presumed relationships among them is also included. The conceptual framework is the map of the territory being investigated, and is operationalized addressing two especific research questions -derived from the implicit general research question in which the research is focused- representing the facets of the empirical domain that are most wanted to explore.

The first research question is oriented to identify whether a relation exists between the firm´s pattern of IT use at an aggregate level and the competitive advantage identified by sales volume.

The second question is oriented to the possible different IT uses along the value chain activities and to identify the value chain activity in which the strongest relationship exists. From these research questions the expected relationships are stated and a research model is proposed in three sequential stages.

The research methodology as well as the exploratory nature of the study are defined in Chapter III. Several implications for this type of investigation are discussed. Given the starting conceptual framework and the research questions, the case is defined first providing the arguments to position the study in the context of the Mexican Beer Industry and to select the MODELO Mexico Plant as the case or unit of analysis to be developed.

At this moment of the investigation, this previous analysis introduce a new perspective to the study, and taking advantage of the case study method regarding adjustments to the research questions as a consequence of data disclosure, the third research question is posed: How Information Technology is used in a firm with competitive advantage?

Due to the explicit objective, the perspective of how much IT the firm is using to support its operations and procedures is elected over the popular

perspective of how much the firm is paying to support them. The research design alternates three kinds of data collection: interviews to key respondents, middle managers and general users, a survey conducted in parallel, and individual use reports. All data are productive for exploratory purposes.

The main issues for the quantitative instrumentation through a questionnaire and a report of use are the selection of measures and the operationalization of variables which are supported by an intensive literature review.

A report of the variety of measures used under different perspectives of analysis is also included. (IT Use) is considered at two levels of aggregation: an aggregate level, reflected in the overall IT use, and a disaggregate level comprised in its use in the value chain activities of the business unit selected for analysis.

As no single measurement instrument is available, the measures selected for application are derived from a vast research done in relation to the role of IT in a firm´s performance/value. Minor modifications are made in order to meet the requirements of the investigation.

A first set of measures is selected for the analysis of IT use at aggregate level, and a second set of measures is selected for the disaggregate. At this stage, measures are grouped as quantitative and perceptual items to provide the benefit of two complementary views: how users perceive, and how they use IT in their daily tasks.

Competitive Advantage is measured by the sales of the unit, data of daily sales during the period of investigation are provided by the finance management.

In Chapter IV. Analysis of Results and Findings, the combination of qualitative and quantitative evidence is specially noted. To elaborate analysis

providing richer detail, qualitative and cuantitative data are linked. Quantitative evidence indicates relationships, while the qualitative data help to understand the underlying relationships revealed by the quantitative analysis, a suggestive theory which can be strengthened by quantitative support.

Aggregate level analysis reveals that no similarities in the pattern of IT use, either CPU or ASP and Sales can be concluded. Intense fluctuations in Sales and CPU use contrast with ASP trend. To investigate whether the relation exists, a regression model, relating the total sales volume to the full capacity with %CPU and %ASP as measures of the aggregate IT use is fitted for the available data.

Using the indexes created for such a purpose, a second type of analysis appears at disaggregate level. A first exploration is made for each activity considering the resulting indexes from the sum of all quantitative and perceptual items. A second exploration is made considering only the resulting indexes from quantitative items to avoid aggregation bias.

An important finding in the quantitative analysis is the presence of an inflation effect when using the perceptual items in the model. When removing this effect, thus reflecting that the perceptions of the respondents about the advantages of IT Use, are not consistent with the real use for supporting their tasks.

A positive relationship between Sales and IT Use along the value chain activities is expected but instead, for some of the activities a persistent presence of a negative slope results. The statistical analysis at disaggregate level provide evidences of existing differences in the extent to which IT use in each of the value chain activities affects competitive advantage. Further descriptive analysis enriches the obtained results

providing information regarding how IT is used in a firm with competitive advantage.

Upon the basis of the data collected, findings from the second research question reveal the presence of differences in IT use within the different value chain activities of the firm revealing that IT use in each value chain activity has different relative influence on competitive advantage. From the third research question it is concluded that IT is used for transactional purposes, thus reflecting a traditional role.

Chapter V is the Theory Building chapter. A contradiction is found between the individual´s perceptions and the intensity of the individual´s use of IT, revealing a use paradox. Contradictory results are provoking and lead to deep into the knowledge of attitudes and behaviors.

From this discussion it is concluded that a positive perception about a technology is a necessary but not sufficient condition to use it. This perception by itself cannot lead to support the competitive advantage. The source of support of a competitive advantage is the intensive use of technology demanded by an implicit or explicit need.

The novel Technology Use Theory emerges at the end of the study as a result of the contradictory evidence found among the user´s perceptions on IT use, the benefits for the firm, the direct impact on the competitive advantage, and the wide range of reported use which goes from 100% to nothing.

The discussion, conclusions and implications of the study are presented in Chapter VI. Regarding the research questions, it is concluded that, at the aggregate level, IT use contributes to the competitive advantage of the firm because of the positive %ASP effect on sales. But due to the aggregation and complexity of the variables that affect competitive

advantage, IT use explains a 14% of the variation on sales. Since IT is a complementary technology, this percentage is considered significant.

At the dissagregate level, as it is expected, different impacts of IT on sales resulted for each activity. An inflation effect was observed in a test of one of the variables with quantitative items. Aggregation bias is suspected. Lower values of correlation coefficients and beta weights, which is a standardized measure of relative influence, result in a second analysis performed only with the quantitative items.

Evidences suggest that in a core stable manufacturing technology firm with competitive advantage, Information Technology is only used in operational tasks, not in strategic or informational ones, eventhough Information Technology use is perceived as a key resource to support competitiveness by administrators and users.

Gathering all these pieces, it can be concluded that the research objective is fulfilled. Additional findings add value to the results obtained through four types of explorations.

The large bibliography presented is a useful reference for those practitioners and academicians interested in technology planning issues. The questionnare included in Appendix B can be either a matter of discussion or a matter of replication for other industries of the kind. The respondents profile in Appendix C can also be useful, with comparison purposes, in studies of the beer industry which include larger samples of firms or a cross cultural perspective as well.

Admitedly one limitation of this study is its cross sectional nature which results in little data series for the analysis collected during a single business cycle period, thus suggesting that further research should consider longitudinal studies.

CHAPTER II. RESEARCH QUESTIONS AND PROPOSED MODEL

2.1 Related Literature Review

2.1.1 The Importance of Technology

From the broadest perspective of technology, attention is increasingly given to the importance of technology and innovation at the macroeconomic, industry, and firm level. There has been virtually unanimous agreement that technology "is a good thing"; therefore, it is a key element to maintain competitiveness. Categorical opinions of this kind are frequently encountered in literature.

Arguments given are variations of the same theme. Some of them sustain that firms try to use technology to generate and gain advantage over their competition (Lucas, 1993), or that firms can no longer afford to miss a generation of technology, that technological domain is one of the key factors of the level of competitiveness of the firm, and that the industrial winners will be those firms who seize and exploit technology as a corporate strategic "weapon" (Vasconcellos, 1990; Flemming, 1991; Kodama, 1992).

It is generally accepted that in the long run, competitive position, that is the fundamental performance of most individual firms, depends on how well they learn to manage and increase their technological asset base (Capon and Glazer, 1987). Technological dimension has been inserted in the firm´s planning processes recognizing that a critical link between technology and strategy exists (Kantrow, 1980), thus inferring that a technology strategy is the aspect of strategy which is concerned with exploiting,

developing and maintaining the sum total of the organization´s knowledge and abilities (Ford, 1988).

Previous discussion supports that technology is now recognized as an essential element affecting firm's competitiveness, development and growth, as well as a major feature to be addressed in strategic management. Technology is also recognized as one of the most fundamental core capabilities in a firm.

Inevitably technology has become one of the central factors to act on strategy in favor of the firm. In this context, technology strategy is one component of the overall strategy of the company that cannot be isolatated from other facets of corporate activity such as finance, investment and marketing, in order to configurate a coherent whole (Capon and Glazer, 1987; Dodgson and Rothwell, 1991; Hohn, 1986; Jester, 1987; Teece, 1988).

The substance of technology strategy was framed by Burgelman and Rosenbloom (1989) around four dimensions: competitive positioning, technology and the value chain, scope of technology strategy, and depth of technology strategy. As technology is present in different dimensions, its analysis is subject to several perspectives and levels of aggregation, such as the value chain dimension. Therefore, one of the first requirements to solve a technology-ralated problem, as the one to be explored, is to frame the nature of technology defining the boundaries in which it performs.

2.1.2 The Nature of Technology

The term technology has numerous connotations. The formal concepts of technology follow two categorical points. First, it is the neoclassical conception of technology in the form of a production function that expresses the relationship between various feasible combinations of

imputs or factors of production and output, where the focal point is the process of production. Second, there is what might be termed (Sahal, 1981) the Pythagorean Concept of Technology in terms of patent statistics and chronologies of major innovations where the uniqueness and novelty of an event is of crucial importance. Both viewpoints have been subject to voluminous literature.

As the nature of technology widens because of its functional properties, the concept is broadly defined as the "know-how", that is the information required by a firm in order to produce and /or sell a product or service. As a result, (Capon and Glazer, 1987) three components or sources of the "know-how", are identified. Namely, the product technology (the set of ideas embodied in a product), the process technology (the set of ideas involved in the manufacture of the product or the steps necessary to combine new materials to finish the product), and the management of technology (the set of management procedures associated with selling the product and administrating the business unit). This conceptualization distinguishes technology from new products themselves and from the more general notion of knowledge.

Building upon the idea of Capon and Glazer, further disaggregation of product technology, process technology and management of technology may carried out. These conceptual elements are summarized by Wilson and Valcourt (1991), when defining technology as the knowledge and the "know-how" that people apply to their work. Whether as new equipment as a new technique, technology is developed by highly skilled people, and it can be fully exploited only if it is used properly by well trained people to whom the knowledge has been transferred.

Under the perspective of their importance to the firm, technologies have also been classified as base, key or pacing (Ketteringham and White, 1984; Meyer and Roberts, 1986; Scharlacken, 1992).

*Base Technologies.- They are fundamental to the product or service being offered, but as they are widely shared they do not provide a source of competitive advantage. A unit must be necessarily proficient in its base.

*Key Technologies.- They provide the technological basis for differentiation. Relative strength in key technologies and the ability to sustain competitive advantage by themselves are critical to successful competition. They are also referred to as "core technology", considering their material impact on the busines unit as an advantage (Burgelman et al. 1989). The latter is enhanced by Contractor (1990) who believes that the core technologies, on which competitive advantage is based, may not be easily shared outside the firm, not even in the mature stage, and that each technology may also be classified according to its life cycle.

*Pacing Technologies.- They are new technologies without current competitive significance but that may replace the present key technology and thus provide the future basis of competitive advantage. The consideration of these technologies is relevant for a company, under the assumptions that the necessity for technological change is imperative if willing to survive (Parm, 1992), and that today´s increasingly competitive business environment demands the use of technological resources as imperative (London and McDuffie, 1987).

These categorizations support the idea that an organization must deal with different types of technology to enhance its competitiveness, and that

technology strategy is the means to fit all of them to the overall business objectives.

The most critical issue for maintaining competitive advantage is technological innovation (Electronic Bussines/Ernst & Young CEO Survey, 1991). The evolutionary nature of technical advances follows two patterns: the radical change or major breakthrough over some current product, process or management technology that fosters the emergence of new industries or segments the possibilities of marketing, producing or delivering, as well as the ancillary services provided.

The timing of these changes, referred to as the rate of technological change (Hambrick,1983), and the product sophistication (need to follow-up service and major role of professionals in the purchase decision) as well, provide the characteristic of "dynamic", as an evidence widely applicable to technologies such as Information Technology.

The alternative pattern that follows the evolution of a technology considers the incremental changes that are gradual refinement of an essentially invariant or "stable" pattern in process, product or management technology. Improvements come gradually, as a result of minor changes and alterations rather than major significant change. Andrews (1987) warns that the obsolescent industries protected by stable technology will become more quickly vulnerable to new processes and to cross-industry competition.

Due to the fact that the most recent wave of technological change, either radical or incremental, is as dramatic as any in history, the implications for firm decision-making are perhaps more pervasive now. Consequently they involve numerous key areas of corporate strategy and structure. Literature of Corporate Strategy suggests companies to be aware of the environmental aspects that are specially susceptible to the kind of

change that will affect their future (Andrews, 1987). Technology is identified as one of those key elements.

The environment of a business organization is defined as the pattern of all external conditions and influences that affect its life and development. Dess and Beard (1984) empirically supported two environmental dimensions in organizations. The first one is munificence, a condition of slack resources in the environment and the second one is dynamism, a condition of changes that are unpredictable.

Under this perspective, technological changes are identified with dynamic environments. Contractor (1990), points that the environment in many industries has changed so rapidly that technology acquisition from other firms, internal development, or the sale of technology beyond the firm´s boundaries have a great strategic importance.

The impact of technological change in the behavior of a company can be evidenced by changes in product life cycles, changes in definition of industries/new sources of shifts in traditional product-market competition boundaries, as well as in an increased globalization of markets (Chait, 1994).

The importance of technological change is also recognized at country level. A growing number of countries, such as Mexico, are integrating the technology issues into their economic and industrial policies to reduce the technological gap between the national firms and their foreign competitors, and to develop new mechanisms to accelerate the absortion of technology from other countries (National Development Plan, 1995-2000). The development of a national technology policy is a main concern to assure the entrance of Mexican products to foreign markets.

2.1.3 Technological Sources of Competitive Advantage: Core-Support/Stable-Dynamic Technologies

The importance of technology, to provide and sustain competitive advantage has already been corroborated broadly. Firms seek through competitive strategy to define and establish an approach to competing in an industry that is both profitable and sustainable. The approach to competing is termed competing strategy. Two central concerns underlie the choice of a competitive strategy: the industry structure in which the firm competes and its positioning within an industry that embodies the overall approach to competing. Concerning positioning is referred to as Competitive Advantage (Porter, 1990).

Anshoff (1984) suggests that competitive advantage is the positioning and relation of the organization to its environment in order to assure its continued success. In the long-run firms relatively surpass their competitors if they posess sustainable competitive advantage. This depends on the number and particular sources of advantage and on the constant improvement and upgrading to avoid replication.

Porter (1985:165) states technology has strategic importance for the firm as it often represents either an opportunity or a threat that affects competitive advantage. The frame for technology identification results useful at this point. The question is if it should be used in a general or specific sense.

When analyzing a technology-related problem, technology must be properly specified as base, core, or pace; and its environment must be identified as stable or dynamic so as to clarify the context in which the analysis is undertaken. Due to business strategy requirements, an organization can manipulate its technology in different ways producing technology mixes which create its technological spurce of advantage. For

instance, an organization oriented to financial services can support its competitiveness using a single technology such as IT, which in this case is a core technology with dynamic characteristics, and on the other hand, a manufacturing firm can use a technological mix of a core stable process technology and a complementary-dynamic technology such as IT to support operations and management functions.

The combination of different types of technology creates the technological environment. Core technologies, on which the company depends and without which it would not be able to operate in its markets, can be combined with support technologies, those technologies on which the organization standing bases its distinctive competence (Bickford and Spital, 1992). The combination of technologies or technological mix is a source of advantage. Therefore, technology strategy, in which this mix is determined, is an important tool for the organization.

It is crucial to identify the technological environments in order to analyze how a technology behaves. For example, the use of Information Technology when a Department Store Chain or the Bank industry can be identified as a core dynamic technology as it is the single component of the organization´s technology mix. When analyzing an engine manufacturing firm, in which the technological environment results of the mix of a core stable manufacturing technology and a support dynamic technology, the use of IT is part of the technology strategy.

Regarding their technological environment some business units operate in environments that are more turbulent or dynamic than others (for instance the computer industry and the electronical industry). Technology dynamism may be caused by rapid changes in product technology, by process technology advances or by technology management as well. Differences in technological environments result from the type of industry in

which the organizations are. According to the context the technological source of advantage could be either the core technology or the technology mix.

The wide range of technological environments suggests that the technology mix of each successful firm is related to its competitive position, and that in a core-stable technology environment the use of a dynamic-support technology has a positive relation to its competitive advantage. Consequently the interest to investigate how IT affects competitive advantage in a firm with a core stable manufacturing technology arises.

Still, the level of analysis considering the disaggregation of technology according to its nature (recall, base, core, pace) and environment (stable/dynamic), remains aggregate if the understanding of how each of the technologies in the mix contribute to the different activities is also meant. The sources of competitive advantage (CA) can not be completely understood by only looking at a performance that has been measured at a high level of aggregation.

Porter´s value chain (1985) concept disaggregates the activities, allowing researchers and managers to understand the strategically relevant activities and the linkages among them. It seems to be an appropriate reference to relate the network of activities, connected by linkages that occur when the performance of one activity affects the cost or effectiveness of the others.

The value chain is a useful tool for this analysis because the sources of differentiation are exposed. Differences result fundamentally from the way products, associated services, and other activities affect the buyers actions. This categorization is considered to be useful to explore the activities of the value chain where the application of a dynamic technology such as IT is positively related to the core/stable competitive advantage.

As information plays an important role in the value chain, it is expected that IT can change the way in which activities in the chain are performed and can thus affect linkages to customers and suppliers. When adopting a disaggregate perspective for the analysis, it is expected that IT impacts are not alike along the value chain activities due not only to the nature of the technology required for each of them, but also to the role it plays in the business environment.

The underlying consideration is that gaining competitive advantage requires that the value chain be managed as a system rather than as a collection of separate parts. Competitive advantage results from the performance of these activities at a lower cost than the competitors or from the use of these activities to create better products or services. Therefore, the technological mix or combination can be used as a particular source of advantage.

Different technology combinations used along the value chain activities can create a number of distinct sources of advantage, like flexibility which results in constant improvement and upgrading according to their own rate of technological change. Johnston and Vitale (1988) suggest that firms gain long term advantages from IT applications.

2.1.4 Technology Strategy

Exploring how IT affects competitive advantage of a core stable manufacturing firm results in useful information to build an Information Technology strategy for an effective IT use within the organization. Such a technology strategy consists of policies, plans and procedures for acquiring knowledge and ability within the company and exploiting them for profit.

For Bickford and Spital (1992) technology strategy is composed of a set of strategic decisions and actions required by managers to transform

input into output, with the objective to achieve competitive advantage. Product technology strategy embodied in the products of the business unit, process technology strategy used to manufacture the product line, and support technology strategy embodied in the standard managerial operations procedures of the firm are included.

Technology strategy demands a long term perspective this is important because will force the company to analyze the core and support technologies on which its operations are based (Hambrick, 1983) to know if the technology base is being fully exploited. The term strategy in technology strategy, presumably means the basic policy the firm takes in the technological fields (Quinn, 1961; Quinn and Cavanaugh, 1964; Rosenbloon and Kantrow, 1982).

In the 1990s, strategy meant the fundamental policy which determine the basic framework of the various activities of the firm and the basic principles of its game plan in the market place (Itami and Numagami, 1992). This perspective is consistent with authors as Foxall and Fawn (1992) who consider that firms reflect their strategic behavior because they act to create and control the environment.

Technology strategy is a useful means to capitalize on competitive advantage (Anshoff, 1984; Burgelman and Rosenbloom, 1989; Buttler, 1988; Chester, 1994). For such a purpose it must be modeled in the firms overall business strategy. It is considered that if a company is trying to gain higher performance from technology, the connection between technology strategy and overall corporate strategy is a major influence (Roberts, 1995).

Literature review on technology strategy provides a general framework in which a specific technology must be considered. Attention is focused on Information Technology (IT).

A selection of the abundant literature in technology strategy and related issues is reported in Table 2.1

Table 2.1

Technology Strategy: Selected Issues

PERSPECTIVE	AUTHORS
TECHNOLOGY STRATEGY	Bickford and Spital, 1992 ...relationships between technology, strategy, environment and performance... Burgelman and Rosenbloom, 1989 ...technology strategy as an evolutionary process integrated to overall business strategy... Buttler, 1988 ...incorporates organizational theories to anticipate patterns of technological innovation as part of an evolutionary process, to more fully understand and exploit the strategy-techology linkage... Capon and Glazer, 1987 ...proposed a framework for technology strategy: the strategic coalignment of technology and strategy... Dodgson and Rothwell, 1991 ...internal strategic cohesion between technology strategy and other facets of corporate activity including finance, investment and marketing... Ford, 1988 ...the meaning of technology strategy and what is involved in its introduction... Hambrick, 1983 ...identified types of strategies in mature capital goods industry... Itami and Nugamani,1992 ...strategy as the fundamental policy of the firm...

Table 2.1
Technology Strategy: Selected Issues. (Cont.)

PERSPECTIVE	AUTHORS
STRATEGIC MANAGEMENT AND TECHNOLOGY MANAGEMENT	Foxall and Fawn, 1993 ...technological, marketing and strategic development cannot be separately treated because they form a continuum... Hohn, 1986 ...technology forecasts including technology assessment and estimates of the social consequences are integral elements in strategic planning... Teece, 1988 ...extracting economic value from the innovation. Implications for economic relations, for commercial policy and for corporate strategy...
TECHNOLOGY AND BUSINESS STRATEGY	Anshoff, 1984 ...technology as an strategic issue to be managed... Jester, 1987 ...analysis of firm performance due to technology as a critical success factor in different strategic contexts... Quinn, 1961; Quinn and Cavanaugh, 1964 ...managers can position their firm to maximize opportunity if they can correctly interpret or have the power to act on technological signals....

2.1.5 The Importance of Information Technology

The precise definition of "IT" varies from study to study, IT can be definedin verious ways. Among the most common is the category "office, computing and accounting machinery" of the U.S. Bureau of Economic Analysis (BEA). Somoe researchers use definitions (Panko, 1982), that also include communications equipment, instruments, photocopies and related equipment and sotware and related services. Others define IT more broadly, including software, services and related peripheral equipment. Morrison and

Berndt (1990) included scientific instruments, communication equipment, photocopiers and other office equipment as well as computers in the definition.

IT is the means used to gather, process, store and transmit data, text, sound, graphics and other symbolic images. It has strategic significance (Reich and Bembasat, 1994).

To be effective, IT should have an articulated and communicated strategy (Henderson and Venkatraman, 1993), modeled on its business strategy in order not to limit the use of IT to that of a glorified fire extinguisher (Holohan, 1992) but to use it as an enabler to help bridge the gap between formulating and implementing a business strategy oriented to achieve and sustain competitive advantage.

Sustainability of competitive advantage, or the ability to maintain an initial gain in business performance from strategic IT, is a concept that has grown in importance, gaves a premium value to organizations. The introduction of IT may be a "strategic necesity" to maintain current competitive position (Clemons, 1986).

The strategic role of IT and its consequences for the firm have been widely studied under diverse perspectives such as IT and the competitive position as well as the changes in the strategic role of IT over time (Cash and Konsynsky, 1985; Ives and Learmonth, 1984; Porter and Millar, 1985). IT is considered as a global business driver (Ives, Jarvenpaa and Mason, 1993) and as an important issue to be included in organization tasks, in order to assure global competition (Jarvenpaa and Ives, 1992).

Several authors have suggested that IT plans should be linked to other artifacts in business, such as business plans (Conrath, et al., 1992 ; Lederer and Mendelow, 1986), business strategies (Pybum, 1983) or business objectives (Zviran, 1990). Weill (1994) considers that in the

strategic sense IT is aimed to enhancing current and future business results and in improving tha way the firm competes and operates. (Figure 2.1) Among the IT capability is required, the IT infrestructure is the is the largest contributor to long-term strategic business advantage. The IT capability includes both the technical and managerial expertice required to provide reliable services.

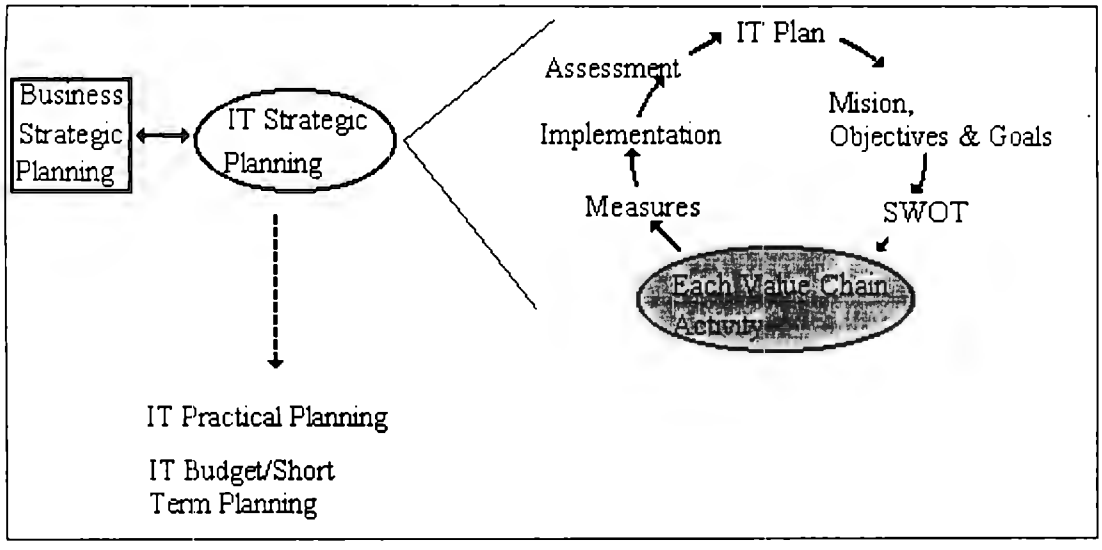


Figure 2.1
IT Strategic Planning Process

In recent surveys of IS and business managers (Galliers, et al, 1994), IT planning is consitently been rate as one of their most important concerns.

The business value of IT has been extensively investigated. To quote a few examples, Lucas (1993) developed a historical perspective analysis of the business value of IT, Westland (1993) digged into the question of how much value IT creates to business, while Weill (1993) analized the role and value of IT infrastructure. Ackoff (1967) studied systems use and the firm's benefit and added value; and Dos Santos, Peffers and Mauer (1993) used a

finance perspective to investigate about IT investments announcements and market value.

Other issues of interest to Academia, and practitioners as well, have been the analysis of IT investments (Banker and Kauffman, 1990; Booz-Allen Report, 1993; Harris and Katz, 1991; Kambil, *et al.*, 1993; Kekre and Mukhopadhay, 1993; Weill and Olson, 1989), and the relationship between IT and organizational performance (Bender, 1986; Dos Santos, 1991; Earl, 1989; McKeen and Smith, 1993; Miller and Doyle, 1989; Weill and Olson, 1989; Wilson, 1993).

In the business world, a common corporate concern is to seek alignment of IT investments with business needs and goals (Brancheau and Whetherbe, 1987; Reich and Benbasat, 1994). Top management has constantly doubted if IT has been applied in the most beneficial areas. In addition to these pressures firms feel the need to discover competitive advantage opportunities in IT and thus the corporate interest in the strategic planning of IT is understandable. IT strategic can be defined as "a pattern of decisions that sets the [IT] goals and the principal means for achievint both those [IT] goals and the business goals of the organization" (Adler, 1989, p.26). This definition does not presume that an organizations IT strategy is either written or widely shared.

There seems to be a generalized approach to find business themes on IT rather than to formulate IT strategies for the business. If IT strategy is an integral part of a vision of a business and if IT project is essential to achieve the business goals, it is possible to state the benefits, not only quantity but more confidently in terms of business rationale. The most important requirement for the IT function, is if IT is to be effectively exploited, whether it is well integrated to the rest of the business. Understanding the contribution of IT to business, is one way of putting IT in its place.

The IT community concedes that some benefits are difficult to quantify with some accuracy or certainty. They feel that it is difficult to set priorities between competing claims of IT resources. More recently the question is how managers can decide whether an IT project is more deserving than any other project calling for financial and other resources. What is required in the 1990´s is both a strategic appreciation of the value of IT and a detailed understanding of the key areas where IT use can strongly support the firm´s standard operations and procedures.

An extense recognition to the relationship IT-competitive advantage has raised. McFarlan, (1984) states that the link between a company IT investment and its competitive advantage is by now well-stablished, being instances of underinvestment and underutilization as well as instances of exaggerated expectations or overinvestment in IT.

Toraskar and Joglekar (1993) consider that the linkage between a firm´s use of IT and its competitive advantage is evident from the spectacular market impact that occurred in several well-documented cases. In their opinion the link between a company´s IT investment and its competitive advantage is by now well-established. For McKeen and Smith (1993), the use of IT can have an impact on the competitive market place or it can focus on the firm´s internal operations. While the end result of deploying IT in a strategic thrust is to achieve a competitive advantage or reduce a competitive disadvantage, the primary impact of IT application is either internal to the firm´s operations or external in the market place. Brown, et al (1995) consider regarding information systems that investment in strategic information systems (SIS) is advocated by numerous authors as an important way for firms to seek competitive advantage.

These arguments, summarized in table 2.2, provide support to the impact of IT in the firm´s performance, its role and its value for the

organization, and it also reflects the context in which it has been studied, and leads to the interest to explore how IT affects competitive advantage in technological environments characterized by core stable technologies, using a disaggregate level of analysis to provide some insight of IT use in each of the value chain activities. This is a new perspective if compared with the works in literature and it is the basic point of this research.

As it can be observed from the literature review, the general approach when analyzing IT and strategy related issues is the underlying idea that IT performs in a technological environment in which IT is the single technology. Only Weill's study (1992) in the valve industry analyzes IT in a shared technological environment.

Table 2.2
Information Technology Importance: Selected Literature

IT STRATEGIC ROLE AND CONSEQUENCES FOR THE FIRM	Cash et al., ...the strategic role of IT within an industry changes over time... Cash and Konsynsky, 1985 Ives and Learmonth, 1984 ...the role of IS as a competitive weapon... Porter and Millar, 1985 ...IT and firm's competitive position... Clemons and Kimbrough, 1986 ...the success of IT creating competitive advantage... Galliers, et al, 1994 ...IT as key issue for management... Ives, Jarvenpaa, and Mason, 1993 ...IT alignment to global business strategy, as a global business driver... Jarvenpaa and Ives, 1992 ...IT as an important issue in organization tasks, for a firm's global competition... Reich and Bembasat, 1994 ...IT alignment to business needs and goals...

Table 2.2
Information Technology Importance: Selected Literature. (Cont.)

IT INVESTMENTS/ EXPENSES	Booz Allen Report, 1993 ...the success patterns of IT, appropriate levels of technology investment... Banker and Kauffman, 1990; Harris and Katz, 1991 Kekre and Mukhopadhyay, 1993 ...IT investments directly affects firm´s performance... Brown, et al, 1995 ...IT investments in seek of advantage... Kambil, Henderson and Mohsenzadeh, 1993 ...IT investments, strategic managent, an options perspective... Toraskar and Joglekar, 1993 ...cost-benefit analysis for IT investment decisions... Weill, 1992 ...the effects of IT investments on firm´s performance... Westland, 1993 ...IT strategic investment analysis...
VALUE OF IT	Ackoff, 1967 ...systems use and firm's value added... DosSantos and Peffers, 1993 ...the direct impact of investments in IT applications on the market value of the firm... DosSantos, Peffers and Mauer, 1993 ...IT investment announcements and firm's market value... Lucas, 1993 ...business value of IT, historical perspective... Weill, 1993 ...role and value of IT infrastructure... Westland, 1993 ...how much value IT creates to the business...

Table 2.2
Information Technology Importance: Selected Literature. (Cont.)

IT AND ORGANIZATIONAL PERFORMANCE	Bender, 1986 ...overall IT effort affects the firm efficiency... Cron and Sobol, 1983 ...the economic benefits of computarization... Dos Santos, 1993 ...direct effects of IT on firm performance... Earl, 1989 ...IT infraestructure as one of the few sources of a long term competitive advantage...McKeen and Smith, 1993 ...IT use and organizational performance, contribution assessment, usage measurement... Miller, 1989 ...IT effectiveness... Wilson, 1993 ...assessing IT impact on organizational performance, discussion of fifteen studies...

It is recognized that an alignment of IT to business strategy must exist, but there is no reference to its alignment to overall technology strategies. This observation suggests that is not frequent for researchers to consider IT strategy as a subset of a technology strategy, or to study its impact when combined with other technologies such as process technology. IT strategy follows from the business strategy as a functional integration.

Is widely recognized the need for external alignment of IT strategy and for cross alignment with business strategy. In situations in which IT is combined with other technologies, its relationship with overall bussines strategy should be consider as well. The relationship between the three strategies can be visualized in figure 2.2 to make the point of the strategic planning of IT.

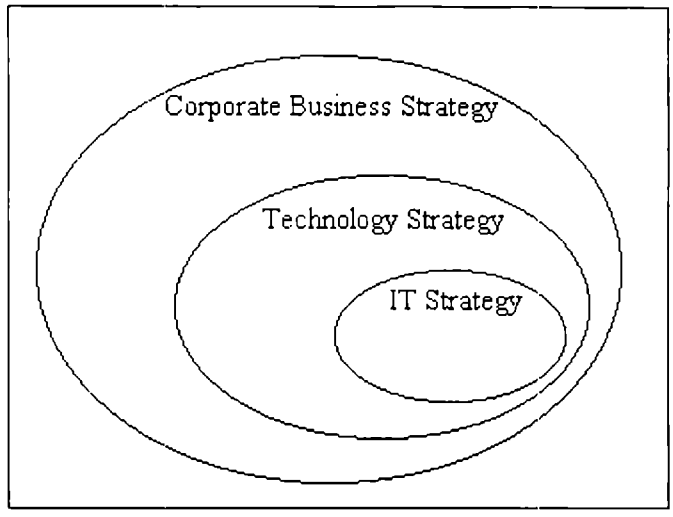


Figure 2.2
Business Strategy, Technology Strategy and Information Technology Strategy Relationship

Previous discussion was focused to the planning process for IT. The next aspect to be considered is the impact of IT on the firm´s performance. An extense literature review reveals that there are several works concerned with the assesment of the impacts of IT on firm´s performance, and that methods for such a purpose are in a state of evolution.

Wilson (1993) analyzed fifteen studies evaluating the effects of IT on economic strategic performance. McKeen and Smith (1993) refer to fourteen studies that analyze the relationship between IT and organizational performance, and categorize them as: I) functional IT investment studies wich determine the effects of specific IT applications on functionality related performance at activity or aggregated levels; II) aggregate IT investment studies that determine the effects of changes in aggregated level of IT investments on overall firm or business unit performance, in terms of either functional effects or organizational goals.

In the Wilson report it is suggested that comparative studies competing in the same industry should be undertaken to test in a more

rigorous fashion the propositions concerning the creation of competitive advantage with IT, and that selected case studies of industry leaders with superior performance are needed if we are to better understand the internal processes and procedures that lead to more effective investment decision making.

2.2. Research Questions

The literature review provides a framework in which the relationship between IT and competitive advantage is considered as two general block´s relationship, regardless of the technological environment and with little emphasis on industries such as manufacturing. This situation raises the interest in a new perspective of analysis. As it has been stated, the general objective of this investigation is to explore how Information Technology affects Competitive Advantage in a core stable technology manufacturing firm by incorporating the element of disaggregation. Therefore, a conceptual framework, that is the main things to be studied -the key factors, constructs or variables- and presumed relationships among them is developed for such a purpose.

The conceptual framework is simply the current version of the researcher´s map of the territory being investigated (Miles and Huberman, 1994). As it can be observed the study is allocated in a core stable technology environment, that is the reason for selecting a manufacturing firm. In this context two important elements exist regarding IT: the IT availability which provides the possibility to use it, and the perceptions of administrators and employees related to the importance of IT in relation to competitiveness.

Weill (1994) refers to IT infrastructure as the base foundation of IT capability, shared throughout th firm and usually provided by the information systems function in the form of reliable services.

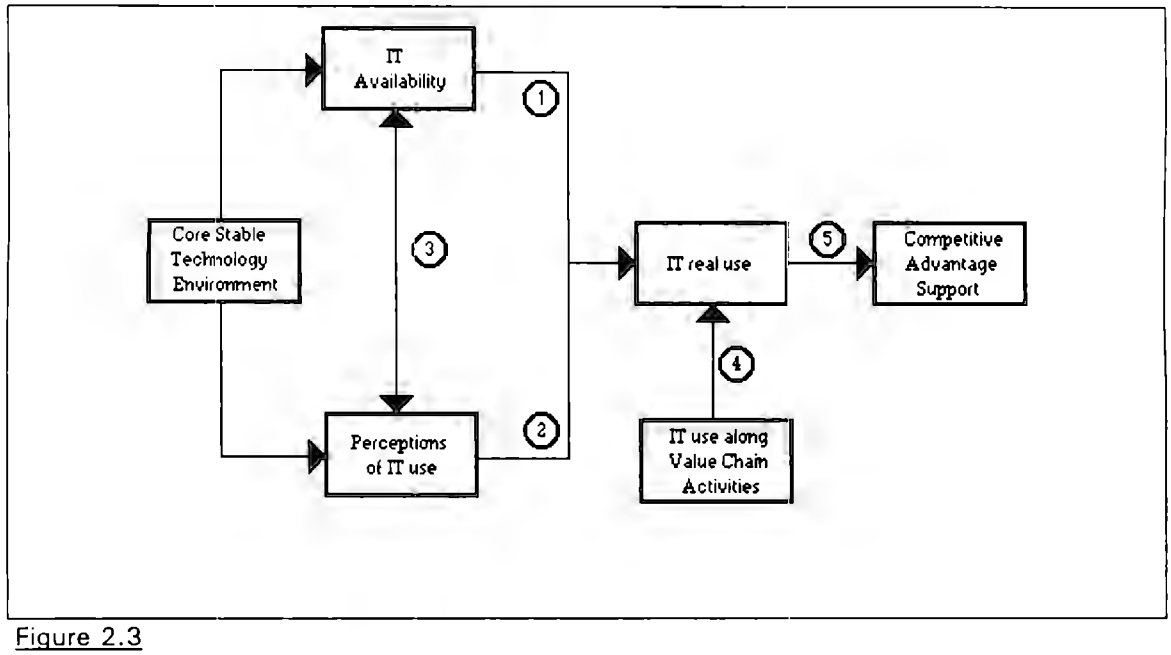


Figure 2.3

The Conceptual Framework for the Study of How Information Technology Affects Competitive Advantage in a Core Stable Technology Environment.

It seems natural that if a technology is available people will use it. A first relationship, (arrow one), could be suspected among the availability and use, leading to competitive advantage. According to this logic, the first thing to investigate is what elements of information technology are available in the organization and how much administrators and employees use them.

The second element is the individuals perceptions about IT use. How IT is perceived by individuals leads to an attidude toward IT use, (arrow two), to support competitive advantage. Perceiving the importance of IT by itself does not affects competitive advantage, the presence of IT use is required for that purpose.

These two elements can be related among them, (arrow three), when individuals perceive IT as an important source of advantage. IT is available to them, and they use it coherently. This combination is the most desirable and a relation between IT use and competitive advantage can be suspected as well. Use can be translated to discrete events while perceptions can be translated to attitudes and from there to behaviors. These are important assumptions for the selection of the data collection methods. The use of IT in an organization results from IT use along value chain activities, as it is pointed by arrow four.

As presented in previous segment 2.1 literature reflects the presence of a general assumption regarding the existing relationship between IT and competitive advantage. Pursuing an answer for the general implicit research question of How Information Technology affects competitive advantage in a core stable manufacturing firm? two specific questions are addressed. First, must be identified whether a relation exists between IT use and the firm performance. This problem rises the first especific research question:

The IT-Competitive Advantage Relationship

Research Question 1: Is the use of Information Technology related to the firm's competitive advantage ?

It is questionable that a firm has sustained a competitive advantage from employment of IT if it is studied in a core manufacturing environment. In this research question, the researcher is not looking for causality, the concern is limited to know if a relationship exists between the use of IT and the firms advantage. The test of causality is beyond the scope of this study.

Due to the nature, of the phenomenon under study, it is expected that the core technology will be the main source of advantage because of its direct impact in the product- thus, minimizing the possible impact of the support technology. To avoid this influence, an industry with a core technology, in the mature stage of its life cycle, is the appropriate environment to explore if the combination of manufacturing technology and IT or the use of IT are a relevant means to achieve this advantage. From these possibilities, the use of IT is selected for the exploration.

The concept of IT use (Miller, 1987), seems to be the most appropriate to know how much IT a company is using so that it can be correlated with the company performance. Data of IT use in determined periods of time (daily, weekly, monthly and so on) configurate a serie which reflects a pattern of use that can be compared with data which similarly reflect a pattern for competitive advantage and then, explore if there is any relation and if so what type its relationship.

The perspective considering IT value, investments and infrastructure, (discussed in 2.1.5) reflects *how much companies are paying*, and not necessarily *how much companies are using*. Therefore, the first one is not considered useful in the present discussion of the impact of IT on a firm's competitive advantage. Focusing in the use perspective is a main issue of this investigation.

As competitive advantage reflecting the firm´s performance is normally defined as the ability to earn returns on investment persistently above the average of the industry (Porter,1985), it is interpreted as the positioning and relating of the firm or organization to its environment, in a way in which it will assure its continued success, and it is measured as total sales growth over a five-year period (Weill, 1991).

In a firm with such a conditions, the firm´s performance can be identified with it sales volume during a time period. It is reasonable to expect that if IT contributes to the organization´s performance a relationship exists, and IT use will be positively related to the sales volume. In sake of the undestandin of the purpose of the study, it is important to make clear thjat the presence of such relationship does not implies causality. Recall the exploratory nature and the stated objectives of this study.

The data patterns can present differences due to fluctuations on business environment which impact the sales level, while IT use to support the organization´s operations can remain the same. Another difference in the patterns can be related to the presence in the operation of the firm of business cycles which impact the organization´s operations intensifying use during short periods.

The question is important in the context of the development of a corporate strategy, as well as in providing the strategic IT planning process of valuable information to consider in the IT development strategy which is supposed to be oriented to provide a necessary and unavoidable service to support the firm´s performance, is potentially more troublesome and requires to test causal relationships not addressed here.

From this question, at first, one might reasonable suspect that a positive relation exists between the use of Information Technology and competitive advantage, identified by the sales volume. Taking this into account the second research question is posed.

How IT Affects Competitive Advantage

Research Question 2: Are there differences in IT use within the different value chain activities of the firm?

Direct references to IT and value chain activities can be found in the IT literature. Dos Santos (1993) considers that the impact of IT investments of the firm cannot be completely understood by looking only at a performance that has been measured at high levels of aggregation. This consideration can be extended to IT use, because at aggregate level it reflects overall use and doesn´t allow the distinction between types of application that lead to identify how IT is being used.

Porter's value chain (1985) disaggregates the activities of the firm, allowing researchers and managers to understand the strategically relevant activities and the linkages among those activities. Information has important roles in the value chain. Usually, every activity has a physical and an information component. Therefore, IT can change the way that activities in the chain are performed and can affect linkages among activities. This reasoning suggests that not all IT uses are alike within the firm, and that an specific IT use is configurated along each firm's value chain. Learning these differences can be useful to allocate managerial efforts to take advantage of IT resources.

Wilson (1993) includes among seven approaches for assessing IT performance the value chain perspective as a useful tool to determine how a particular application of IT has altered a firm's value system or value chain. According to this author, by focusing on the value systems, managers gain deeper understanding of how IT is impacting economic and strategic relationships between suppliers, distributers and customers. The value chain perspective seems to be appropriate for an analysis at disaggregate level of the relationships between IT and the firm's competitive advantage.

Other references to the use of the value chain framework for the analysis of the impacts of IT in the firm's activities are founded in the Booz

Allen Report (1993) which refers to the value chain structure of a business as a means to develop an IT strategy, and in the Computer Technology Research Corporation (1993) publication, which considers the value chain approach as one possible framework for Information Systems (IS) strategic planning. These literature sources do not provide any empirical evidence of this approach.

Porter (1991) states that competition position can be shaped by the firm. To identify how information technology can be used to gain or sustain competitive advantage, a key concern focuses on the way IT can be used to enhance the coordination of the firm's value chain activities relative to competition. Once the role of technology has been explicit, it is much easier to improve how technology is used, resourced and managed to achieve the desired objectives.

As explained above, when IT becomes part of an organization's technological mix with another core stable technology, it is identified as a support technology. Then, it is reasonable to suspect that in a firm with core stable manufacturing technology, the use of IT differs largely across the firm's value chain activities, with different levels of association with the competitive advantage, creating a unique configuration to support the firm's competitiveness. From these arguments, it is presumed in second place that IT use in each value chain activity has a different relative influence on competitive advantage.

Information Technology's Position and Competitive Advantage

In the technological environment under analysis, IT applications in the primary value chain activities are more close to the influence of the core technology. For that reason, it is possible that their relationship with

competitive advantage be not so relevant as in support activities, where they are free of that influence.

The impact of IT positioned in different activities of the value chain is identified in scattered literature sources. Several primary activities such as suppliers, production and marketing are referred by Parsons (1983), who argues that IT impacts at firm's level affect key competitive forces: buyers, suppliers, substitution, new entrants and rivalry. IT applied at this level affects the firm's position through these forces.

At strategic level it can affect the firm's strategy in one of three ways: lowering costs, that is enhancing the ability of a firm to design, produce and market a comparable product more efficiently than its competitors, supporting a strategy based on a differentiation of products, or assisting the firm following a market niche strategy. In the context of the firm's operations, Ayres (1992) considers that extraordinarily rapid improvements in the basic "enabling" technologies of telecommunications, microelectronic and computers have created new possibilities for manufacturing that simply did not exist before. Computer Integrated Manufacture (CIM) increases integration of functions and control. In some circunstances, applying IT to a value chain activity is essential, even where it provides no lasting competitive advantage. The technology becomes a strategic necessity "because failing to attend to it results in strategic disadvantage (Floyd and Wooldridge, 1990).

Weill (1988) defines IT as a major vehicle for changing the factors of competition creating entry barriers, increasing power over buyers or suppliers and lowering risks of substitution. In later works Weill (1993), states that all IT uses are not alike, and that managers expect IT investment to influence performance in a number of ways.

From these statements, it is suspected that the relationship between IT positioned in primary activities and competitive advantage is different to the relationship between IT positioned in support activities and competitive advantage.

Other literature sources refer to the use of IT in value chain activities considered as support in a manufacturing environment. Flexible Manufacturing Systems (FMS) are an example of IT aplications directed at enhancing this organizational capability.

Candance and Kane (1992) consider that IT applied to Management of Information Systems (MIS) focuses primarily on transaction processing, such as accounting and payroll systems. MIS automates manual procedures related to the daily operations of the organization. Through Management of Strategic Systems (MSS), information technology is applied to satisfy the information needs of managers, typically, these systems enable ad-hoc query and analysis of historical databases to support the decision-making process. Strategic Information Systems (SIS), the use of information, information processing, and/or communications for implementing business strategy, often include the use of an organization's computer system by its customers and suppliers. Further more, a system is strategic if it changes an organization's product in a way in which it competes in its industry. This typology can be easily related to Weill´s transactional, strategic and informational IT applications.

It can be derived that at the firm level, IT has different types of applications as the ones mentioned above, and that those applications and their related intensity of use, are different for primary activities and for support activities. In a core stable manufacture technology organization, it is expected that the use of IT positioned to support activities of its value chain, will be positively related to competitive advantage.

2.3 The Proposed Model

For the purpose of this investigation, a three stage model is developed. The arguments about the relationships between IT and organizational performance, and about IT value for the firm are based on the theory of the firm. Those grouped under the perspective of the firm search to achieve competitive advantage are from strategy theory, while the value chain approach, in which the firm organizes its activities to achieve its goals in such a disaggregate manner that conform a value chain are identified with organizational theory. Building upon these arguments, those about the nature of technology considered as core or support, stable or dynamic, and in one previous relational model by Miller (1989), a three stage relational model is proposed for this exploratory study.

The model´s first stage explore the relationship IT $\rightarrow$ CA at an aggregate level and it is expected to provide information about the relationship between them. The latter identified by IT use obtained from Mainframe Registers (average percentage of CPU and ASP System used in a time period, as suggested by Computer Research Corporation, 1993), and from the sales of the same period. This model does not intent to demonstrate causality.

It is assummed that in a core stable manufacturing technology environment the influence of the core technology on competitive advantage is considered constant when it is stable in nature and mature in its life cycle. Therefore, IT, due to its dynamic nature, is expected to be positively related to the organization´s competitive advantage. Using sales volume to identify competitive advantage allows to avoid possible influences of price inflation that can appear if value units are used and keeps secrecy of data.

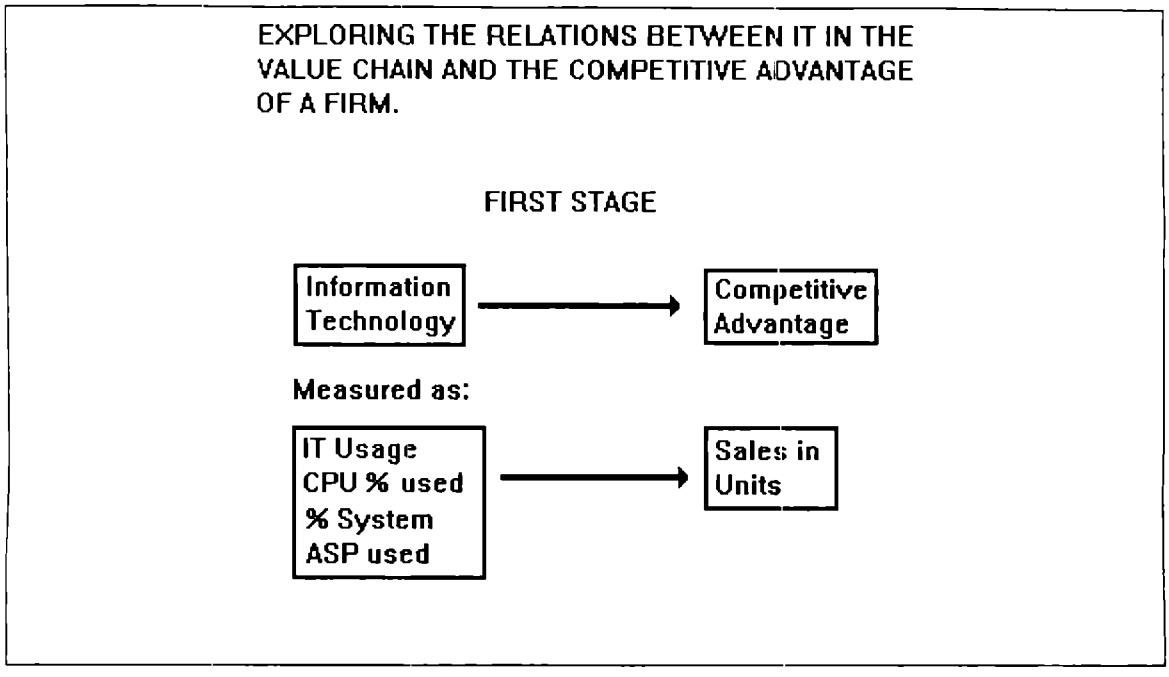


Figure 2.4

1st. Stage of the proposed Relational Model: Aggregated Level (Miller's basic statement)

In the second stage of the model the statement of the relationship is not altered, what is different is the dissaggregation of IT use according to the firm's own value chain, to explore the existence of different types of association between each activity and the sales volume that remains at an aggregate level. Regarding how a particular application of IT affects competitive advantage this is accomplished by breaking down the value chain into its component parts and quantifying the contribution of IT to the firm´s sales volume.

Due to the model´s disaggregation, (Figure 2.5) the use of IT along the value activities (Porter,1985) can be organized as primary activities: inbound logistics, production/manufacturing, outbound logistics, marketing and sales, and as support activities: firm infrastructure, human resources management and procurement.

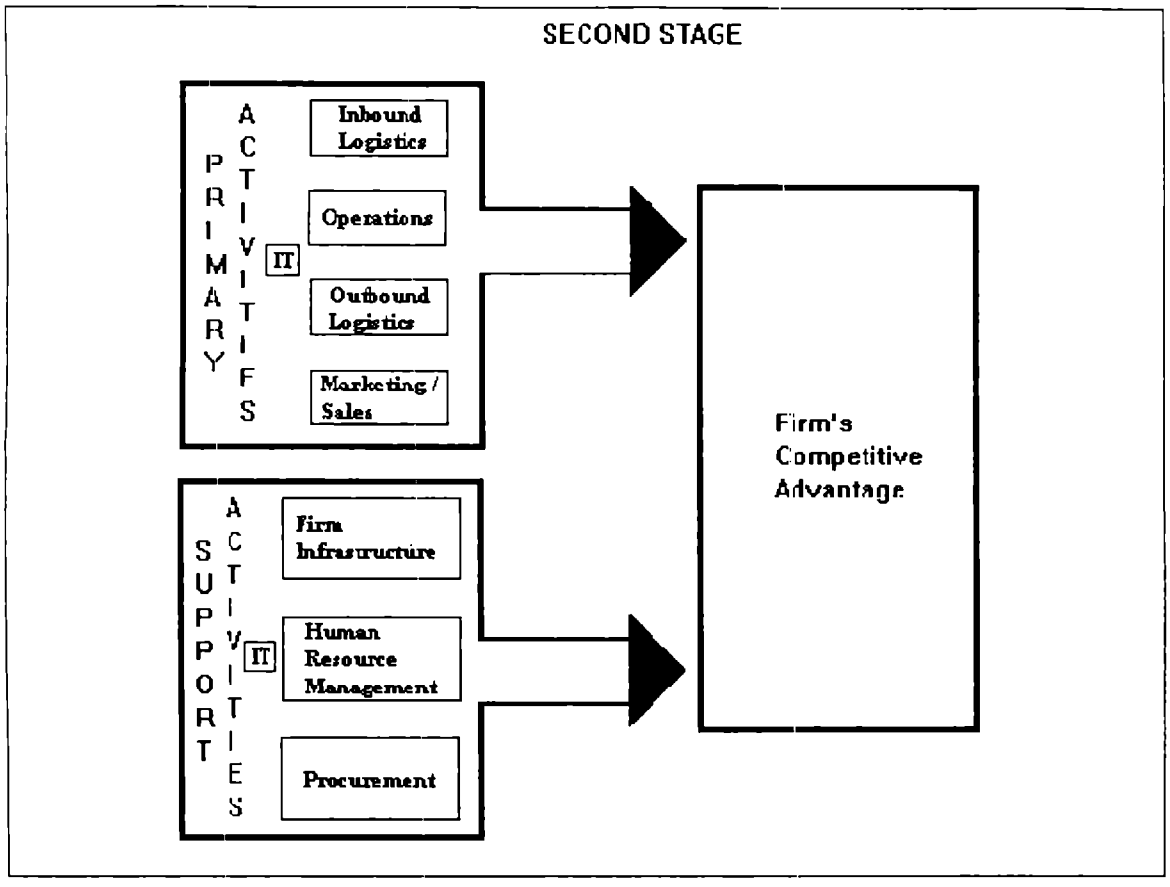


Figure 2.5

2nd. Stage of the Relational Model: Disaggregate Level

As IT use in each of the value activities is expected to have interactions with other activities, the Porter's value chain diagram is considered a useful tool to frame the possible types of correlation between the primary and support activities that lead to competitive advantage (Figure 2.6). By looking internally at the first value chain, managers can evaluate what effect IT has un the linkages between primary and suport activities.

So far, the situation to be investigated has been largely described, as well as the technological environment in which it is developed. From the

second research question a large number of relationships can be expected as seen in figure 2.7.

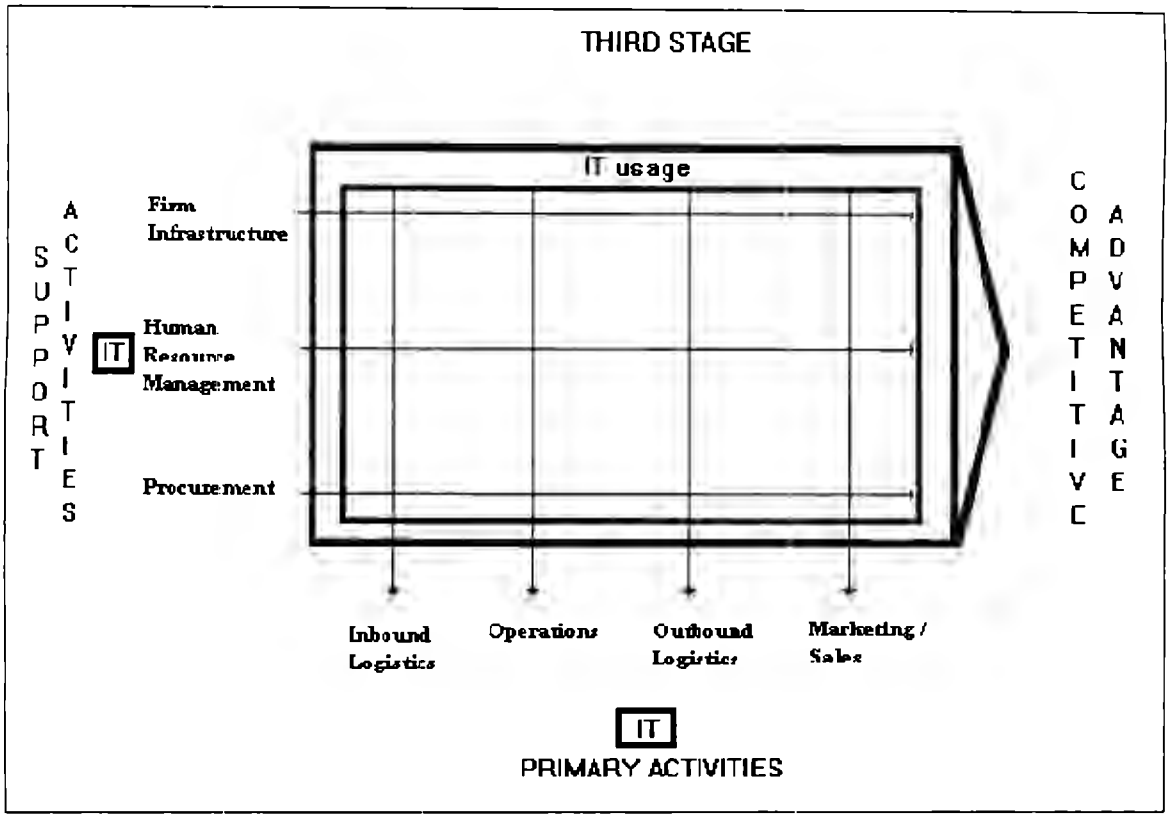


Figure 2.6

3rd Stage of the Relational Model: Relational Level

Due to the stable nature of the core technology, the exploration of the expected positive relation of IT use in the support activities strongly influenced by the firm infrastructure, is considered, as one objective of the analysis in this model´s stage, eventhough additional information can be obtained. At this point of the study, several pieces are gathered: the literature review, the study´s conceptual framework, the research questions, and the model which frames the research strategy to be used as well as the field activities of the investigation.

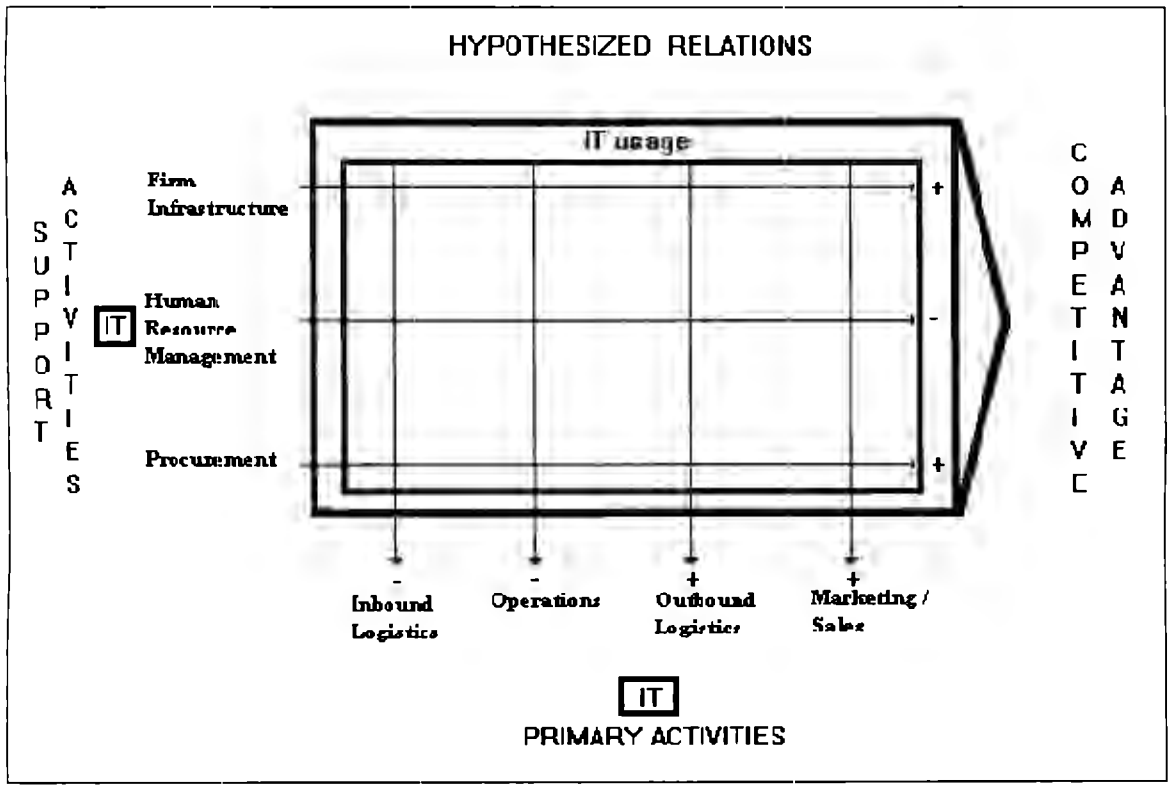


Figure 2.7

Possible Relationships Between IT along the Value Chain Activities and CA

III. RESEARCH METHODOLOGY

3.1 Case Study Research Strategy

Due to the nature of the general research question ("how" question), a qualitative approach using case study is used (Yin, 1994). Case Study research is recommended where the research focuses on a "how", "why" or exploratory "what" questions and focuses on contemporary (rather than historical) phenomena that the researcher have no control over. "How" questions are likely to favor the use of case studies or histories. Their derivative "how many" or "how much" are likely to favor survey strategies and statistical tests can be used to analyze the data. Case studies, like experiments, are generalizable to theoretical propositions and not to population or universes. In this sense, the case study, like the experiment, does not represent "a sample", and the investigator´s goal (Yin, 1994) is to expand and generalize theories (analytic generalization), and not to ennumerate frequencies (statistical generalization).

The case study method is used when the investigator deliberately wants to cover contextual conditions. In case study research a combinatory approach can be followed including the lines of a formal survey. Such a survey could be designed as part of the sampling procedures and the instruments used in regular surveys, and it would be subsequentely analized in a similar manner. The difference is the survey´s role in relation to other sources of evidence (Yin, 1994. p. 85).

It has been stated that this investigation has an exploratory character, therefore exploratiry analysis prevails. Exploratory analysis, as opposite of confirmatory analysis, defines possible relationships in only the most general

form and then allows the multivariate technique to *estimate a relationship* based on its methodology. The researcher is not looking to confirm any relationships specified prior to the analysis (or to explain the causal links), but instead lets the method and the data do the work and define the nature of the reltionship.

3.2 Selected Business Unit of Analysis

So far, the first component of the case study research strategy, the study questions, has already been described in Chapter II. The exploratory nature of the investigation is a legitimate reason for not having propositions as second component. According to Yin (1994), instead of stating propositions, an exploratory study should state a purpose. This condition is covered by the statement of the Research Objectives also seen in Chapter II. Following Yin´s methodology the third component of a case study research design is related to the fundamental problem of defining what the case is.

The research objectives and the research questions addressed require: a technological environment with a mix of core stable manufacturing technology (termed task technology by Weill,' 1992) in the mature stage of its life cycle, and IT as dynamic support or complementary technology. They also need a firm with an observable competitive advantage within its industry; identifiable value chain activities, and the firm's collaboration to develop the research above all.

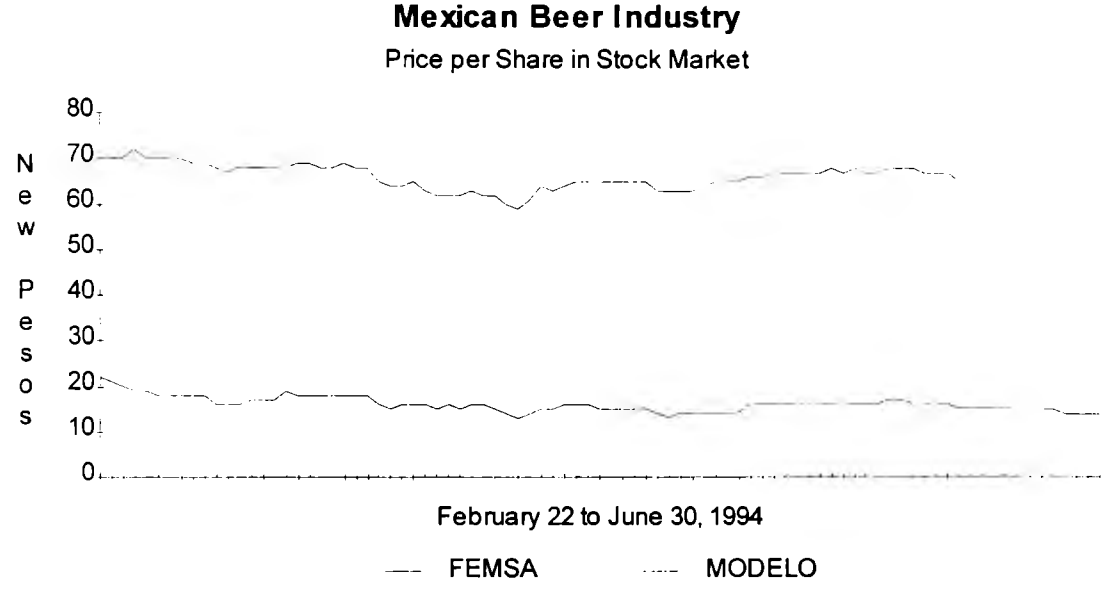
To cope with the technically distinctive situation stated in the research´s objective, this study is about the use of Information Technology in the MODELO Mexico Plant -the unit of analysis- to support its competitiveness in the Mexican and international beer market. The first requirement is covered by the brewery industry whose brewing process is

the core stable technology in the mature phase of its life cycle, in which the use of IT is considered as a complementary technology. For the second requirement, the Mexican brewery industry allows the identification of the industry structure consisting of two groups. Both of them are in the stock market. This situation allows to identify more easily which of them possess the competitive advantage. The two last requirements are met at business unit level by MODELO Mexico Plant facilities, currently the most important complex for Mexican beer production. Mexican Brewery Industry is integrated by: MODELO Group and FEMSA who merged two former groups: Cuauhtemoc and Moctezuma. These groups have fourteen facilities allocated in different geographic points of the country.

To identify which of the firms has competitive advantage over its competition, Weill's (1992) performance constructs were used: competitive advantage measured as total sales growth over a five-year period, and the firm value measured as market value of the firm, considering that if the firm is public its value is reflected in the price of its shares. This is consistent with Wilson's (1993) reference to outcome variables such as: sales, profit, market share and Return on Investment (ROI), which are considered as performance variables.

Under the sales growth criteria, MODELO Group reflects a sustained competitive advantage over its competitor. MODELO registered the 50.50/ 50.60/ 50.28/ 51.70/ 52.00/ and 52.5 % of overall industry sales from 1988 to 1993 (National Association of Beer Producers, Statistics 1989-1994). It is rated as the 12th brewery of the world with the 1.9 % of the world market share. Its participation in the Mexican beer exports raised from 2.48% in 1980 to 46.1% in 1985 and to 69.28% in 1992. It is the second rated firm in USA beer imports after Heineken.

The Firm's Value criteria states that the best value of a firm is its market value (Dos Santos and Peffers,1993). The financial market of a firm is an external measure of firm value. If a company is public, then its value is reflected in the price by share. The value of a firm whose securities are publicly traded can be determined by the value of these securities on financial markets. This criteria is applied to cross validate the results obtained from the use of the sales growth criteria.



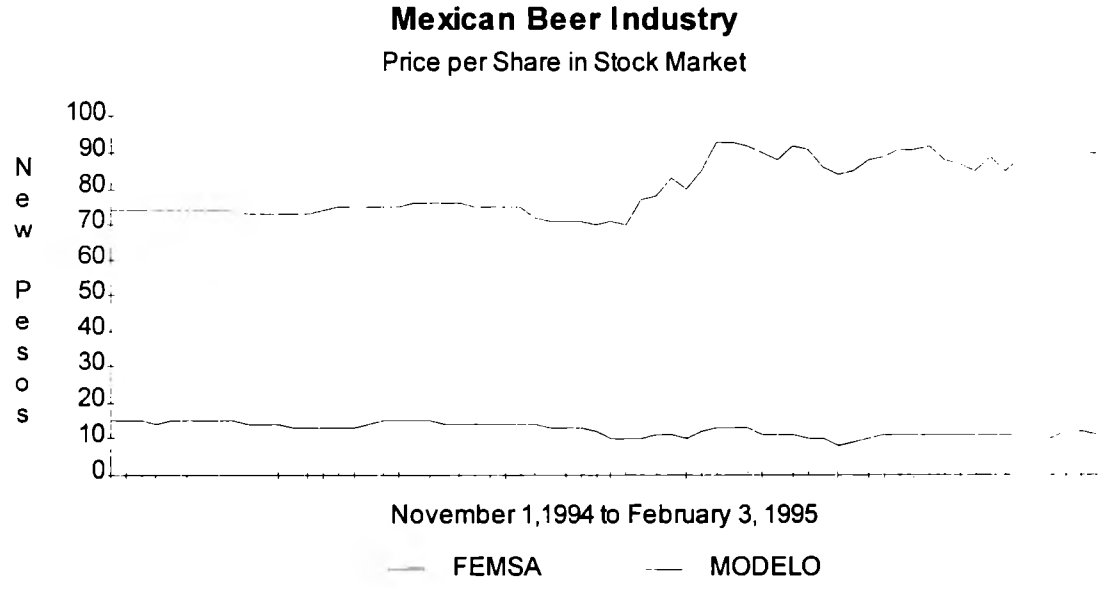
Source: Daily Data from the Mexican Stock Market, February 22-June 30 1994
MODELO Quarterly Reports FEMSA Quarterly Reports.

Graphic 3.1 The Market Value of the Firms in the Mexican Beer Industry

For the purpose of this research, an investigation is conducted through the quarterly and daily Mexican Stock Market Reports from February 22, 1994 to February 1995 to follow-up the prices of the share of each group. This period was determined by the fact that Modelo went public on February 22nd, 1994. The outcome of this investigation, at an aggregate

level, supported Modelo's Competitive Advantage as can be appreciated in graphics 3.1 and 3.2.

The strength of Modelo is confirmed by a specific event. During the hardest moments of the Mexican economic crisis of January-February 1995, in the middle of a situation considered as a crack in the Mexican Stock Market due to index fall that went in a single day to -11.6%, Modelo's price share reflected a pattern of growth, and the gap with its competition reached its widest point to more than ten times by January 11th, 1995, when Modelo's share price was 91.0 new pesos and FEMSA share price was 8.2 new pesos. This phenomena can be attributed to the financial position of Modelo, whose policy is to work with capital instead of debt of any kind. Therefore, the Group has a unique history of no liabilities.



Source: Daily Data from the Mexican Stock Market, November 1, 1994-February 3, 1995. MODELO Quarterly Reports. FEMSA Quarterly Reports.

Graphic 3.2 The Market Value of the Firms in the Mexican Beer Industry during the Mexican Economic Crisis (1995)

Once the point of Modelo's competitive advantage is established under two different approaches, another reduction is required to define the Business Unit of Analysis (BUA). Positioning the field study at BUA level, provides a unique opportunity to explore how IT affects competitive advantage at a disagregate level, and also to cover the gap noted by Miller (1987) when he pointed that most of the research in this field has been used either by industry or in individual projects as the unit of analysis, and therefore, has left a gap at the business unit level.

Elaborating on the arguments developed in segment 2.2, and taking advantage of the possibilities offered by the case study method regarding adjustments to the research questions leaded by the data obtaines, from this situation emerges a third research question : How Information Technology is used in a firm with competitive advantage?

The selection of the BUA is a key issue for the research, due to the fact that MODELO Group is vertically integrated by seven breweries, two malt plants, eighty-five distributors, five international enterprises, thirty-two real estate companies, one machine-tool plant for packaging, one firm in Spain for agricultural products, one crown and one aluminium can factories, one glass consortium and one board card consortiurn.

To study the research questions addressed, MODELO Mexico Plant, whose total annual production is consistently the highest of the seven breweries of MODELO Group and of the seven competitors plants as well, representing consistently the largest contribution (20% average in the last five years) to MODELO Group, is selected as business unit of analysis using its sales volume as an indicator of competitive advantage. Later on this chapter it will be observed that the plant sales volume had the same tendency to growth as the price share, reflecting that the economic climate does not affect the firm's performance.

Choosing MODELO Mexico Plant as Business Unit of Analysis is appropriate for two reasons: first MODELO has more than one business unit and may have different IT use for each. Second, within the plant there are the representative activities of the business that can be related to Porter´s value chain activities.

The selection of this business unit is founded on two definitions. A business unit is defined as one which sells a distinct set of products to an identifiable set of customers in competition with a well-defined set of operating units (Definition used in the PIMS database. Schoeffler, 1977). It is consistent with the definition used by Moore and Tushman (1982): "the product line and the smallest part of the firm which has some control over marketing, manufacturing, and research and development and engineering". This unit may share a sales force, manufacturing plant or R&D laboratory, but may be able to exercise some control over these functions.

Although MODELO Mexico Plant (MMP) doesn't share its manufacturing plant, it shares its R&D and other facilities as Information Systems with the other breweries and bussines units of the group. On the other hand it may share the use of group facilities of the sales infrastructure. For the purpose of the research questions stated, the business unit level - MODELO Mexico Plant- seem appropriate.

For its current operation, MMP core stable technology for beer production consists on fermentation, filtering, bottling and pasteurization, with very strict quality controls along the process that starts in the raw materials production.

Regarding the dynamic technology in the daily operations and procedures, the available IT infrastructure -during the fieldwork period- includes:

*1 LAN (Token Ring Protocol TCP/IP) in AS/400 F60 to support each of the plant's operations and procedures, its use is terrned production.

*1 AS/400 F60 to support systems development, for the exclusive use of the Systems Department, its use is termed development.

PC environment on line:

*PC's 111 units

*Printers 51

*Lap Tops 8

*Servers 3 (systems, accounting/costs, and treasure/accounts receivable).

* PC's 18

Commercial Software Packages are licensed and used in the PC online and outline environment, while especialized software developed in-house MMP are available online along the plant's value chain activities for target users. This situation meets the third requirement for the field study at BUA level. Top Management of MODELO Mexico Plant generously collaborated for the development of the field study, covering the fourth requirement mentioned previously.

Weill (1994) explain the IT infrastructure components, which are commodities and readily available in the market place, a set shared IT services such as a full service network and the human IT infrastructure. The IT infrastructure is a major business resource, the human IT infrastructure of knowledge and skills and the IT management vision provide much of the value added of IT infrastructure.

The Finance Division through the Systems Department controls about the 90% of the IT infrastructure used whithin MODELO Mexico Plant, and locally supplies processing services. IT planning and software development

are undertaken following on from business strategy. MMP IT infrastructure and services is identified with utility role and include:

*Maintainence and support of the mainframe computing facilities

*Communication network facilities

*Consultancy and support service when needed and required

*Software development when needed and required

*Information Technology education services

3.3 Measures and Operationalization of Variables

3.3.1. Literature

The nature of the research questions and the proposed model, reflects that the relationship to be studied belongs, in its broadest conception, to the group of studies about IT impact on organizational performance. IT impact is measured in Organizations using different criteria such as IT investment or expenses (Barua and Kriebel, 1991 ; Barua et al, 1991). On the IT side of the relationship, common measures used are IT budget, IT investment, IT expense or substitutes as computer ownership, number of software capabilities, or type of software (Kettinger et al, 1994).

To evaluate the quality of the investment -the other side of the relationship- the preferred performance measures are sales growth (Weill,1992), net income, return on investments or return on assets, revenue growth rates, productivity, return on management, and profit (Brynjolfsson, 1994 ; McKeen and Smith,1993).

The measures proposed by the investment perspective (Table 3.1) do not seem to meet the research questions requirement because they support more directly the questions related to how much the firm is paying for IT, and not to how much the firm is using. This argument is consistent with

Lucas' (1993) who points that there is no guarantee that by investing or adopting technology, the firm will necessarily derive value.

Table 3.1

The Impact of IT on Firm's Performance

Measures of IT Used Under Investment or Expenditure Perspective

Measure of IT	Author
Some measure of total IS expenditures either by organization or by industry	Banker and Kaufman, 1988; Bender, 1986; Datamation, 1987; Harris and Katz, 1991; Panko, 1991; Roach, 1989
MIS dollars by office worker Amount invested in different types of systems	Panko, 1982 Weill, 1990
A number of "substitutes for investment" such as computer ownership, number of applications	Alpar and Kim, 1990 Cron and Sobol, 1983
Number of personal computers	Mahmood and Mann, 1990
Amount spent on computers	Mahmood and Mann, 1991
Type of software capabilities	Cron and Sobol, 1983
ROA and market share as performance variable	Barua and Kriebel, 1991

Brown et al (1994) argues that large IT expenditures may reflect an inefficient IT operation or poor planning instead of reflecting a high level of innivation to support the firm competitiveness. On the other hand, because investments and implementation of an IT does not guarantee profitability (profits may in fact initially decline as a result of such investments), widely accepted measures as ROI (Return on Investment), ROE (Return on Equity), and ROA (Return on Assets) used to evaluate performance are not used in

this study. This view is closer to the thinking of many CEOs who seek economic justification for large IT investments.

IT use is a more comprehensive measure because as Markus and Soh (1994) argues, it is not "IT expending" that produces financial and non-financial returns, because expenditures can be wasted. Barua et al (1991) found that computer investments are not significantly correlated with increases in return on assets. Other authors (Floyd and Wooldridge, 1990) state that research has not demonstrated a consistent relationship between investment and IT and organizational performance.

From IT investment literature an important categorization arises distinctively among the different types of IT. Recognizing that IT is not an homogeneous entity, Weill (1992), categorized the different types of IT investment, particularly with respect to performance effects, as transactional IT, strategic IT and informational IT investments. He explains that:

* Transactional IT processes the transactions of the firm and IT investment of this type usually cut costs by substituting capital for labor. It is considered as the traditional IT investment where the transactions of the firm such as payroll, accounts receivable and order entry are automated. It is expected that this type of IT investment will be associated with improved firm performance measured by profitability and labor productivity. This is the automated vision for IT.

* In Strategic IT investment is made to gain a competitive advantage and increase market share, via sales growth (Ives and Learmonth, 1984). IT is used as an enabling technology to better meet market demand. In this case, the objective is expansion rather than efficiency. Strategic investments

in IT are expected to influence the growth aspects of firm performance such as market share or sales growth. IT is defined as the major vehicle for changing the basis of competition.

* Informational IT provides the information infrastructure to manage the firm and meet other management objectives besides cutting costs or gaining sales. It enables management tasks such as control, budgeting, planning, communications, accounting and analysis, is the information backbone of the firm and includes the IT infrastructure. A vision to informate, distributing knowledge about the administration and production processes at all levels of the organization.

Weill's categories of IT investment provide a useful framework for analysis and introduce it indirectly to the second stream of research, termed the productivity perspective, to assess the impact of IT on organizational performance. The productivity perspective is oriented to study this relationship through the impact of IT investments, expenditures or infrastructure on firm's performance giving attention to the second side of the relationship using productivity measures. This perspective deals with the effectiveness of the investments. The angle is the firm strategic and economic performance.

The question of what impact IT has had on organizational performance is analyzed by Wilson (1993) in a revision of fifteen studies reporting that half of them used multiple performance constructs and measures such as productivity, profitability, competitive advantage, operating cost efficiency, output quality, and effectiveness. Reported IT related measures are the number of software applications, the total IT capital stock, the IT expense ratio, the IT cost efficiency ratio, the units of

CPU, the total IS expenses, the strategic/transactional/informational IT stock, the laptop computer use, and the total IT expenses. As a result of the revision, Wilson raises the conclusion that making US companies more productive in the future will not be simply a matter of investing more capital in information technology.

Wilson´s work describes seven approaches for assessing IT performance: productivity, user utility, impact on the value chain, comparative performance, business alignment, targeting assessment and management vision. The value chain approach is described as an assessment of how a particular application of IT has altered a firm´s value system or value chain. This is accomplished by breaking down the entire value chain system into its component parts and quantifying the contribution of IT to a critical performance change. No empirical reference is made about the use of this approach to identify what firm's value chain activities are associated with stronger positive relationships between IT use and firm performance.

The specific problem of development of measures to assess the extent to which an IT provides competitive advantage is treated by Sethi and King (1994). They operationalized the construct "Competitive Advantage Provided by an Information Technology Application" (CAPITA) under the perspective of IT applications which had been developed to gain competitive advantage. Their study is based on user´s perceptions on general features of IS, impact of IS on the company and impact of IS on users. Objective measures of use are not included in this work.

Some of the IT measures presented in the Wilson review, such as units of CPU, computer use and number of software applications are related with the third stream of research which proposes IT use as an objective measure of the impact of IT in the organization performance.

Due to the consideration that an IT has an impact on an organization , it has to be used. The purpose of these measures is to determine *how much IT a company is using* so that it can be correlated with the company´s performance. Therefore, it seems to be the adequate perspective for this investigation.

As the nature of organizations varies, some of them deal with rutinary activities that process large quantities of data. For instance, production facilities´ data from inventories control or for accounting registers. Others deal with decision making processess as the financial institutions, or commercial firms that deal mainly with transactions. The configuration of the type of use of each of them is derived from their nature. Thus, the type of use that is important for one organization can not be so important for another.

Under this perspective, it is possible to make inferences about the type of use on the basis of the amount of it. A single organization type of use should be incorporated as a more refined means to identify the configuration of IT use in the organizational units or activities.

Focusing on Information Systems, DeLone and McLean (1992) reported a large number of empirical measures of Information System Use. Although there is no general agreement about its significance, as seen in previous studies such as Lucas´ (1975), who found that the use of information systems does not explain a great deal of variance in performance.

As the focal question of this study is how IT affects the firm´s competitive advantage, that is a variation of what is the impact of IT on a firm's performance under the IT use perspective, IT use is selected as independent variable because it reflects not only the expenditures in IT but also its application to the business operations. It is considered that IT

investments by themselves do not affect the firm's competitive advantage. It is the effective use of IT which contributes to achieve its goals and objectives. This argument leads to IT effectiveness and its measurement.

Table 3.2

The Impact of IT on Firm's Performance

Measures of IT Used Under IT Use Perspective.

Authors	Description of Study	Description of Measure(s)
Culnan (1983)	Overall IS; 2 Organizations, 362 Professionals	Frequency of Use
Fuerst and Cheney (1982)	DSS; 8 Oil Companies, 64 Users	Frequency of General Use Frequency of Specific Use
Ginzberg (1981)	On-Line Portfolio management system; U.S Bank,	Number of Minutes Number of Sessions
Hogue (1987)	29 Portfolio Managers DSS; 18 Organizations	Frequency of Voluntary Use
Kim and Lee (1986)	Overall IS; 32 Organizations, 132 users	Frequency of Use Frequency of Use
Raymond (1985)	Overall IS; 464 Small Manufacturing Firms	Regularity of Use
Snitkin and King (1986)	Personal DSS; 31 Users	Hours per Week

There are four categories of measurement of IT effectiveness in the literature (Miller, 1987): economic benefits, process outcomes, *IT usage*, and users perceptions. IT effectiveness is equated with IT performance and is studied at the firm, the system, or the unit level. Miller concludes that the

last two categories offer more potential as measures of the effectiveness of an IS, product or department.

Overall computer utilization is a measure of both the effectiveness of IT in an organization and the degree to which it is used. It is believed to be a measure of system effectiveness superior to subjective variables such as reported use or satisfaction (McKeen and Smith, 1993). The operationalization of the computer utilization variable is studied by Trice and Tracy (1986) as well, reporting subjective and objective measures (Table 3.3).

Table 3.3

Operationalization of the Computer Utilization Variable

Subjective Measures	Objective Measures
* Reported use	* Machine usage statistics
* Frequency of use	* Total production computer hours
*Plans to use a system	* Overall systems usage

Arguments against utilization for measuring are basically related to the negative influence of bad or wrong utilization, but are minimized taking into account that few businesses will continue to use any instrument that leads to bad decisions or that management will not tolerate an ineffective but mandatory system over the long term.

To understand how utilization links IT to performance, one explanation can be found in the argument of the different types of IT that affect performance: transactional IT, strategic IT, and informational IT, or any other to the degree in which IT is used in an organization.

3.3.2 Measure of Competitive Advantage

Considered as one of the most important performance outcomes, the most widely used measure for competitive advantage is a five-year sustained growth (Weill, 1992; Porter, 1985), Clemons and Row (1991) consider that theoretically, a company achieves competitive advantage, by being able to earn returns on investment persistently above the average of the industry. It is argued that competitive advantage can be measured not only in financial terms, but in terms of market share and new customers (Wiseman, 1988).

Considering as Business Unit of Analysis the MODELO Mexico Plant, this variable will be operationalized as the overall national and foreign sales volume. Due to its nature, this measure will remain at an aggregate level in the three stages of the proposed model.

3.3.3 Measures of IT Use

IT use is investigated at both aggregate level and dissaggregated value chain activity level. A fairly narrow definition of IT which includes all computer hardware, software, and communications (Dos Santos, Peffers and Mauer, 1993) is adopted. As in Weill (1992) IT embedded with productive capacity is excluded. This application is derived from the interactions of IT use. As the purpose of this study is to capture IT use that supports the firm´s value chain activities rather than the direct production purposes.

This is consistent with the considerations that firms can choose to apply IT at any point of the value chain in order to be competitive (Porter and Millar,1985). A view of the organizational role of IT and its fit with the strategic concerns of the firm is required to align IT investment with the business strategy.

Following the Ives and Jarvenpaa´s definition (1991), IT use is considered as the application of IT within an organization´s operational and strategic activities for a particular purpose.

Adapted from Hartwick and Barki (1994), a user is defined as a person who, as part of his/her reguklar job, use IT infrastructure hands-on.

3.3.3.1 IT Use at Aggregate Level

In the first stage of the proposed model, the relationship between IT and competitive advantage is explored at an aggregate level. As reported in many other studies (McKeen and Smith,1993; Wilson,1993) IT is operationalized using an objective measure derived from machine use statistics that are supposed to reflect the overall system use: % CPU and % ASP used.

Adopting these criteria, in the fieldwork, data should be collected in the BUA during a time period of 45 consecutive labor days to be sure to capture its full business cycle reported to be of 30 days. As suggested by Trice and Tracey (1986) data can be captured from mainframe registers. This condition requires that a designated executive of the BUA´s Systems Department collects the data daily during the considered peak period of use, and reports it as representative of the average use for each day.

The explanation given by the BUA´s personnel for using these criteria is that they monitor the mainframe capacity during the day. Once it reaches its maximum use in the day (they developed an expertice to identify mainframe workloads related to the business cycle of the organization) they have noticed that it is sustained the largest part of the day. This is considered as the average use for that day.

The use of standardized computer usage statistics is considered a better measure of IT effectiveness than more subjective ones. Higher

correlations between this measure and organizational performance are expected. Using CPU as a measurement (Computer Research Corp.,1993) provides a sense of how the computer system works and determines the amount of reserve, or excess, capacity availabe. Auxiliary Storage Processor (ASP) helps to enhance the CPU capacity.

As CPU usage is a measurement of the processor's activity overtime, a 100% CPU indicates a severe shortage of processing power. The industry generally aims for 50-70% usage (Computer Research Corp.,1993) providing both responsiveness and cost effective processor use.

3.3.3.2 IT Use at Disaggregate Level

A key assumption of this study is that IT is not an homogeneous entity (Weill,1992). Different IT applications and use intensity exist for quite different management objectives. Consequently, there is a need to distinguish the different intensity of IT along the BUA's value chain activities.

Based on this assumption, in search of an answer for the second research question, the second stage of the proposed model requires data from IT use in each of the value chain activities of the BUA, which are not available in machine statistics and can hardly be derived from mainframe records such as jobs in system. Therefore, the measurement strategy turns to subjective measures to know how and to what extent the BUA uses IT along its value chain.

The value chain is the series of activities performed by a firm to produce products or services for delivery to customers. Value chain activities include both primary activities and support activities. Primary activities begin with inbound logistics and continue through operations, outbound logistics, sales, marketing and service. Support activities are

required by the organization to function efficiently, and in addition, each of the primary activities uses the support activities to add value to a firm´s product.

As derived from IT use literature, subjective measures IT Use can be classified into quantitative and perceptual items providing the benefit of two complementary views: how users *perceive*, and how users *use* IT in their daily tasks.

To incorporate a large number of both items in the analysis, for each IT use along the BUA´s own value chain two sets of measures are defined, one for quantitative items and a second set for perceptual items. (Figure 3.1 and Figure 3.2).

The quantitative items are identified from Table 3.2 as reported use, frequency of use, and hours of use of equipment, software or telecommunications facilities. The number of computer hours is used as a measure of how much IT resource of the organization is used.

The quantitative set of IT use has four dimensions, termed items hereafter:

IT Use, operationalized as weekly hours of use of equipment, software programs and LAN instalations;

Application Type, operationalized as weekly hours of use for transactional, strategic and operational purposes;

IT role, operationalized as weekly hours of use oriented to support the BUA´s operations and procedures as well as the strategies; and

IT Interactions, operationalized as the number of interactions within the value chain activities through IT use.

It is relevant for this study to make it clear that these items, integrated in a set of quantitative items are not the variables of the relationship explored.

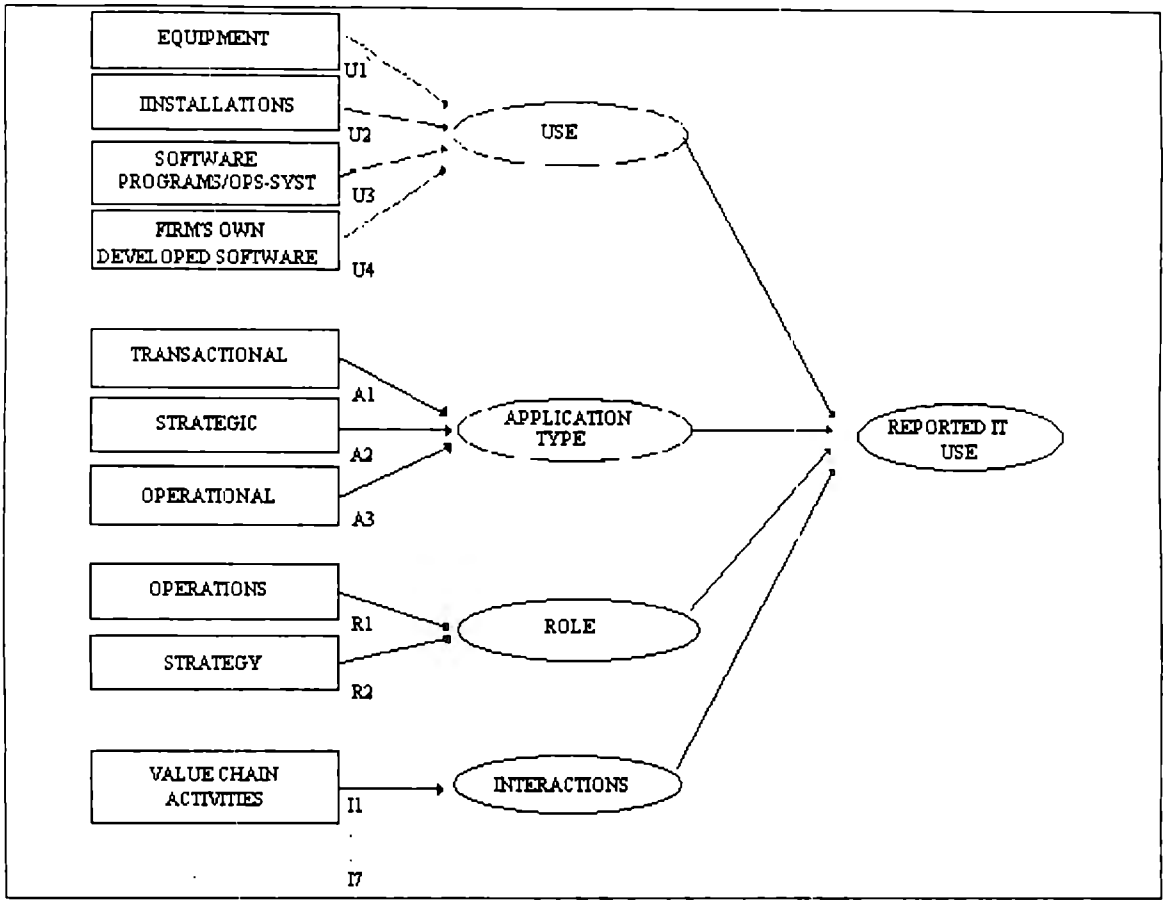


Figure 3.1 IT Use at Dissaggregate Level. Quantitative Items.

The operationalization of a construct: IT use is measured by four categories of cuantitative items as mentioned above. These items, gathered with a set of three perceptual items, will be the components to be integrated into an IT Use Index for each of the BUA´s value chain activities, in order to create the six independent variables required to fit the relationship being explored.

As it has been discussed in the literature review, one of the categories for measurement of IT effectiveness selected for such a purpose, is user perceptions (Miller,1987). Based on surveys of users´ beliefs and attitudes

towards IT, proponents of users attitudes argue that if they feel positive towards a system, it must help them to do their job better. Termed perceptual items in this study, user perception is defined as the degree to which a person believes that IT provides or enhaces competitive advantage.

A second set of IT use measurement referred to as IT Users opinion is operationalized to increase confidence in the results. The measures come from previous studies with minor modifications as required for the research purpose and the BUA´s characteristics as well.

IT Usefulness has three dimensions:

Strategic Importance of IT is operationalized as IT use oriented to support the BUA´competitiveness;

Integrative Strategy is operationalized as the users opinion about the enhancement of IT capabilities in cumulative levels of equipment and software acquisition, and in-house software development for internal use, Business Group level and the internal-external level to establish links with external entities such as banks, customers or suppliers that are not part of the Business Group;

Users´ Perceived Satisfaction with IT is operationalized as users´satisfaction with infrastructure support, training in IS, and with infraestructure performance. After a second thought, if users are satisfied with IT performance they will define *Plans to Use* IT. This item is integrated into User´s Satisfaction. Previously, the item is operationalized as the users plans in one year to use enhanced IT resources such as equipment, software/interfaces, internal networking, nationwide networking and international networking.

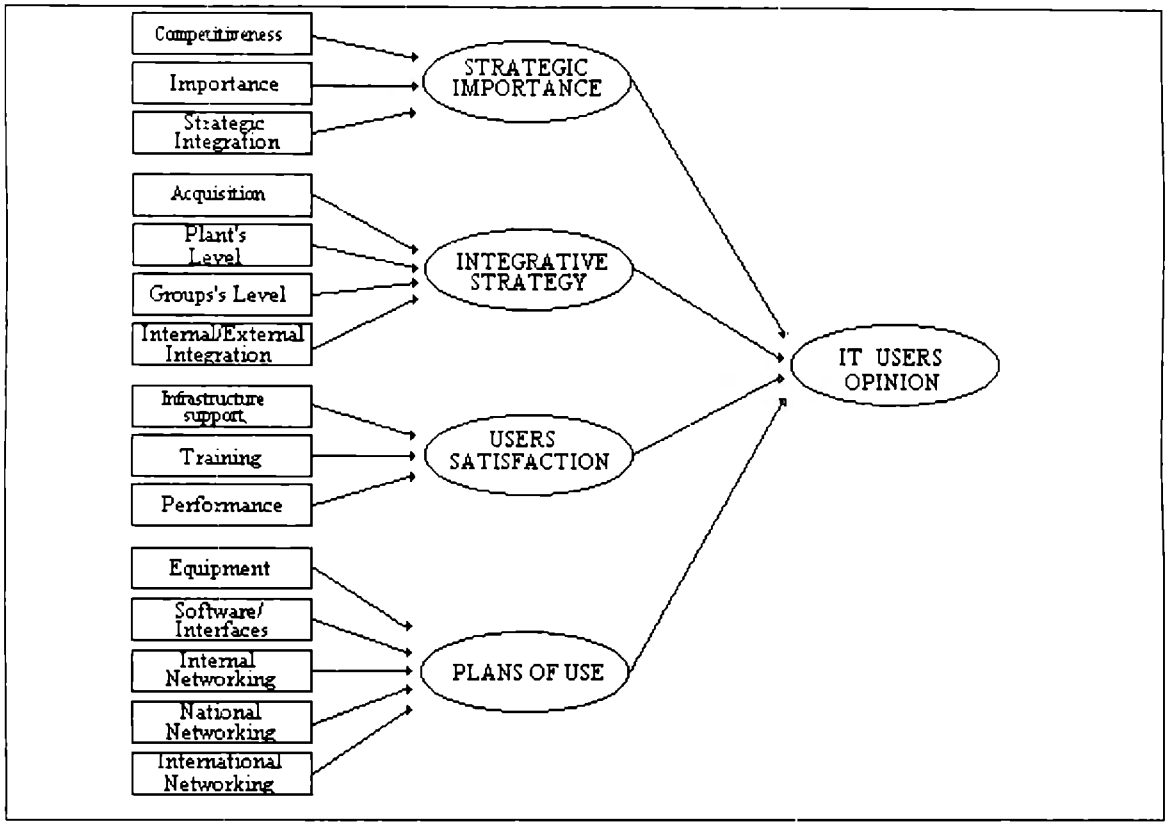


Figure 3.2 IT Use at Dissaggregate Level. Perceptual Items

The theory of reasoned action, (Fishbein and Ajzen´s, 1975) provides a basic framework that appears well suited to the task of explainning the differences between attitudes toward objects (IT opinions) and behaviors (IT use). In this author´s therms, users opinions as defined here, is a believe and refers to the extend to which a person beliefs that an IT possesses two characteristics: Important for the firm´s performance and personal relevance. Acording to Fishbein and Ajzen, beliefs link an object or behavior to some attribute, characteristic or outcome. Acording to this theory, the inmediate determinant of a person´s behavior is his/her intention to perform the behavior. The person´s behavioral intention is said to be determined by his/her attitude concerning the behavior. It is reasonable to expect that the

more personaly relevant, and the better IT is perceived to be, the more likely they will use IT. Of course, there are other influences also leading to IT use such as firm´s policies, orders from supervisors and underlying personal needs.

A related construct, perceived usefulness, has been proposed in IS by Davis (1989). Acording to Davis, perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhace his or her job performance". Davis measures have the purpose of predicting and explaining use, in this study the purpose is to know how the users perceive IT as a means to achieve or sustain the firm´s competitive advantage.

Perceptual data should be collected only one time from each of the respondents in the BUA´s value chain activities. For such a purpose, the use of a type of interview entailing more structured questions was selected, along the lines of a formal survey. Such a survey requires to be designed as part of the case study, involving the design of an instrument as in regular surveys.

The appropriate instrument seems to be a questionnaire to be applied during an interview with the users participating in the six- week period of reported IT use. As a distinctive feature of this Chapter, Table 3.4 summarizes the index component measures, literature sources, operationalization and scales used to built the report use and the questionnaire as instruments for the data collection. The rationale for the quantitative items is presented in Table 3.5. For the perceptual items is presented in Table 3.6.

Table 3.4
Index Components: Measures, Sources, Operationalization and Position in the Questionnaire

IT Use for each Value Chain Activity

Index Components	Measures Reported in the Literature	Source	Operationalization	Scale
1. IT USE Objective Measures:	Hours of Machine Usage	Proposed by Miller, 1987 as a measure of IT effectiveness		
	Hours of Machine Usage	Miller, 1987	Weekly hours of use	Questionnaire item
	%CPU used, %ASP System Used	Computer Technology Research Corporation, 1993	Equipment Commercial software (PC environment)	Q. 6 Q. 7
	Total Production Computer Hours	Trice and Tracey, 1986	Firm's own developed software (mainframe environment)	Q. 8 a/f manufacture
	Overall System Usage			Q.8 g/i inbound logistics
	Lap Top Computer Use			
	Computer Ownership	Cron and Sobol, 1983;		Q. 8 m/n procurement
	Type of Software	Alpar and Kim, 1990		Q. 9 a. outbound logistics
	Number of Software Capabilities or applications	De Lone and Mc Lean, 1992		Q. 9 b/d marketing / sales
	Number of Personal Computers	Mahmood and Mann,1991		Q. 9 e,f,g,h,i,k,l firm's infrastructure
				Q. 9 j/m human resources management

Table 3.4
Index Components: Measures, Sources, Operationalization and Position in the Questionnaire (Cont.)

IT Use for each Value Chain Activity

Subjective Measures:	Reported Use Frequency of use IS use	Miller, 1987 Miller, 1987; Culnan, 1983 Kim and Lee, 1986 Raymond, 1985 Sintkin and King, 1986 Miller, 1987		
2.APPLICATION TYPE	Plans to use a System	Weill, 1992	Degree of importance and frequency	Q.10 b,c,d,e
Transactional	Automated Transactions of the Firm (Payroll, receivable accounts, order entry, etc)	Weill, 1992	User's applications of systems to automated operations of the firm	10. a
Strategic	Channel to the Customer Automated Task as Control, Budgeting	Weill, 1992	Services to customer support	Q.10 f,g,h,i,j,k,l
Informational	Planning, Communications		Information structure to management	

Table 3.4
Index Components: Measures, Sources, Operationalization and Position in the Questionnaire (Cont.)

IT Use for each Value Chain Activity

3. ROLE Traditional Role Evolving Role Integral Role	Job Support (productivity) Job Quality, Speed, Complexity Use as Firm's Strategy Support Usage as Competitive Tool	Weill and Olson, 1989 Grover, 1990 Grover, 1990	Degree and frequency of IT use for job support Performance assessment IT use for firm's strategy support IT used as competitive tool	Q.11 a,b,c Q.11 d,e Q. 12
4. INTERACTION THROUGH IT	Number of Interactions Reported within each of the Value Chain Activities.		Frequency of interactions reported	Q.13 a/d sales Q. 13 e/h inbound logistics Q. 13 i/o production/ operations Q.13 p/q outbound logistics Q.13. r, s, v, u, x firm infrastructure Q.13.u procurement

Table 3.4
Index Components: Measures, Sources, Operationalization and Position in the Questionnaire (Cont.)

IT Use for each Value Chain Activity

5. STRATEGIC IMPORTANCE	Support operations Support strategy Integral part of strategy		Extent to which IT use is perceived as a support tool or as an integral part of the strategy. Frequency of use	Q. 14 Q. 15 Q. 16
6. INTEGRATION STRATEGY	Degree of Integration Type of Integration Vertical Horizontal	Clemons and Row, 1991	Frequency of own solutions Frequency of external solutions Frequency of vertical integration suggestions Frequency of horizontal integration suggestions	Q. 17 a Q. 17 b Q.1 7 c Q.1 7 d

Table 3.4
Index Components: Measures, Sources, Operationalization and Position in the Questionnaire (Cont.)

IT Use for each Value Chain Activity

7.USERS SATISFACTION	Users Perceptions (Attitudes toward IT or Users Satisfaction) Users Satisfaction	Miller, 1987 Bailey and Pearson, 1983 Davis, 1989 Baroudi, Olson and Ives, 1986 Baroudi and Orlosky, 1989	Satisfaction toward IS Support for daily operations Degree of satisfaction toward IS training program quality Degree of satisfaction with performance of IT infrastructure	 Q. 18 Q. 19 Q. 20
8. PLANS TO USE	Equipment Growth Software Systems Growth Applications Development Telecommunications Growth	As in Miller, 1987	Degree and frequency of requirements: Equipment Software Application development Telecommunications	 Q. 21 a/c Q. 21 d Q. 21 e/f Q. 2 1 q/i

Table 3.5

Index Components First Set: Quantitative Items Rationale

IT Use for each Value Chain Activity

Index Component	Item	Rationale
Use	Equipment Installations Software/ Programs Operations Systems	The level of use identifies how much of the current infrastructure capacity available is supporting the tasks in the workplace environment. It is assumed that the real use is the possible source of advantage rather than the perceptions of its importance.
Application Type	Transactional Strategic Informational	The type(s) of application identifies how the organization uses IT to support its operations and procedures to do business, and to influence the intensity of use.
Role	Operations Strategy	The type of role assigned to IT identifies if it is used as a tool to support operations, or as a means to achieve its business goals with an influence on the intensity of use. (Grover´s traditional, evolving, and integral role)
Interactions	Interactions within the value chain activities	The amount of interactions influences the level of use.

Table 3.6

Index Components, Second Set: Perceptual Items Rationale

IT Use for each Value Chain Activity

Index Component	Item	Rationale
Strategic Importance	Orientation (competitiveness)	Users perceptions of the strategic importance of IT for the organization as an influence to the intensity of use is considered.
Integration Strategy	Acquisition Own Plant Level Business Group Level Internal/External	The type of integration strategy or perceptions of future IT evolution to match their needs results from their current intensity and type of use.
Users Satisfaction	Integration Infrastructure Support IT Use Training Infrastructure Performance Plans to use	The level of satisfaction influences the current use and the perspective of use in the long term.

3.4 Data Collection Modes

3.4.1 Aggregate Level

During the field study, data from IT use are collected from the Mainframe Registers of CPU, and ASP% of use. Upon the basis of the criteria suggested by the Systems Management of the business of analysis, registers are made during what is considered the peak hour of the day.

The Plant system personnel consider this as the most representative for the intensity of use. For the criterion, daily Sales Reports are listed by the Finance Management using volume in hectolitres (usual beer unit of

production volume), to maintain secrecy in information. They are then transformed into percentages upon the basis of the factory´s daily installed capacity of production of 40 000 hectoliters, (MODELO Stock Market Financial Report, 1994). The reported sales that are above the 100% of the installed capacity are explained by the accummulated inventories of product and by the plant policies of extra-production times. With this procedure data for the dependent variable and from the predictors are homogeneized.

The time period of data collection is 45 natural days to be consistent with the business cycle of the plant, which is informed to be of 30 days. This criteria give the possibility to capture different intensities of IT use that result from differences in workload. An adjustment is made to fit the data to the five-day per week operation of the factory offices and the six-day per week operation of the sales area. Consequently, the resulting data for the period are 36.

During the data collection period in mainframe registers, an important event alters the data collected during one third of the observation period: the auxiliary memory is expanded, and the implementation works are reflected in down time. Therefore, the initial data of ASP% required to be homogenized transform them into a percentage of the new capacity of auxiliary memory in order to provide consistency.

3.4.2 Model´s First Stage Disaggregate Level The Questionnaire Survey

The data collection strategy requires the use of two sources. As mainframe registers do not allow to obtain data at disaggregate level in such a way that it can be grouped according to the BUA´s value chain, the data collection to input the IT use index, in order to have available data series for IT use, requires to conduct a survey in MODELO Mexico Plant. The means

to collect data is carried out through a questionnaire complemented by an interview to the respondents. The first step is to develop a questionnaire that fits the organization´s IT environment framed in the measures selected from the related literature.

Several interviews are applied to top executives of the Finance area and the Systems areas to gather information about IT infrastructure, available software programs and program developments, the equipment characteristics, personnel distribution, equipment assignation, business cycle and organizational culture, that can be important for the application. This is the first time the organization agrees to participate in an investigation. Issues as language to be used, structure, type and form of questions and presentation of the instrument are intensively discussed with the executives and carefully incorporated before releasing the instrument for its application.

As mentioned previously, technical issues such as the position of items and measures in the questionnaire are summarized in table 3.4. As derived from the measures literature, perceptual and quantitative components of the IT use index are considered as two separate constructs: IT Use and IT users opinion. For this reason, the data collection instrument is designed in two segments, one for a single application in an interview mode to capture demographics and perceptual items, and a second segment termed Frequency of Use Report, to capture quantitative items during a consecutive six-week period. A key assumption is that in the absence of substancial changes related to IT, the user´s perceptions will not have any change in six weeks, but IT use intensity will vary due to the business cycle of the BUA. Recall that IT is not in the introductory stage but well integrated into the managerial operations.

During the development phase, the questionnaire is subject to revisions by the Plant systems experts and executives, one technology

expert, and one statistics expert. Pertinent observations and suggestions are incorporated. As a result, an eight-pages instrument with 21 questions organized in three parts is used, and a code was developed (Appendix B).

In the preliminary interviews, the systems area provides valuable information which strongly influenced the use of systems and IT infrastructure. The intensity of use varies monthly in response to the organization business cycle. Each month, legal requirements such as: sales taxes, social security, market stock reports and movements of the kind, must be accomplished intensifying data processing and in consequence IT infrastructure use. Every two months these movements are even more intense, due to the addition of other type of legal requirements such as mandatory retirement security. Thus, IT use increases its level.

As MODELO Mexico Plant´s business cycles are considered to be four weeks long, the executives suggest to extend the observation period to six weeks in order to capture the influencing events. The selection of this time period is consistent with another requirement of the investigation: the number of data to be processed. The selection of a six-week period enables to generate from the IT use index, a series of six data for each value chain activity. That can be matched with the sales series for analysis.

The second step was to define, together with the top management, the strategy of application and of interviewing the forms and the persons to introduce the group of collectors and the forms to interact with the respondents, in order to cause the less inconveniences at the workplace environment. Each participant is interviewed during the first application of the questionnaire. The IT Use Reports are collected every week. The use of multiple sources of evidences is one of the tactics available to increase the construct validity of a case study research (Yin, 1994).

In *consistency with the research objective and with the research questions addressed, the questionnaire is applied only to a single organization, looking for a variety of applications of IT*, instead to a variety of organizations. The crucial strategy for this investigation is to take the analysis to the organization level.

The BUA´s value chain is configurated by identifying the fitting activities: IT applications for Inbound Logistics (ITUILOG) in the area of inventories control, Marketing and Sales (ITUMSALES) for order fulfillment in the department of foreign sales, for Outbound Logistics (ITUOULOG) in control of distribution in local sales (Mexico City), and national sales (country territory) areas; for Procurement (ITUPROC), suppliers control and accounts payable; for Human Resources Administration (ITUHRM), payroll which concentrates the function and the use of IT resources; and for Firm Infrastructure (ITUFIIN) in systems development, and accounts receivable. This gives a total of nine organizational units included in the study.

The learning of the experience of configurating the organization value chain is that in the business environment things are not organized as straightforward as related literature states. It is expected that each organization has a especific configuration for its value chain, thus creating an obstacle for comparison between organizations.

The participating organizational units share common characteristics such as: computer use or shared use of one, access to the mainframe systems, support of their daily tasks with IT use, or IT use for specific and determined purposes. They are also willing to participate in the investigation for six consecutive weeks by completing the survey instruments.

Taking as the application environment, workplace is an important reason to consider a procedure that requires the minimum time from the respondents and a minimum inconvenience for the management of the Plant.

Therefore, the questionnaire is validated in the field under the researcher's criteria of 15% of non-response during the first application, the questionnaire is administered to a total of 48 respondents of MODELO Mexico Plant, in their workplace, during the time of their normal activities. The non-response rate was 2%, meaning that one respondent doesn't answer the questionnaire in its first interview-application.

Each interview has a duration of about half an hour and include the project's presentation, the questionnaire description, the discussion and response of each question, the respondent general comments about IT use and IT performance in their job tasks, and a further agreement to collect the weekly reports of use. Some of the comments from the interview are included in Chapter IV in the Descriptive Analysis of each value chain activity. The composition of the group is 13 middle managers and 34 employees. The respondents profile is detailed in Appendix C.

One limitation of the study is that due to the internal policies of private information existing at MODELO Mexico Plant, it is not possible to collect data from operations and purchases personnel. This is overcome by the introduction of indirect procurement activities such as suppliers control and accounts payable.

The questionnaires are processed for comprehensive data coding and analysis producing a data base that permits sorting by respondent, value chain activity, and each of the seven items considered.

To create the independent variables, data are processed, homogenized into metric values through standardization to percentages, and organized in several data registers. Quantitative and perceptual items are summed and integrated into an index, from which six series are obtained for each value chain activity. For the Dependent Variable daily sales volume report for the

same six weeks are transformed into percentages applying the same criteria used in the aggregate level of analysis. Data registers are constructed for:

* Each of the seven items of the index (each respondent/each one of the six weeks)

* Each of the seven items grouped in each of the independent variables (each respondent/each one of the six weeks)

*Consolidated overall results for each of the independent variables (each of the six weeks) and sales (daily data grouped in each of the six weeks)

* Consolidated overall results for perceptual items of each of the independent variables

* Consolidated overall results for quantitative items for each of the independent variables (each of the six weeks) and sales (daily data grouped in each of the six weeks)

3.5 Methodology of Analysis

In order to determine whether a relationship between IT and competitive advantage exists, an objective menas for identifying the presence of such a relationship is necessary. While such an identification process in difficult, the must objective means to explore the presence of the expected relationship is to use a Regression Analysis. Regression here is not used to test causal relationship.

This is the method of analysis that is apropiate when the research problems involves a single metric dependent variable presumed to be *related* to one or more metric variables (Hair, Black and Anderson, 1991). Regression analysis is a powerful and versatile statistical tecnique for analyzing variable relationships. If two or more independent variables are

analyzed simultaneously, regression analysis help to determine their relative importance explaning dependent variable variation.

Through regression analysis, a researcher can determine the statistical significance of a relationship (whether a relationship exists). With this analysis one is able to do two things: (1) measure the strength of the relationship, and (2) determine the nature or form of the relationship.

The measure for firm performance is:

Research Question 1.....Daily sales volume (national +foreign sales) (February 9-March 31, 1995)

Research Question 2.....Daily sales volume (national +foreign sales) (March 15-May 3, 1995)

IT use for the aggregate level of analysis is measured as in Table 3.7.

Table 3.7

Research Question 1 IT Use

Independent Variable	Measures	Source	Data Collected
IT Use (Aggregate level)	%CPU average use %ASP average use	Computer Research Group, 1994	45 days February 15-March 31, 1995

This research question is supported if the coefficients of the predictor variables (CPU and ASP) are significant in the following Multiple Regression Model :

CHAPTER IV. ANALYSIS OF RESULTS AND FINDINGS

While this study relies mainly on qualitative data and descriptive analysis, it provides, for interested readers statistical analysis in adition to the graphical displays regarding how IT is used in a firm with competitive advantage. The benefits of combining cualitative and cuantitative research have been noted by Kaplan and Duchon (1988).

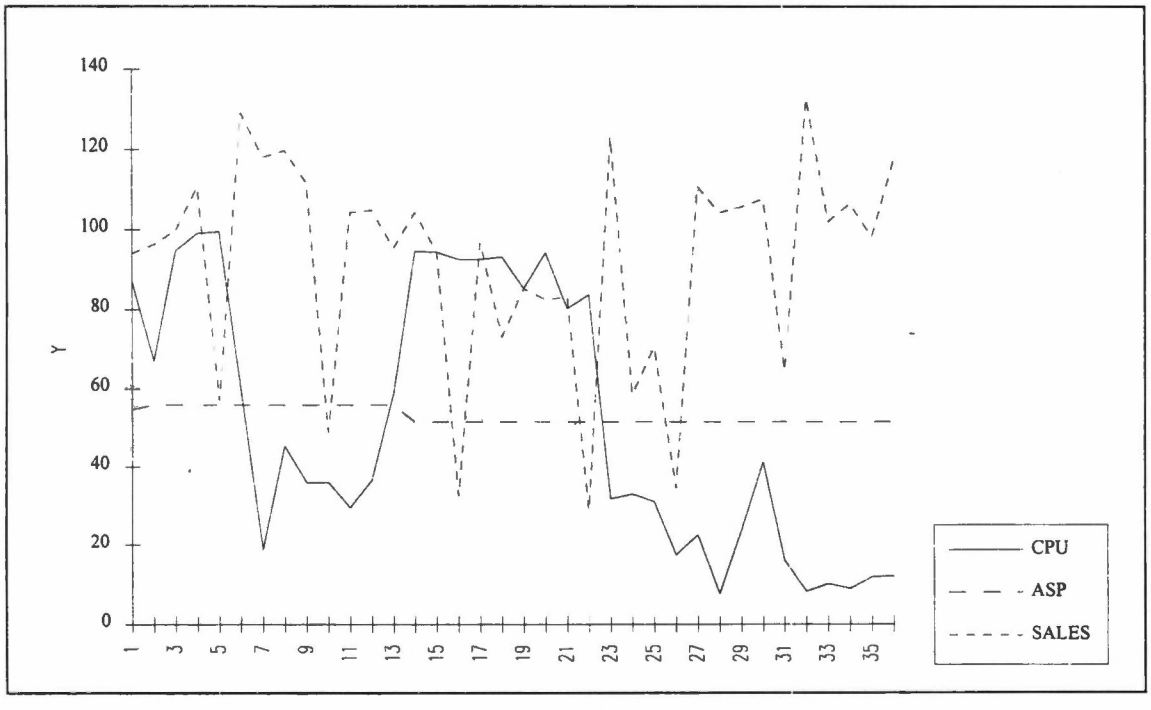
4.1 Quantitative Analysis

4.1.1 Aggregate Level Model´s First Stage

The fourth and fifth components of a case study research strategy are the logic linking of the data to the propositions -stated in Chapter II as the expected relationships among the variables- and, the criteria for interpreting the findings. These last two components represent the data analysis in a case study research, and thus the research design should lay the foundations for this analysis (Yin, 1994).

From Campbell (1975) Yin discusses "pattern matching" as a promising approach for linking data to propositions for case studies of whereby several pieces of information from the case may be related to some theoretical propositions. Elaborating on this idea, a presumed relationship between IT and Competitive Advantage arises from research question one. Therefore, it could be expected that the time-series pattern of IT use and the sales pattern reflect the same trend. The data collected during the time period considered for this investigation, are plotted before the quantitative analysis of the survey data with the purpose to have some knowledge of the similarities or differences of the behavior of each variable.

These patterns of performance show no apparent relationship between IT use -either CPU or ASP- and Sales. The CPU % of use shape reflects the presence of the business cycle in the observed days 3-5 and 14-22, revealing intense use and a severe shortage of processing power. Industry generally aims for 50-70 % of CPU usage as providing both responsiveness and cost effective processor use. Nevertheless, if installation objectives are met, a case can be made for numbers anywhere between 10-100% under varying conditions (Computer Technology Research Corp, 1993). The ASP % of use is constant, and as it is expanded, contributing to solve the CPU shortage in the intense use periods of the business cycle.



Graphic 4.1 . Observed Pattern of Sales and IT Use Behavior Aggregate Level

The sales pattern of the observed period presents small cycles with a tendency to contraction for the first 23 days, and an unstable recuperation the last 10 observed days, reflecting a different shape in its behavior from

those of CPU% of use and ASP% of use. Lowest Standard Deviation (2.056) was registered by ASP.

In order to determine whether IT use and sales volume are related, a regression model relating the total sales volume to the full capacity with %CPU and %ASP as measures of the aggregate IT use, is fitted to the available data. The adjusted model is the following:

$$\text{TOTAL SALES VOLUME} = -74.42716 + 3.38455\ (\%\text{ASP}) - .25200\ (\%\text{CPU})$$

The individual test for the ASP% coefficient is not significant at the 10% significance level (estimated significance level was 12%), while the coefficient of CPU% was statistically significant at the 10% level). The above model explains only the 13.997% of the variability in sales, but the overall regression model is declared significant after the ANOVA. From the observed pattern graph and the statistical tests it is concluded that the only relevant variable related to total sales is CPU%.

Table 4.1

ANOVA: Sales by CPU and ASP

	Sum of Squares	DF	Mean Square	F	Signif. of F (α)
Regression	3574.79708	2	1787.39854	2.68547	.0831
Residual	21964.20292	33	665.58191		

R Square = .13997 13.997 % of Sales variation is explained by the model

The individual statistics for each variable and the correlation matrix are given below :

	Mean	Std Dev
SALES	91.881	27.013
CPU	51.475	33.687
ASP	52.970	2.056

Correlation Matrix:

	SALES	CPU	ASP
SALES	1.000	-.274	.209
CPU	-.274	1.000	.155
ASP	.209	.155	1.000

From the above correlation coefficient values, one can conclude that %CPU and %ASP at the individual level are slightly related with sales, but also related between them. As a result, only one of the regression coefficients is declared significant when both variables are included in the regression model. Since the data are obtained at different time periods, autocorrelation is suspected. Therefore, a residual analysis is performed and the Durbin-Watson statistic computed. No autocorrelation is declared, and the plots of the residuals are not abnormal. Therefore, the usual regression assumptions (normality, independence and homocedasticity) are not violated for these data. This section reports the findings for Research Question 1, in which it is suspected that the use of IT will be positively related to competitive advantage identified by the BUA ´s sales volume.

Given the expected relationship, the results of the analysis (statistical significance) support that a relation exists ($F = 2.68547$, overall $\alpha = .0831 < .10$ $\alpha = 0.10$, is considered an acceptable level due to the reduce number of data included in the analysis $N = 36$, and to the exploratory nature of the research). The strength of the relationship is indicated by Square $R = .13997$. Individual results for independent variables indicate a negative relationship of CPU with sales (-.274) and a positive relationship with ASP (.209).

The regression equation of sales volume indicates Square R of .14 This shows that 14 percent of the variation in sales volume is explained by this equation. To give an interpretation to this number, readers should recall that in the BUA observed, IT is a complementary technology considering the nature of this organization which has a core stable manufacturing technology. Therefore, the strength of the relationship is suspected to be relevant. To provide a meaning to this number the Top Management is consulted and the relevancy confirmed.

> "MODELO has a sales volume of 21.94 millions hectoliters by year, which represents 52.23% of the total sales -national and international- of the Mexican beer industry. According to our data the current (1995) total installed capacity of its seven breweries is 25 750 millions of hectoliters per year. From those, MODELO Mexico Plant has 11 000 million installed capacity from which 82.9 is utilized to produce 24% of the sales of the whole group. If the combination of CPU and ASP use accounts for the 14% of the variation in MODELO Mexico Plant sales, this fact is important to me! IT is a valuable resource to support our competitiveness...."
> MODELO Mexico Plant Finance Manager

For the sake of the interpretation of this results, it is important to make it clear that the existence of a statistical relationship does not imply causality, however it is one of the elements required to support it.

Of the two independent variables included in the model CPU variable and ASP variable, CPU variable is the only significant in explaining the variability in the performance measure, although the relationship is a negative one. The interpretation of the results from the regression analysis is that one of the independent variables -ASP- has a positive effect upon sales volume (correlation coefficient = .209). An increase in this variable is expected to enlarge the sales volume, while CPU has negative effects (correlation coefficient = -.274). This suggests that expanding the ASP capacity to support increasing use of IT infrastructure can have a possitive effect on sales. Thus suggesting that proper attention should be given to the follow-up of the ASP% behavior and to the determination of the capacity required. This finding should be very interesting to top and middle managers considering investments in IT.

The variable having negative effect on sales volume in this regression equation is CPU% of use.This suggest that the current capacity of the computer equipment devoted for production (as termed by the BUA´s Systems Department) is no longer sufficient to attend the requirements of the users´, and that it has increasing needs for memory enhancement, recomending that IT strategy should be revisited.

These results can raise a controversy because, from one standpoint, even when ASP is used to expand the CPU capacity and it is not independent of it, the difference of the signs of the two predictors can be argued to be a reason why the analysis does not provide support to suggest that a positive relationship exists between IT and sales. From another standpoint, as ASP´s role is to overcome the CPU limitations, its positive

effect can be said to answer Research Question 1, where a positive relationship is expected between IT and the firm´s competitive advantage identified by its sales volume. The second standpoint will prevail in this investigation.

The internal validity in this case is threatened by the event of ASP enhacement during the study period. No other threats (maturation, instrumentation, selection or mortality) to internal validity are identified. This analysis deals with only one type of organization and is cross-sectional in nature. Additional research on this matter should be done longitudinally in order to assess the impact of time on the phenomenon of interest.

Admittedly, a limitation is that the results presented here are drawn from one organization at one point in time. Generalizing the results to other core stable technology organizations must be done with caution. Much aditional research needs to be performed before to know whether or not IT provide measurable competitive advantage for firms. The general value or contribution of the findings of this study exists in the methods and techniques used to identify the relative influence of IT at different levels of aggregation to the selected performance variable.

4.1.2 Disaggregate Level Model´s Second Stage

In order to identify how IT affects the BUA´s competitive advantage, data required for this stage of the model are collected and codified to create each of the independent variables to be used. As explained in Chapter III, because this phenomenon had not been previously examined empirically, instrument construction and assessment prove to be a major undertaking. When constructing the instrument, attention is given to content validity. Careful planning before items are selected is considered the best way to ensure content validity, which refers to the representativeness and

comprehensiveness of the items of the scale. The seven items for both constructs, IT Use and IT Perceptions, are drawn from conceptual definitions in the literature and a representative collection of items is used (Tables 3.4 and 3.8).

In order to assess the semantic, the instrument is revised by two MODELO Senior Executives, the instrument is reduced from 25 to 21 items. The correct operationalization of the constructs of interest -construct validity- is assessed ahead through a separate analysis of quantitative items and perceptual items. Discriminant validity was indicated after those analyses.

The internal consistency method is selected when assessing the instrument´s reliability. For each construct the correlation among items is calculated. Since the questionnaire for quantitative items is applied for each one of the 6 weeks of the study, the consistency of the reliability coefficients is also analyzed. This is done because two potential problems can occur: a) subjects may respond based on recall, affecting the instrument´s ability to produce consistent results; and b) the problem of reactivity due to the fact that subjects become sensibilized to the instrument and can "learn" to respond as they perceive they are expected to respond.

The internal consistency reliability, which looks at the extend to which the items used to assess a construct reflecta a two common score for the construct, was calculated using Cronbach alphas. The reliability coefficients between test and retest administrations range from .016201 to .93. This high dispersion is related to one of the coefficients (.016201), which is obtained for the sixth week. This coefficient is considered an outlier because the IT Use Report instrument is administered during a national three-day vacation where IT use is irregular and lower than usual.

Therefore, only five of the coefficients are considered for an average (range between .43 to .93), providing an average coefficient alpha equal to 0.59.

Reliability for perceptual items is assessed separately (coefficient alpha = 0.52) denoting that measures are moderately reliable. No average is computed due to the single administration of the instrument. One point concerning the coefficient alpha calculation is the fact that the more items included in a scale the higher the alpha coefficient observed. Therefore, the relative low alpha coefficients reported in this study are particularly impressive in light of the relative few numbers of construct items (four items for reported IT Use and three items for users opinions)..

For this reason, it is considered that they provide adequate support for concluding that the instrument is reliable. Although Nunnally (1967) indicates that for exploratory research, correlations above .70 are the adequate.

For qualitative data collected through interviews, the tactic used to test reliability is the development of a case study protocol, in which the procedures followed in this case are documented (Appendix A), as well as the use of the data base developed from the survey´s data.

After the quantitative analysis, of the BUA´s value chain activities (termed DEPTO for the ANCOVA and for the ANOVA), the simple average of the four quantitative subjective measures used on all the subjects involved in this activity -during six weeks- are computed, and then added to the three perceptual subjective measures used which are measured only once. To avoid confusion between the single variables created and the index, its components will be referred to as items hereafter. The total sum provides a weekly index for IT use in that particular activity.

For each week, six indexes are available one for each of the firm´s value chain activities, giving a total of 36 numbers for the total six-week

period. Then, for each activity, a regression model is fitted by using the 6 weekly IT-use indexes and the total weekly sales. These data pairs correspond to the same time period. The difference in the magnitude of the slope of the linear regression models represents the extent to which each IT-Use, along the value chain activities, affects the BUA´s competitive advantage. This implies that total IT-Use is disaggregate in six components (as in Chapter III segment 3.3.2):

ITUINLOG	IT use at inbound logistics
ITUMSALES	IT use at marketing and sales
ITUOULOG	IT use at outbound logistics
ITUPROC	IT use at procurement
ITUHRM	IT use at human resources administration
ITUFIIN	IT use at firm infrastructure

4.1.2.1 The Exploration Considering All Types of Items from IT Use Indexes

A first exploration is made for each activity considering the resulting indexes from the sum of all quantitative and perceptual measures and sales. An Analysis of Covariance under the Regression Approach (Weekly sales = IT Use + Depto effect) is performed, results are shown in Table 4.2.

The model explains 10.09% of the variability in sales. The effect of IT Use on sales is declared significant with an estimated significance level of 8%. Raw Regression Coefficient indicates negative slope in the relationship between sales and IT use over the value chain activities (termed Deptos as well). No differences between departments are declared (estimated significance level is 0.839).

Table 4.2.

ANCOVA Under Regression Approach: Sales by Depto with Use

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F (α)
Covariates IT USE effect on Sales	200.135	1	200.135	3.253	.082
Main Effects Department	125.842	5	25.168	.409	.839
Explained	1784.427	29	61.532		
Total	1984.562	35	56.702		

Square R = 200.135 / 1984.562 = 0.1009 10.09 of Sales variation is explained by the model

Covariate: Raw Regression Coefficient ITUSE -.748

In search of information for Research Question 2, in order to explore how IT use along the value chain activities affects the BUA´s competitive advantage, an individual regression model is fitted for each value chain activity (department). A negative or inverse relationship with the dependent variable Sales, results in five of the six value chain activities, but only one is declared statistically different from zero. Results are given in Table 4.3.

For the only significant regression model, the one corresponding to the Inbound Logistics activity (ITUINLOG), the model explains the 47.13% of the variability in sales. The regression coefficient for IT use is significant at the 13% level. Since only 6 data are available, this relaxed significance level is admitted. From this analysis, results indicate that as more IT is used

in the Inbound Logistics activities, a reduction of - 2.83% in sales is expected.

Some influences in these results are suspected from the index composition, in which the reported perceptions related to the benefits of IT use for the organization are consistently higher than the reported use. This means that among the respondents, the idea that IT use brings benefits to the organization is widely accepted, but the reported use does not correspond to their perceptions. This contradiction is an opportunity to go deeper in the analysis.

Table 4.3

Individual Multiple Regressions Results ALL ITEMS Considered

Dependent Variable SALES

INDEPENDENT VARIABLES	R Square	F	Sig F (α)	Slope	Significance
ITUINLOG	.47127	3.56529	.1320	- 2.82892	S
ITUMSALES	.28255	1.57533	.2778	- .76388	NS
ITUOULOG	.23782	1.24812	.3265	- 1.14067	NS
ITUPROC	.00454	.01824	.8991	.36816	NS
ITUHRM	.02030	.08288	.7877	- .72583	NS
ITUFIINF	.00822	.03315	.8644	- .17030	NS

To further explore if IT use perceptions are different for the six value chain activities (DEPTO), the perceptual items of the index are analyzed as a single component. The ANOVA results indicate that no two groups are significantly different at the .050 level. Additional to the ANOVA, Depto pairs are compared by using Duncan´s test. All means are assigned to the same set confirming the ANOVA results.

Table 4.4

ANOVA Perceptual Items Variable IT PER by Variable DEPTO

Source	DF	Sum of Squares	Mean Squares	F Ratio	F Prob.	Significance
Beetwen Groups	5	144.0508	28.8102	.2317	.9465	NS
Within Groups	41	5098.7457	124.3597			
TOTAL	46	5242.7966				

MULTIPLE RANGE TEST: DUNCAN PROCEDURE

Ranges used correspond to a .050 level

2.86 3.00 3.10 3.17 3.22 Same IT perceived utility

No two groups are significantly different at the .050 level

Homogeneous subset

(Subsets of groups, whose highest and lowest means do not differ by more than the shortest significant range for a subset of that size)

SUBSET 1

Group	Mean
Group 3	71.6900
Group 4	71.9387
Group 6	72.7880
Group 5	74.1852
Group 2	74.3695
Group 1	77.4367

The general conclusion from this analysis is that the perception of the advantages of IT Use is the same for all the DEPTOS. The presence of an "inflation·" effect in the first analysis´ results is suspected. Using only the four quantitative items of the index (hereafter QUANTI), an aditional analysis in variable ITUINLOG reveals differences in R Square (.25959 < 0.47127 with overall IT Use index components), and in the Slope (- 1.15572 > - 2.82892 with overall IT Use). Discriminant validity is supported. A Correlation of the six independent variables for each set of items confirms the presence of such an effect.

CORRELATIONS:	ITUSE	ITQUANTI
SALES	- .6865	- .5095

N of cases: 6 inflated " r " due to IT preceptions

An explanation is given by the literature of quantitative applications in the social sciences. Langbein and Lichtman (1978) consider two distinct causes of discrepancies between the expected values of parameter estimates at different aggregate level of analysis. These discrepancies have

been termed "aggregation bias". It is considered that the most important and troublesome source of aggregation bias occurs first when grouping of individuals produces specification error in aggregate parameter estimates. As a result, the expected values of unstandardized coefficients at the aggregate and at the individual levels may no longer be equal. Second, the grouping of individuals may alter the relative variance of independent and dependent variables, thereby affecting the values of such standardized measures as correlation coefficients (r´s) and beta weights (a standardized measure of relative influence). Thus, different forms of grouping can affect relative variation generating aggregation bias in the estimation of standardized measures. From these arguments, it follows that depending upon the strength of grouping variable correlation with the independent and dependent variable, the grouping procedure may increase, decrease or leave the value of R Square unchanged. In this first exploration with IT use in each of the value chain activities, the overall differences in the magnitude of the slope of the linear regression models are observed, representing differences in the extent to which each IT use affects the BUA´s competitive advantage. This provides an answer for Research Question 2, in which it is expected that IT use in each value chain activity has a different relative influence on competitive advantage. No support was found of a general positive influence in all activities.

4.1.2.2 An Exploration Using Only IT Quantitative Items

A second exploration for each activity (Deptos) is made considering only the resulting indexes from quantitative items to avoid aggregation bias. As expected, the results of the Analysis of Covariance performed under the Regression Approach are adjusted. The effect of IT Use on sales is declared

significant (F raised from 3.253 for all items to 4.374 for quantitative items) with an estimated significance level of 5%.

Table 4.5.

ANCOVA Under Regression Approach QUANTI: IT Use Effects on Sales

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F
Covariates					
IT USE effect on Sales	260.77	1	260.177	4.374	.045
Main Area Effects	182.144	5	36.429	.612	.691
Explained	260.177	6	49.363	.729	.630
Residual	1725.043	29	59.484		
Total	1985.220	5	56.721		

Square R = $\frac{260.177}{1984.562}$ = 0.1306 13.06 of Sales variation is explained by the model

Covariate: Raw Regression Coefficient ITQUANTI -.574

The QUANTI model explains 13.06% (previous All Items model explained 10.09%) of the variability in sales which seems to be consistent with the results obtained (13.99%) in the analysis at aggregate level. The overall Raw Regression Coefficient (-.574) indicates the presence of a negative slope in the relationship between sales and IT use.

As was done before, the differences between Deptos are studied by adjusting individual regressions to each department. Results are in Table 4.6.

Table 4.6.

Individual Multiple Regression Results. QUANTI ITEMS

Dependent Variable SALES

INDEPENDENT VARIABLES	R Square	F	Sig F (α)	Slope	Significance
ITUINLOG	.25953	1.40198	.3019	- 1.15583	S
ITUMSALES	.09631	.42628	.5494	- .61401	NS
ITUOULOG	.13778	.63921	.4688	- .49715	NS
ITUPROC	.01009	.04076	.8498	.14729	NS
ITUHRM	.09184	40451	.5593	- .47143	NS
ITUFIINF	.39944	2.66045	.1782	- .88908	S

In comparative results under the All items criteria and the QUANTI criteria, that is with the inflation effect and afer removing it, differences in R Square appear in all independent variables. The inflation effect seems to be greater for ITUMSALES, ITUHRM, ITUINLOG and ITUOULOG, reflecting that the respondents perceive the advantages of IT Use, but they are not consistent with its actual real use to support their tasks.

The persistent presence of a negative slope is a motive of concern. A positive relationship between Sales and IT Use is expected to be found along the value chain activities. Even after removing the inflation effect, the negative sign persists, but a considerable reduction of that relative influence results for four of the six variables.

A possible explanation to these results is that the effects of IT can follow an evolution similar to an S shape curve, which implies that the positive effects decline over time. As the use of IT in the business unit of analysis is reported to be in the last nine years, it is possible that the results obtained correspond to the declining part of a life cycle curve. Evidences for this explanation can only be obtained by studying the complete difusion cycle of IT Use in the business unit of analysis, in a longitudinal study that follows up the evolution of the effects of the implementation of new IT infrastructure, or in a new Systems development. An inference derived is that the effect of IT in a firm´s competitive advantage is not alike during a long time. It can have a life cycle, and further research is required in such a direction. A precedent of this situation is founded on the effects of Advertising on sales. There is a certain moment in which the Advertising expenditures no longer affect the firm´s sales. On the other hand at the same time, it cannot reduce or eliminate those expenditures because they are part of its survival in the business environment. In these cases, the only way to test the positiveness of the effect is by elimination, but this is not feasible in a real business environment.

Table 4.7

Multiple Regression Results Comparison of Both Sets

Dependent Variable SALES

INDEPENDENT VARIABLES	R Square		Slope	
	All items	Quanti items	All items	Quanti items
ITUINLOG	.47127	.25953	- 2.82892	-1.15583
ITUMSALES	.28255	.09631	- .76388	- .61401
ITUOULOG	.23782	.13778	- 1.14067	- .49715
ITUPROC	.00454	.01009	.36816	.14729
ITUHRM	.02030	.09184	- .72583	- .47143
ITUFIINF	.00822	.39944	- .17030	- .88908

Other differences are found between the two sets of results. While in the first exploration ITUINLOG is the only variable declared significant (at 13% estimated level of significance), in the QUANTI set it is no longer declared significant, eventhough this can be an effect of the limited number of data available. After removing the inflation effect, the regression coefficient for IT use for the finance department increased considerably. Based only on the magnitude of the F-Test, the two areas where IT use is more relevant are identified as Finance and Inbound Logistics.

The results obtained under the two criteria of grouping the index items provides evidences of different levels of influence of IT use in each activity of the value chain with sales as a measure of the BUA´s competitive advantage. This is the answer expected to Research Question 2.

Table 4.8

Set Comparison Results Independent Variables Significance

Dependent Variable SALES

INDEPENDENT VARIABLES	F		Signif F (α)	
	All items	Quanti items	All items	Quanti items
ITUINLOG	3.56529	1.40198	.1320	.3019
ITUMSALES	1.57533	.42628	.2778	.5494
ITUOULOG	1.24812	.63921	.3265	.4688
ITUPROC	.01824	.04076	.8991	.8498
ITUHRM	.08288	.40451	.7877	.5593
ITUFIINF	.03315	2.66045	.8644	.1782

For Research Question 2 resulting negative signs in beta weights of primary activities ITUPROC, ITUHRM AND ITUFIIN in either first as in second explorations at disaggregate level, do not support the question´s second expectation in which Information Technology use in support

activities of the value chain will be positively related to the competitive advantage. Only one positive relation is founded in ITUPROC in the first exploration, before removing the inflation effect. From the perspective of the BUA´s executives, these findings should assist in developing a set of IT strategies that can potentially help the organization in the aggregate to maintain acceptable levels of performance (sales volume).

The most significant finding is that those factors which influence sales volume most strongly are IT use in firm infrastructure (Accounts Receivable and Systems) and IT use in Inbound Logistics (Inventories). One explanation is that both activities have two important characteristics in common: they are controllable by top manager level and they absorb large amounts of capital from the firm. These characteristics suggest that IT strategies can be implemented and manipulated by top management level in the finance area, and as accounts receivable and inventories are short-run in their scope, the results and changes in these IT strategies can be noted relatively soon.

> "About fiftheen years ago computers were introduced to this facility due to the need to control the inventories of raw materials and of empty materials. As this is a very conservative firm, only after the benefits of this technology were visible, the requests of middle managers were satisfied and the new technology started to expand to accounts receivable first and to the creation of a Systems area later. For Top Management this two areas have priority because they absorb large amounts of the firm´s working capital. After the experience of Mexico Plant, the use of Information Technology was extended to the other facilities of the Group."
>
> MODELO Mexico Plant Finance Manager

Since an inverse relationship between ITUINLOG and ITUIINF is suggested by these results, Top Management may want to know if IT

infrastructure is appropriate for the business or if it is already obsolete for their current needs instead of being supportive for the firm´s competitive advantage adhere costs.

4.2 Relationships Among Value Chain Activities Model´s Third Stage

The third stage of the model proposed to explore the relationships among the different value chain activities respect to its IT use intensity. Form model in Figure 2.6, the expected relations were:

* procurement with outbound logistics
* procurement with marketing and sales

In search of evidence for the existence of the above relations, simple correlation coefficients for each pair of value chain activities were computed. Results are provided in the following correlation matrix.

Table 4.9

Independent Variables Correlation Matrix

	ITUIBLOG	ITUMSALES	ITUOULOG	ITUPROC	ITUHRM	ITUFIIN
ITUIBLOG(X1)	1.0000	.4107	**.7098	.1808	.0533	*.7914
ITUMSALES(X2)	.4107	1.0000	*.7419	**.6050	-.4572	.3124
ITUOULOG(X3)	.7098	.7419	1.0000	**.5777	-.0041	.4250
ITUPRO(X4)	.1808	.6050	.5777	1.0000	.2512	-.3157
ITUHR(X5)	.0533	-.4572	-.0041	.2512	1.0000	-.2451
ITUFIIN(X6)	.7914	.3124	.4250	-.3157	-.2451	1.0000

The results of the analysis allow to identify the following relationships and discard some of the relations expected from the proposed model:

		* $\alpha \leq .05$			** $.05 < \alpha < .15$
X1X6	0.030	Contrary to the expected	X1X3	0.057	Not expected
X2X3	0.046	Not expected	X2X4	0.102	Expected
			X3X4	0.115	Expected

The first relationship was expected to emerge as a consequence of the orgnanization's monitoring of distribution volumes (ITOULOG), dealing with suppliers control and accounts payable (ITUPROC). This relationship was supported by the results (0.115 when $.05 < \alpha < .15$).

The second relationship was expected because marketing and sales activities (ITUMSALES) affect the orders to suppliers and accounts payable. This relationship was supported by the results as well (0.102 when $.05 < \alpha < .15$).

An additional finding, not expected, was the relationship (0.030 when $.05 < \alpha > .15$). between inbound logistics (ITUINLOG) and outbound logistics (ITUOULOG) This is explained because once the product has been distributed, inventories move raw materials and empty materials for production.

4.3 Descriptive Analysis

Moving the study's perspective toward how IT is used in a firm with competitive advantage, data are used to derive figures for IT Use along each value chain activity and of each of the items considered to configurate the previous IT Use index. Differences in the rating results reflect variability in each variable composition, providing valuable information to management about how the areas take advantage of IT resources and about how the importance of its use is perceived.

Data are analyzed from two angles: the first deals with the results of each of the items along the six value chain activities, which allows to identify general differences between them; the second angle deals with each predictor composition, which allows to make a profile level diagnosis of single situations in each of the areas observed.

Graphics are elaborated for each situation to summarize the information. It must be said that in addition to the purpose of this investigation, from the data collected and the registers derived, a more detailed diagnosis can further be made at department level and even at individual level, making it possible to identify how each respondent uses and perceives IT as a support for his tasks. This type of diagnosis can be helpful to management to define development plans for IT in the organization.

4.3.1 Descriptive Analysis for Each Item

Average use means the % of available capacity used during an eight hour period of work (Labor time in Mexico is 8 hours/day, 40 hours/week). Under the standard of use criteria mentioned in the literature above, a low overall average results for ITUMSALES (55%). In the foreign sales department, the use of computers and specialized software is declared to be a need. The group is integrated by six people who deal with sales in more than 80 countries. MODELO´s foreign sales represents 67% of the Mexican beer exports. MODELO Mexico Plant contributes with 64%. A single computer was assigned in March 1995 to this department, being shared by one manager and four employees. In a collective interview, they declared IT use as a need for their daily operations as well as a possibility to interact with foreign customers. They have great expectations for the expansion of IT in the facility.

> "Sometimes when I am working on an embarkation order, the name of the country sounds so unfamiliar that I have to look into the worldmap to identify where that country is. There are other occasions in which the embarkation order is for a newborn country, and then I also have to investigate where it is!"
>
> MODELO Mexico Plant Foreign Sales Manager

A highest intensity in use is reported by ITUPROC (78%) due to the daily volume of operations that are managed in the plant´s purchase procedures. The areas involved are suppliers and accounts payable who are linked to account and treasury. Therefore, there is a great need for computarized procedures.

> "Computer is so important to deal with the data volume that a specialized software was developed in-house by the Systems area."
>
> MODELO Mexico Plant Purchase´s responsible

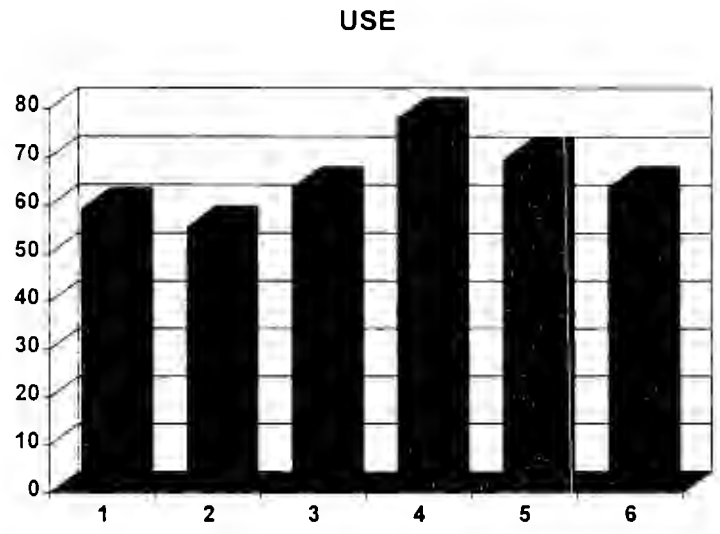
Graphic 4.2 shows the differences in IT use along the value chain activities. This situation can be explained either by the differences in the needs for the use of IT resulting from the nature of the tasks, or by factors from the personnel characteristics such as seniority or abilities developed to integrate IT to the tasks performed. This contrasts with the ratings from foreign sales. Low IT use in local sales (sales in Mexico City´s Metropolitan area) are explained by the manager of this area:

> "We keep daily registers of the sales orders. For years, the personnel have done this task by manual procedures. About a year ago (interviewed in 1995) the computer system was introduced and I received a 20-hour training course. Since we have to do monthly consolidated reports using the computer, because it is a corporative requisite for the stock market information, we use the computer only for this purpose. It will be helpful for my white collar employees to receive more training in computer use."

In the National Sales area, the manager, with a 25 year seniority hired two young employees with computer training, specifically to give attention to the new reports requirements. The equipment is not linked to the network. These employees declared during the interview:

> "Currently the computer is used to elaborate the reports required by the corporative area. Registers are kept as always. Now, we

are working in building a data base. More training in computer programs is required for this purpose."



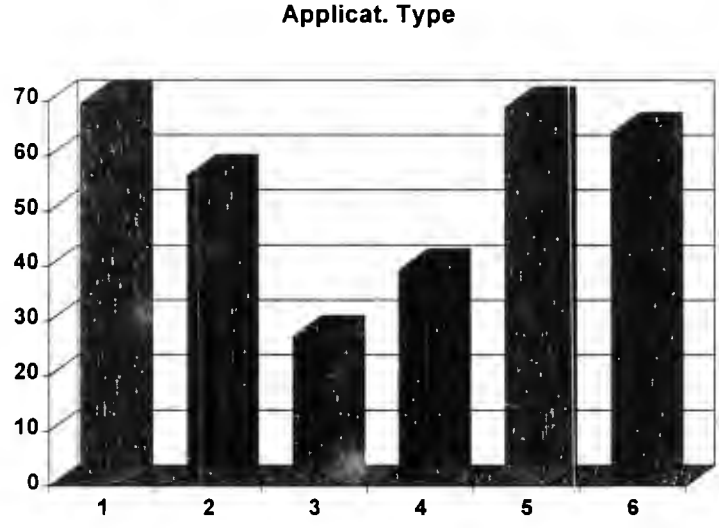
1. ITUINLOG 2. ITUMSALES 3. ITUOULOG
4. ITUPROC 5. ITUHRM 6. ITUFI N

Graphic 4.2 Reported Rating for Item Use All Value Chain Activities

Application Type means the application of IT for transactional use, strategic use, or informational use. From the criteria adopted in the questionnaire´s coding, results up to 33.3% are considered as transactional use oriented to cut costs by substituting capital for labor and to handle high volumes of transactions. Results between 33.3% and 66.6% are strategic use whose purpose is to gain a competitive advantage and increase the market share. Results above this percentage are considered as informational use which provide information to manage the firm and meet other management objectives..

The results in Graphic 4.3 shape an organization which mainly uses IT for transactional uses in the distribution tasks (ITUOBLOG) and it can be

said that also in ITUPROC as well, the remaining activities apply IT for strategic uses, with an incipient informational use. Usually, transaction systemas must be in place before strategic or informational systems are feasible. These results are consistent with the results obtained in item Role.

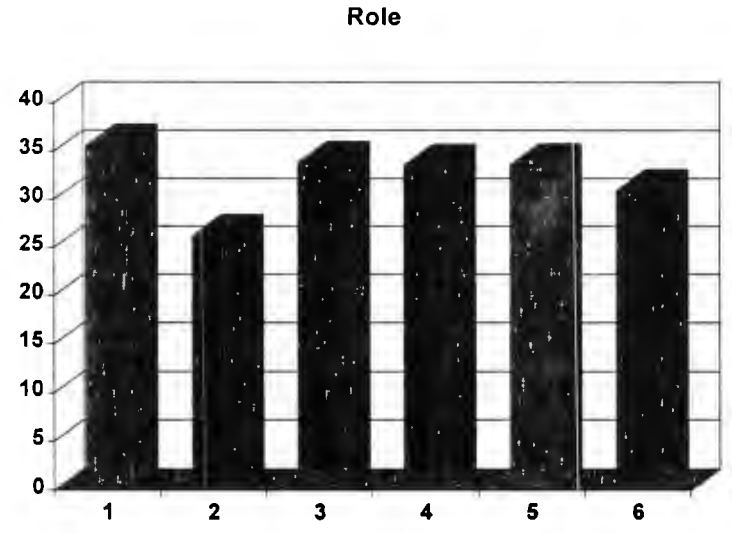


1. ITUINLOG 2. ITUMSALES 3. ITUOULOG
4. ITUPROC 5. ITUHRM 6. ITUFIIN

Graphic 4.3 Reported Rating for Item Application Type All Value ChainActivities

This is a relevant finding that deals with the *How* of the second research question. Resulting data sugest a new view of this question arising: How a firm with competitive advantage uses IT?. At this point, the organization´s nature must be considered. Remember that is a production plant integrated to a business group whose main policies and strategic planning activities are defined by a central corporative level. Therefore, it is expected that the transactional type of use prevails. Using IT to contain, reduce, or control costs is a traditional application of IT, and lacks the agresiveness of strategic and informational aplications

"Strategy is defined at Corporate level. The Plant´s Management follows the instructions in its operations planning. Computers and systems are used basically to support administrative procedures."
MODELO Mexico Plant Systems Department Senior Executive



1. ITUINLOG 3. ITUOBLOG 5. ITUHRM
2. ITUMSALES 4. ITUPROC 6. ITUFIIN

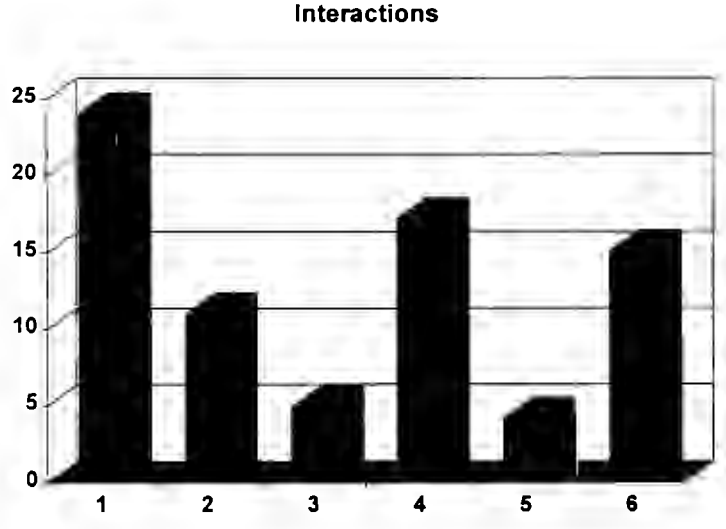
Graphic 4.4 Reported Rating for Item Role All Value Chain Activities

Role assigned to IT refers to the use to support the operations or to support the organization´s strategy. Again from the coding criteria, below the 50%, it is considered as a support for operations and above 51% as a support for the organization´s strategy. Results between 36% and 24% suggest that for IT, the assigned role is to support the operational procedures in all activities. This is consistent with the nature of the organization as mentioned previously.

This results suggest a predominaint utility view of IT, which implies that IT infrastructure is seen primarily as a way of saving costs, this is the

tradicitonal role of IT as a utility that provides a necessary and unavoidable service which incurres administrative expenses. Four activities are giving IT an evolving role, while integral role is not shown.

Interactions along the value chain activities using IT means the use of IT to link as many categories of activities as the organization declares to have. This item obtains the lowest results of the set. An interpretation is that the type of tasks are individual and rutinary. They are not connected among them, even when the operations of one area affects another. Each area is independent and a close territory for the others. The largest interactions are identified in the ITUINBLOG (24.06%). Results suggest that with regard to IT interactions this company is an archipielago.



1. ITUINLOG 3. ITUOBLOG 5. ITUHRM
2. ITUMSALES 4. ITUPROC 6. ITUFIIN

Graphic 4.5 Reported Rating for Item Interactions All Value Chain Activities

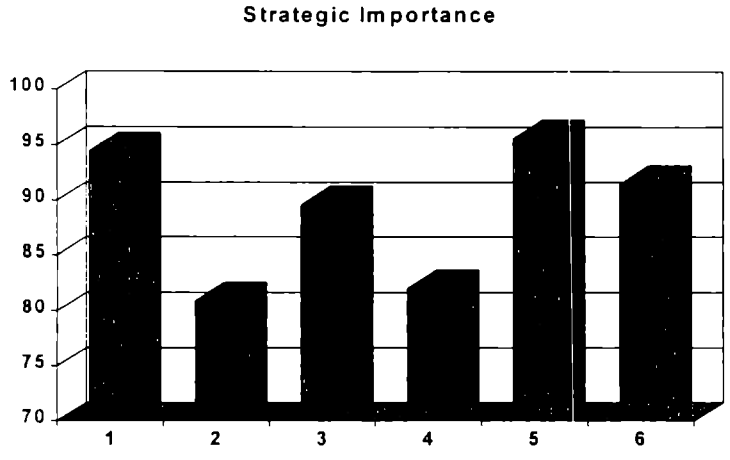
This situation suggests little communication between areas and a low level of information flow requirements for their activities, which can be

centralized in the top management level. It also suggests that information flows by alternative means as paper or telephone, as it is reported by senior executives of the corporative level who where interviewed.

> "Information from all facilities and installations is concentrated at Corporative level to integrate the information required by the stock market. Gathering all this information on time is very expensive. Now we are working in new IT plans to make new investments."
> MODELO Group Corporate Finance CEO

Strategic importance is one of the perceptual items included with the purpose to identify if the IT users are aware of the importance of such a resource for the organization´s position related with its competition. To integrate IT to the organization´s strategy, three levels were considered; the basic if IT helps to support the strategy (33.3%), the second if the system groups support the strategy but are not an integral part of it (66.6%), and the highest when the groups of the system and the top management work together to change the competitive position of the organization (100%). Results indicate a very high perception of the strategic importance of IT, mainly in the ITUIBLOG (94.4%).

The results contradict the low results obtained in the item *Role.* The findings reported above are somewhat contradictory. The users perceive the strategic importance, but they do not use it, or do not apply it to other types of use rather than operational or transactional. This situation is illustrated by ITUMSALES and by ITUOBLOG with a reported IT use of 60% of its current capacity. The application role is for transactions when the strategic importance rate is 95%. The perception seems to be extended to other MODELO installations.



1. ITUINLOG 3. ITUOBLOG 5. ITUHRM
2. ITUMSALES 4. ITUPROC 6. ITUFIIN

Graphic 4.6 Reported Rating for Item Strategic Importance All Value Chain Activities

"All the daily calls to this phone line positioning orders from individual customers are registered in this notebook by city zone. By the evening I have to take the notebook to the Mexico City distribution office where its delivery is programmed for the next day."

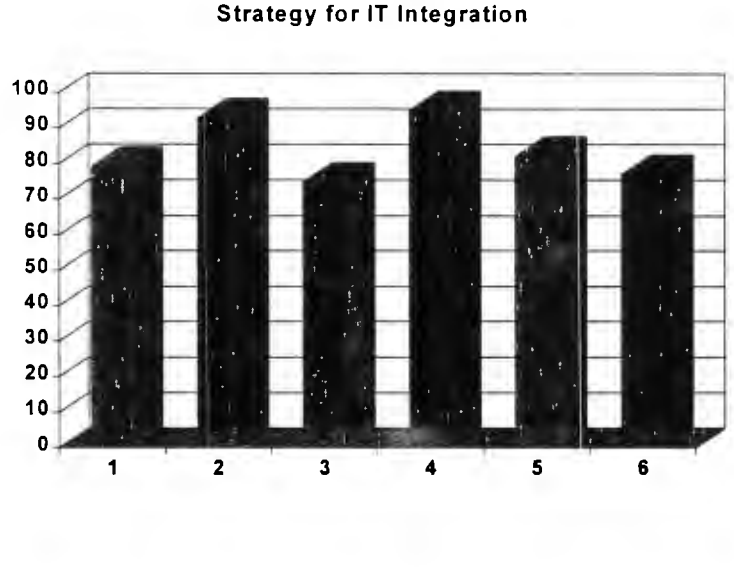
MODELO Mexico Plant MODELORAMA employee

"Now we have one computer and two analysts to deal with the accounting registers of the sales orders and deliveries of this distribution facility. We don't use them for other purposes."

MODELO Distrubutor in Naucalpan Accounting and Distribution Managers

Strategy for Integration of IT in the following five years reflects the user's perception of how IT must be developed in the organization in the future. The valuation criteria implies a basic enhancement of the current infrastructure and of the own software developments; the implementation of independent systems in other facilities of the Business Group; the

implementation of systems which integrate those facilities, and the implementation of a system which integrates stakeholders as well.



1. ITUINLOG 3. ITUOBLOG 5. ITUHRM
2. ITUMSALES 4. ITUPROC 6. ITUFIIN

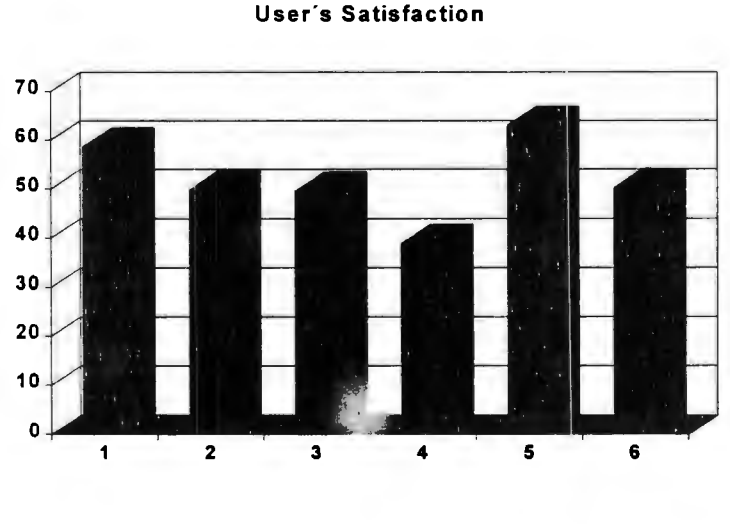
Graphic 4.7 Reported Rating for Item Strategy of Integration All Value Chain Activities

Results from all the activities indicate a highly developed awareness of a strategy that integrates the organization with the external environment.

Users Satisfaction includes the perceptions of individuals related to IT support, training, performance, and their plans of use which are expected to be greater the more they are satisfied with the performance and the results obtained. In general the users´ declared a low level of satisfaction that can explain their expectations for the strategy to integrate IT in the future as iy is evidenced in a previous item.

During the interviews with the MMP Finance Manager and with the Systems Manager, comments about the difficulties to incorporate IT use to the organizational culture are made. It has not been easy to change the work practices and introduce this technology due to the personnel´s, profile

which reflects a long period of time in the same job, the same activity, low job rotation and a personal development based on the expertice acquired in the organization. This situation creates a barrier that rejects changes and provokes a resistance. Even though, they are willing to use the computer. The reality is that such changes require long term actions to be absorbed. It is possible to explain the low rating in Users Satisfaction as an excuse of their resistance to change, when the top management position is to support IT incorporation through infrastructure enhancement, developing plans and strong training programs.



1. ITUINLOG 3. ITUOBLOG 5. ITUHRM
2. ITUMSALES 4. ITUPROC 6. ITUFIIN

Graphic 4.8 Reported Rating for Item Users Satisfaction All Value Chain Activities

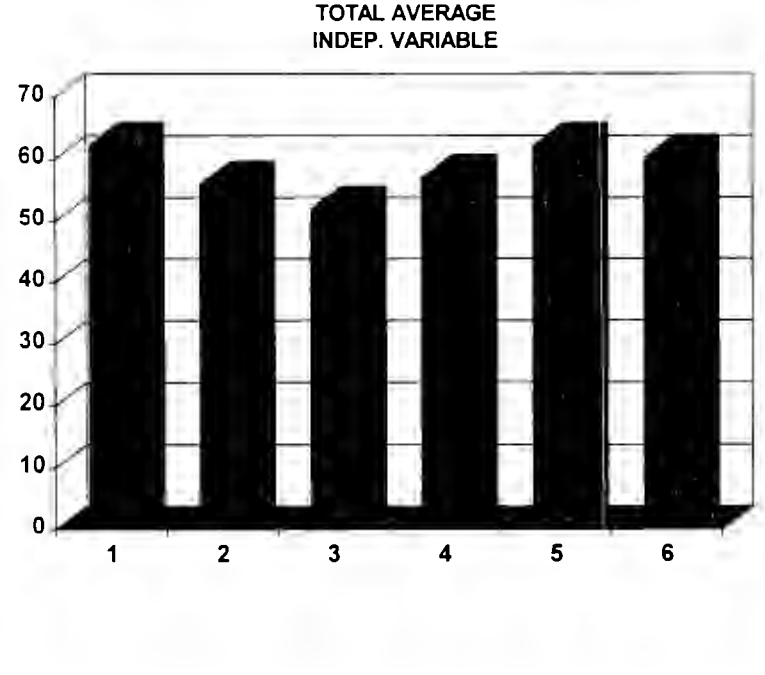
The results obtained provide evidences that users are not satisfied with the current IT support, and as a contradiction they have a low use of the existing one. An average of 43.3 hours of systems training a year, and plans to use IT in the future are reflected in the strategy.

> "Workers and employees of this plant received trainning for more than 23,000 hours, from which 2,000 were computers and

systems courses. We received people from all the MODELO Group facilities in those courses, and our systems personnel provided assistance to them upon request. This type of courses are part of the human resources development."

MODELO Mexico Plant Finance Manager

These average results provides information about IT use for each activity of the value chain. All areas seem to have a low use of the IT resources. When comparing these results with those obtained from the mainframe registers, a difference in use is identified. This can be explained considering that the mainframe registers reflect the connection time and not the actual time of use that the system´s operations are not consistently reliable for users or the existing mainframe environment does not match the organization´s evolving needs.



1. ITUINLOG 3. ITUOBLOG 5. ITUHRM
2. ITUMSALES 4. ITUPROC 6. ITUFIIN

Graphic 4.9 Reported Rating Average of All Items in each Value Chain Activity

Increasing IT use in the areas is a complex task that involves redefinition of processes: users continuous training, changes in the organizational culture, and even taking into account downsizing. Differences of use should be considered by managers and an analysis at individual level is recommended before further actions.

Comparison of the quantitative and preceptual sets identifies differences between the average use of IT in the job environment, and the high perceptions of its strategic importance. This finding is consistent with the idea that competitive advantage is supposed to raise from the use of IT, and not only from the people´s perceptions of its strategic importance.

Descriptive analysis allows to observe that in the presence of a need high volume operations, compulsory requirements, or fasten procedures, people have no other option than to use the technology as a means to accomplish their tasks, as it happens in inbound logictics procurement, and in foreign sales. It is observed, as well, that a good perception does not lead to the use of the technology, as reflects the local sales area, the national sales and the distributors.

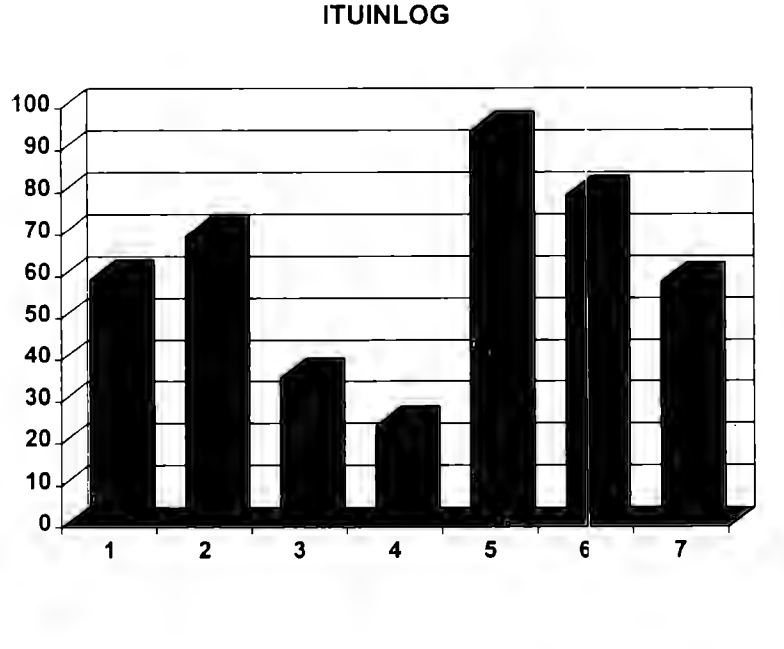
Table 4.10 Quantitative and Perceptual Items All IndependentVariables

Independent Variable	Quantitative Items	Perceptual Items	Total Average Independent Variable
ITUINLOG	47.12	74.41	62.27
ITUMSALES	37.30	74.51	55.91
ITUOULOG	32.41	71.37	51.89
ITUPROC	42.03	71.94	56.95
ITUHRM	44.02	80.26	62.14
ITUFIIN	47.44	72.92	60.18
AVERAGE:	41.72	74.74	58.23

4.3.2 Descriptive Analysis for Each Independent Variable

a. Primary Activities

Inbound logistics represented by the area of inventories includes the tasks of control of raw materials, intermediate materials (termed "empty" in the organization´s language), and finish product (ITUIBLOG). The precedents report a non-intensive use during the observation period. Their application type corresponds to operational and transactional uses because the nature of the tasks performed does not require strategic decision making. The role played for this area corresponds to operations support, with little interactions with other activities; eventhough, they are the largest figures obtained when all the activities are compared.

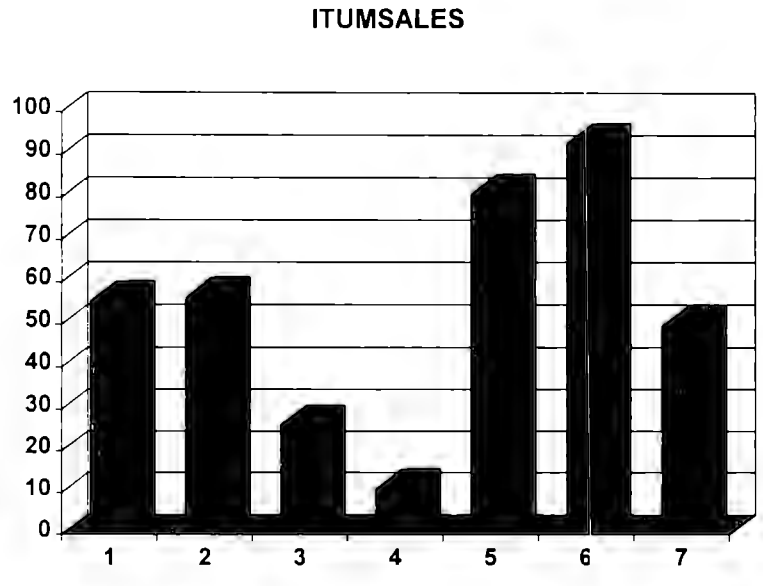


Graphic 4.10 ITUINLOG Configuration

Respondents perceive high strategic importance of IT use which requires to follow a strategy of integration based in the enhancement of IT infraestructure to other facilities of the organization and stakeholders as well. Users satisfacion is below 60%. Several areas of opportunity as intensive training and improvement of infrastructure to facilitate interactions can be considered.

Marketing and Sales including activities of international sales (ITUMSALES) present opposite situations of use impacting the average. During the interview in this area, the employees reported that they are willing for IT infrastructure enhancement. High perceptions are observed in Graphic 4.11 for the strategic importance of IT.

Data reflect applications of the operational and transactional type, with the expected supportive role for operations, and almost inexistent interactions with other activities, but with a high perception of the strategic importance of IT for the firm competitive position, and users satisfaction below 50%. During the interview all the respondents, express their conviction of the IT benefits, and their will to be included in intensive training programs. Foreign sales area reports its need for infrastucture enhancement, with a clear vision of the importance of IT to support and sustain the organization´s foreign sales in more than 80 countries.

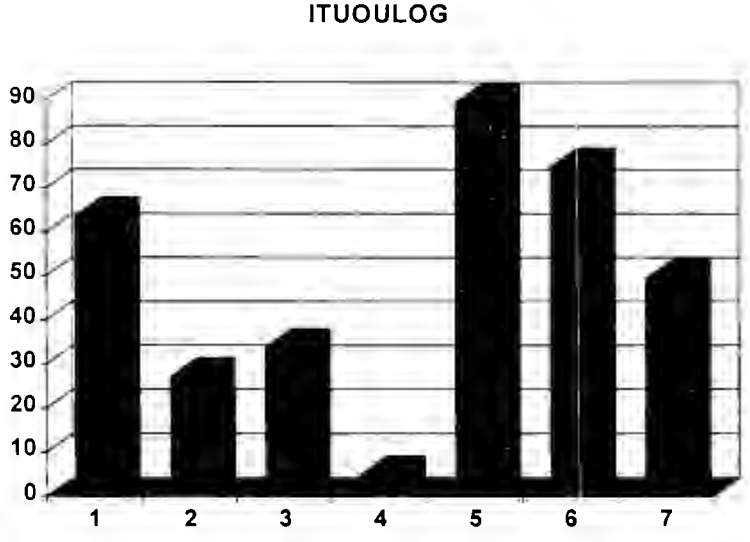


1. Use 2. Application Type 3. Role 4. Interactions
5. Strategic Importance 6. Strategy for IT Integration 7. User´s Satisfaction

Graphic 4.11 ITUMSALES Configuration

Distribution activities are represented in the outbound logistics activities (ITUOULOG). During the time period observed, they reflect an average use of 63.8%, which is considered as moderate an application type oriented to operations, almost inexistent interactions with other activities, and a high perceived strategic importance for the organization. The respondents consider it necessary to follow a strategy oriented to link the plant with other facilities of the business group.

Users satisfaction is below 50%, suggesting an area of opportunity. Local and nationwide sales areas report through the interview marginal use oriented to elaborate end month reports. This situation impacts the results lowering the average of IT use for this activity.

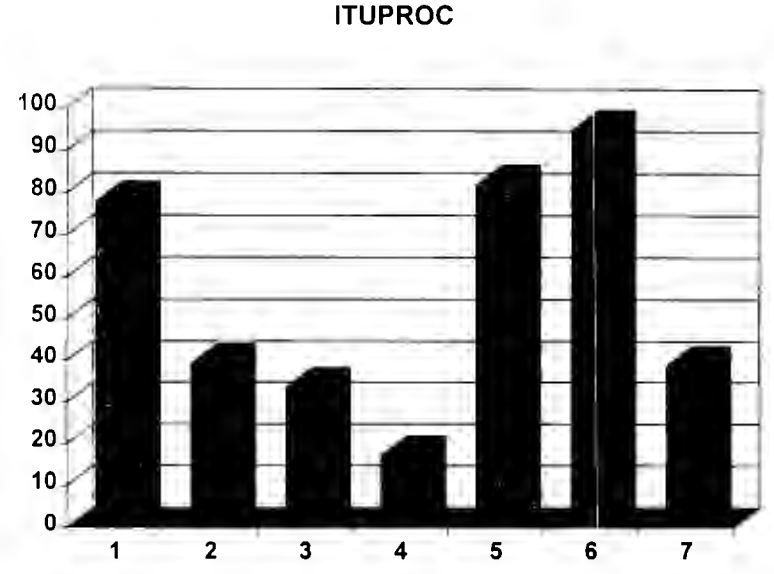


1. Use 2. Application Type 3. Role 4. Interactions
5. Strategic Importance 6. Strategy for IT Integration 7. Users Satisfaction

Graphic 4.12 ITUOULOG Configuration

In a later interview to the MMP Finance Manager from whom Systems Management depends two months after the data collection, it is reported that aggressive plans for IT infrastructure enhancement are starting to be implemented. A new LAN installation is in progress, beginning networking of the distribution warehouses of all the Mexico City Metropolitan area with the Mexico Plant facilities.

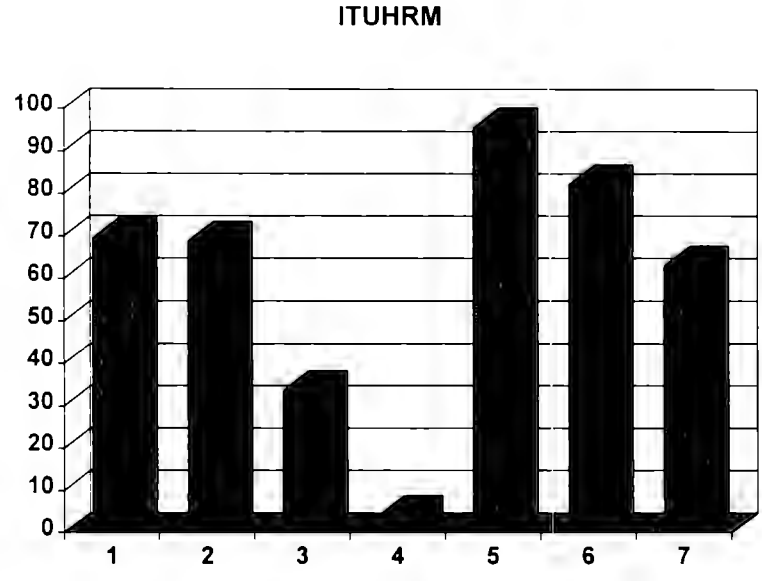
> "Our achievements in software development for the Plant´s operations, the computarization of high volume operation tasks, and a new IT development plan make MODELO Mexico Plant a leader in IT applications in the beer industry not only in Mexico. Senior executives of Anheuser-Bush, which is our partner after an strategic alliance, are interested in implementing them in their facilities in Saint Louis."



1. Use 2. Application Type 3. Role 4. Interactions
5. Strategic Importance 6. Strategy for IT Integration 7. User's Satisfaction

Graphic 4.13 ITUPROC Configuration

Suppliers control and accounts payable areas are identified with the procurement activities (ITUPROC), which report the highest intensity of use during the observed period. As in the other activities, operational use and operation support role result, low but existent. There is a very high perception of the strategic importance and the vision for an international strategy to follow IT enhancement. In contrast, users satisfaction is the lowest in all activities.



1. Use 2. Application Type 3. Role 4. Interactions
5. Strategic Importance 6. Strategy for IT Integration 7. User´s Satisfaction

Graphic 4.14 ITUHRM Configuration

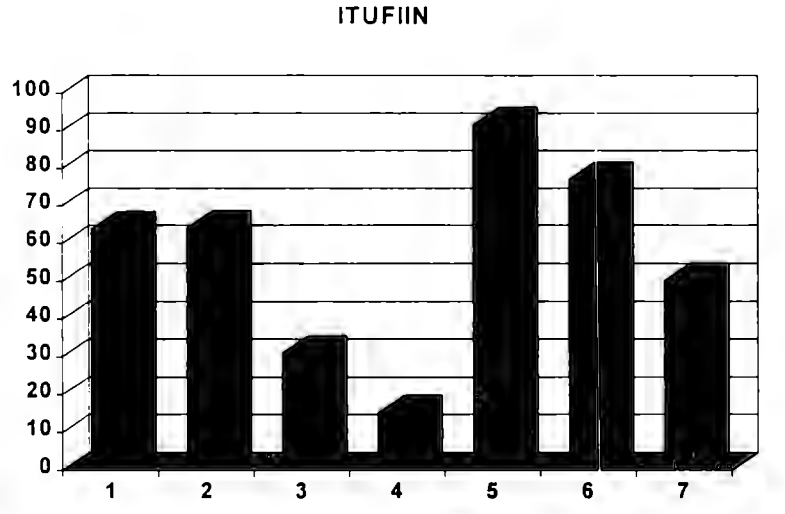
Due to the nature of the organization´s value chain activities, the use of IT for human resources management is mainly allocated in the payroll area. The management and control of salary payments, compulsory social security and retirement security, taxes, saving founds, loans, discounts and all type of movements related to the financial history of the workers and employees are processed in the payroll area with the support of IT.

The traditional functions of human resources management, recruiting, selection, development, etc. use IT marginally to support their operations. For this reason, payroll area is selected as representative of the human resources management activities (ITUHRM). This variable registers: the highest perception of the strategic importance of IT for the firm´s competitiveness, a simi-intensive use, operational and transactional type of

application, support operations role, almost inexistent interactions and the highest users satisfaction in the independent variables set.

"Without the computers and the especialized software developed in-house for this purpose, the workload of this area would be imposible to be managed."

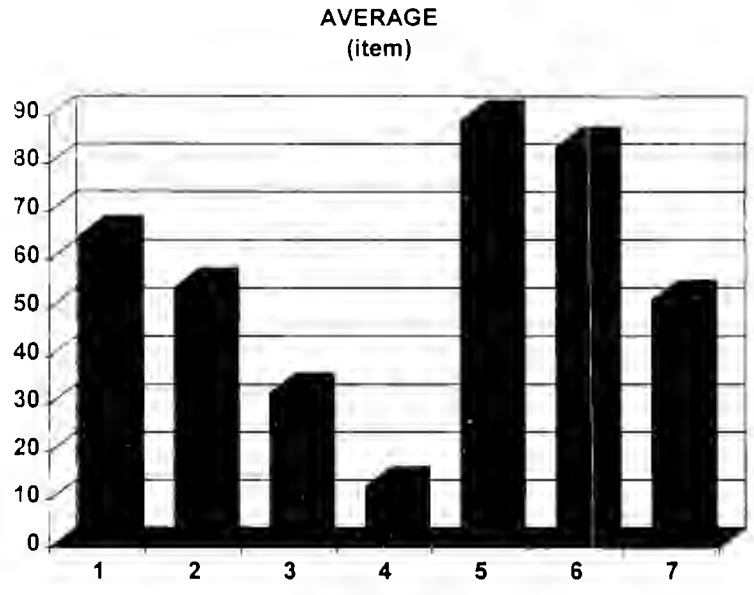
MODELO Mexico Plant Payroll Manager



1. Use 2. Application Type 3. Role 4. Interactions
5. Strategic Importance 6. Strategy for IT Integration 7. User´s Satisfaction

Graphic 4.15 ITUFIIN Configuration

Firm infrastructure (ITUFIIN) activities are identified with accounts receivable management and Information Systems management. The average use is 63.8% which reports application of operations and transactions, an implicit assigned role to support operations, low level of interactions, high perceptions of strategic importance and a medium-term vision of IT integrated nationwide. In contrast, a low level of users satisfaction is reported.



1. Use 2. Application Type 3. Role 4. Interactions
5. Strategic Importance 6. Strategy for IT Integration 7. User´s Satisfaction

Graphic 4.16 Overall Ratings of All Items

Descriptively, the results suggest the following picture: IT use is determined by the user´s needs to use the technology either explisitor mandatory or implicit. Such needs, in turn are determined by the user´s attitudes (perceptions) towards IT use. Behavior is said to be determined by attitude. Here behavior (IT use) is said to be directly determined by an implicit need while indirectly determined by attitude (perceptions). This kind of linkages must be investigated. In previous analysis graphics 4.6, 4.7 and 4.8 shows high levels in the perceptions of IT as important, good and relevant, reflecting a positive attitude (psichologycal state) toward IT. While graphic 4.9 contrary reveals low current level of use (behavior).

CHAPTER V. THEORY BUILDING

The previous research process leads to begin the construction of a preliminary theory related to the phenomenon under study. The theory has been developed by combining observations from previous literature, common sense, evidences and actual data. The theory building process is highly iterative and tightly linked to data. For such a purpose, a roadmap for building theories from case study research (Eisenhardt,1989) is selected.

*Definition of the Research Questions.- In Chapter II. 2.2, two specific research questions are derived from the implicit key, general research question on which the research focuses. In this investigation, the research questions are defined in terms of dynamic technology use and competitiveness in core stable technology organizations. Such definitions of the research questions within a broad topic permit to specify the type of organization to be approached, and once there, the kind of data to be gathered.

During the preliminary investigation, required to support the arguments regarding MODELO 's competitive advantage over its competitors, data suggested a third research question: How a firm with competitive advantage uses IT?

Apriori specifications of constructs , IT Use and Competitive Advantage, help to shape the initial design of the research. It results valuable because it permits to measure the constructs more accurately. These constructs prove to be important as the study progresses, providing a firmer empirical grounding for an emergent theory. The constructs are identified from the literature on competitiveness and from IT and firm performance literature. These constructs are explicitly measured through interviews and the questionnaire. When IT use construct emerges as related

to sales volume (Chapter IV. 4.1), there are strong triangulated measures on which to ground an emergent theory.

*Selecting the Case.- Given the research questions addressed, the leader of an industry, with verifiable competitive advantage is selected (Chapter III. 3.1). To face the crucial task of population specification in MODELO Case, theoretical sampling instead of statistical sampling is used, and 48 IT users from the Finance Division and from the Sales Division are selected due to the links of their tasks with the value chain activities.

*Crafting Instruments.- MODELO Case study illustrates an embedded design, that has multiple levels of analysis within a single study (Chapter III. 3.3 and 3.4, Chapter IV), combines multiple data collection methods such as interviews, questionnaires, and archives, therefore provides quantitative and qualitative evidence as well. According to Eisenhardt (1989), the triangulation made possible by multiple data collection methods provides stronger substantiation of constructs [and hypotheses]. The combination of data types can be highly synergistic, as it is described by Mintzberg (1979):

> While systematic data create the foundation for our theories, it is the anecdotal data that enables us to do the building. Theory building seems to require rich description, the richness that comes from anecdote. We uncover all kinds of relationships in our hard data, but it is only through the use of this soft data that we are able to explain them. (p. .587)

*Entering the Field.- During this stage of the research, when interviewing the survey participants, a new theme emerged when it was observed that those users with high or intensive IT use give as a reason an implicit need to do so due to the nature of their tasks, while users with low IT use declared that there is little need of IT to do their activities. From this observation, it is introduced into the analysis the search of links between IT

use and the explicit or implicit need for it, with the purpose to explore if behind the relationship between IT use and competitive advantage, a precedent relationship exists.

*Analyzing the Data.- Divergent techniques are used in Chapter IV to analyze the expected relationships derived from the research questions. After the quantitative analysis, which provides evidences for the first two research questions addressed, in the descriptive analysis, is discussed how a firm with competitive advantage is using IT, and the differences in use among the areas as well. Some evidences of higher IT use in activities with an implicit need of data processing appear, as well as low use in activities without implicit needs. Additional evidence reinforcing the relationship between need and use is founded in the interview notes, and will be incorporated in this Theory Building Chapter.

*Building evidences for the emergent relationships between IT Use and the implicit need to use the technology.- Survey data support the quantitative analysis and the descriptive analysis, qualitative data from interviews are explored to enrich the statistical results. The qualitative approach facilitates analysis of different users interpretations of the use of IT and the actions around it.

Detailed data collection was conducted through unestructured interviews, review of materials (Annual Reports), and observations in the field (individuals at work). The data was first separate into groups in accordance to whether it reflected statements of key respondents view or surveys respondents view. The examination used is a form of content analysis where the data is read and sorted into categories suggested by the data rather than impose from outside. Once the data are grouped, follows a comparison of each group´s data to determine whether it reflected common

themes (Eisenhardt, 1989). IT as an strategic resource and need for IT use were the most relevant themes for both set of respondents.

The data displays used the relationship matrix format suggested by Miles and Huberman (1994 p.). The displays are designed and intended to be visually interpreted by the reader. The qualitative data are particularly useful for understanding why or why not this emergent relationship holds. Evidences in tables 5.1 to 5.3 show how the new relationship emerges.

A second situation is observed during the interviews with middle managers in the plant. While all of them consider that IT is important to support the organization´s competitiveness, in clear contradiction, some of them do not consider it to be a requirement for their rutinary operations.

Even though IT use is declared by the users to be important, they do not consider IT as a source of competitiveness. Instead, it is considered as a needed instrument to deal with data volumes and speed requirements. In spite of the generalized good perception of IT, little use is identified in some areas.

This contradiction suggests that IT is used only in the presence of an implicit or explicit need. Here, it must be highlighted that a good perception of IT, by itself, does not lead to support competitiveness. The technology must be used if an impact of the technology on competitiveness is expected.

The concept of technological frames (Orlikowski and Gash, 1994) offers a particularly important approach to examining and explaining the differences between perceptions and the use of IT in this organization. Frames are cognitive structures or mental models that are held by individuals. They include not only knowledge about a particular technology but also local understanding of specific uses in a given setting.

Table 5.1

IT Use and Competitive Advantage Relationship Matrix Key Respondents View

Level	Presence of the relationship	Strenght of the relationship	Reasons for this relationship	Examples
Corporate Level	Yes	Strong	Needed for the Group´s competitiveness	Introduction of new standarized Information Systems in all business units of the Group to process production and distribution data for stock market reports. (Group´s Financial Executive Office)
Plant´s Top Management Level	Yes	Strong	Need to control activities with large demands of working capital	Investment and operation of a new LAN to link the seven warehouses of Mexico City with the Mexico plant´s facilities. (Plant´s Finance Senior Executive)
Plant´s Middle Management Level	Yes	Strong	Need for suppliers and accounts payable control to keep the rythm of production required by the market	In-house software has been developed, and a junior executive advisor was assignated. (Systems Senior Executive)

Table 5.2

IT Use and Competitive Advantage Relationship Matrix Survey Respondents ' View.

Value Chain Activity	Presence of the relationship	Strength of the relationship	Reasons for this relationship	Examples
Inbound Logistic	Yes	Strong	Need to control the two main inventories of production imputs.	We register the daily inventories movement and derive the replenishment needs to keep production ongoing. (Inventories area, middle manager)
Marketing and Sales	Yes	Important	We require it for our main tasks, we basically fill orders from international customers. Product quality and brand loyalty are the basis of our competitiveness.	My first computer use was six years ago, now I cannot figure my work without it. One computer is shared by five users. (Foreign Sales, middle manager)
Outbound Logistic	Yes	Important	For the last two years, we have maintained computarized databases for cities, clients, and distributors and fill sales reports for the corporative level.	This area has two computers, I hired a trained person to do this job. The brewery process and the distribution channels are the bases of our competition. (Manager of the National Sales Department, which has distribution functions)
	Yes	Important	For the last two years, we have registered orders and deliveries and loaded the database, printing monthly reports for corporate level.	Our computer is used each month to prepare the monthly report. (Manager of the Local Sales Department, which has distribution functions)

Table 5.2

IT Use and Competitive Advantage Relationship Matrix Survey Respondents´ View. (cont.)

Value Chain Activity	Presence of the relationship	Strength of the relationship	Reasons for this relationship	Examples
Procurement	Important	Weak	Competitiveness depends on product quality and number of sales points.	I use computers to keep suppliers database. I don´t think this directly helps to competitiveness. (Suppliers area analyst)
Human Resources Management	Important	Weak	Direct competitiveness comes from product quality.	Computers are needed to deal with large quantities of operations and registers required by the Social Security and the tax payment systems (Payroll area analyst)
Firm Infrastructure	Important	Weak	Our product is the base of the firm´s competitiveness.	Computers and systems are required to handle the large amount of data required by the plant´s operations. This plant is the leader of software development and systems planning of the Group´s facilities. When some of the other plants need a system, we provide assistance and training to them. This plant is an exporter of systems expertice. (Systems area junior executive)

Technological frames have powerful effects in that people's assumptions, expectations and knowledge about the purpose, context, importance and role of technology will strongly influence the choices made regarding the use of those technology (Orlikowski and Gash, 1994 p. 94). *MODELO Mexico Plant IT users shares a technology frame defined as a core set of assumptions, expectations and knowledge of technology collectively held by a group or community.*

Congruence in themes implies similar expectations around the *role of* technology around business processes, the nature of technology use, or the type and frequency of support or maintenance. Incongruence implies important differences in expectations, assumptions or knowledge about some key aspects of the technology.

Collective interpretations shared cognition around the strategic importance of IT bringing congruence to the answers that are related to perceptions, that is, with attitudes toward IT, but the resulting ratings of IT use (behaviors) are not consistent with them. Fishbein and Ajzen (1974) have argued and empirically shown that attitudes toward objects do not strongly predict specific behavior. That is said to determine whether or not that particular behavior is performed.

To explain the difference, Ajzen and Fishbein (1977) introduce the notion of correspondence. They note that behaviors are specific in terms of both the action and the target of the action. Attitudes toward objects are specific with respect to the target of the action but not specify the action that is to be performance. Since there is only partial correspondence of action and target, a weak relationship can be expected between this attitude and the performance of a particular behavior. This argument helps to explain why users attitudes toward IT are weakly related to IT use. In clear contradiction, recently, Moore and Benbasat (1993) have provided empirical

evidence of a strong relationship between users attitudes concerning system use and their actual use of the system.

Moving the analysis further, the most significant finding is the inconsistency between how IT is perceived as important for competitiveness and the reasons given to use IT by the respondents. Tables 5.1 and 5.2 show that when declaring the importance of IT use for competitive advantage, respondents mention an implicit need to be fullfiled at individual, departamental or at organizational level. When compulsory requirements appear an explicit need such as the corporate requirements of standardized reports, then, IT use is unavoidable for some areas with old fashioned methods of register or data control.

Table 5.3

IT Application Types and Declared Needs of Use Matrix.

IT Use Type / Declared Need	High Need	Moderate Need	Low Need	No Need
Operational	IBLOG (1) PROC (1) HRM (2) FIIN (2)	MSALES (2)	OULOG (2)	-
Strategic	PROC (1)	MSALES (1) HRM (1) FIIN (2)	IBLOG (1) PROC (1)	-
Informational	-	-		All Value Chain Activities

(1) Implicit (2) Explicit

The observable response is to use it only when it is necessary or to hire trained personnel who can deal with the new introduced technology.

From this observation it is considered that higher use of IT corresponds to greater implicit or explicit needs (Table 5.3), thus, suggesting that a relationship between IT use and an explicit or implicit need precedes the relationship between IT use and competitive advantage.

In the MODELO case the highest needs correspond to the operational type of IT due to the nature of the unit of analysis. In this situation, areas with large data volumes with needs of registers, speed or control are positioned. These areas report high IT use during the period of study. Motives and attitudes of users are summarized in Table 5.4.

*Reaching closure.- The results that emerged from the MODELO data embody understandings of, simply stated, how IT is used in a firm with competitive advantage. Taking advantage of a serendipitous finding, the evidences related to the presence of a need as a condition for IT use, and the resulting relationship beetwen IT use and competitive advantage allow to derive, as output, a mid-range theory linking users needs, technology use, and competitive advantage.

Arising from contradictory evidence founded between the user´s perceptions about IT use, its benefits for the firm and the direct impact on the competitive advantage, and grounding on the qualitative evidences discussed above the novel Technology Use Theory emerges.

A direct association between needs and technology use can be envisioned, as well as a direct association between technology use and competitive advantage. No direct connection exists between perceptions about a technology and competitive advantage. Perceptions are linked to technology use in a mutual relation: a positive relationship will be presented when a positive perception leads to a higher use, and then, to a subsequent positive perception, while a negative relationship will be established if a negative perception leads to low use or to avoid the technology use.

Table 5.4

Motives and Attitudes of IT Users Summary Table

Value Chain Activity	Motives	Attitudes	Satisfaction	Problems	Declared Need	Use Strategy
IBLOG						
Employees :	Deal with large data volumes. Control over	+	Little	Systems downs	Daily routine	Self use
Administrators :	registers	+	Little	Overloads	Special Reports	Delegated Use
MSALES						
Employees :	Deal withcomplex data volumes	+ +	Moderate	Single computer	Daily routine	Shared use
Administrators :	Operations registers andcontrol	+ +	Moderate	Personnel´s Training	Daily routine	Shared use
OULOG						
Employees :	Deal with corporate´s requirements	-	Very little	Training	Monthly reports	Self use
Administrators :	Mandatory requirements	-	-	Training	Monthly reports	Delegated use

Table 5.4

Motives and Attitudes of IT Users Summary Table (Cont.)

Value Chain Activity	Motives	Attitudes	Satisfaction	Problems	Declared Need	Use Strategy
PROC Employees : Administrators :	 Large data volumes Speed	 + +	 Moderate Moderate	 Downs Downs	 Daily routine Special reports	 Self use Delegated use
HRM Employees : Administrators :	 Large and complex data volumes Legal requirements	 + + + +	 High High	 Overloads Overloads	 Daily routine Monthly reports	 Self use Self use
FIINF Employees: Administrators:	 Key operations and transactions Key operations	 + + + +	 Moderate High	 Overloads Overloads	 Daily routine Daily routine	 Self use Self use

Therefore the presence, of a need is a necessary and sufficient condition for technology use, while a positive perception is only a necessary condition for it. These links can be expressed as follows:

Need → Technology Use → Competitive Advantage

↑

Perceptions

Technology Use Theory states that an implicit or an explicit need is a necessary and sufficient condition for technology use, while perceptions are only a necessary condition. Technology use and not the perceptions about technology is the supportive element for competitiveness. The resultant theory is likely to be empirically valid because it is consistent with empirical observation. Considering the theory tests, Technology Use Theory has the simplicity of overall perspective (parsimony). IT is testable because generating quantitative gauges such as regression results we are able to assess which are the most important relationships, and due to the research design it is logically coherent. In order to raise the level of generality of the theory multiple studies: an accumulation of both theory-building and theory-testing empirical studies are required.

CHAPTER VI. DISCUSSION AND CONCLUSIONS

This investigation intends to provide evidence about how IT is used for competitive advantage, and how it is perceived by users and administrators for such a purpose. This constitutes an attempt to contribute to a better understanding and improving the general knowledge regarding how Information Technology is used in core stable manufacturing organization with competitive advantage. In the following paragraphs, the main findings of the research will be discussed and some conclusions and managerial implications will be presented. Although the main interest is focused on the results from the case study, the discussion will also mention other results and findings related to the phenomenon studied.

1. Does Information Technology affect the competitive advantage of a firm?

• The observed pattern of sales and IT use in the MODELO Mexico Plant shows no apparent relation, suggesting that in a technological environment characterized by a mix of a dynamic technology, such as IT, and a core stable technology, the base technology is the main technological source of advantage. Further statistical analysis supports that the relationship between IT use and sales exists and that the strength of that relationship is considered acceptable. The presence of the relation must be distinguished from causal relation. Just because the relation exists does not mean that IT causes competitive advantage.

•This result has clear implications for managers because it shows the need to have an articulated IT strategy modeled in its business strategy. The conclusion is that it is not frequent for managers to consider IT strategy as a subset of an overall technology strategy. Nevetheless it is important for

firms to try to understand the influence of IT use in operating results, so as to develop effective strategies for use.

The findings of this investigation provide at least some insight into the puzzle posed by the recent wave of studies identifying a vigorous amount of value emanating from IT applications, from IT investments and from the study of the relationships between IT and organizational performance in different organizations (such as Ackoff, 1967; Lucas, 1993; Westland, 1993; Weill, 1993; Dos Santos,Peffers and Mauer, 1993).

- A special feature of this investigation is the idea that IT also performs in a technological environment dominated by other technologies and not only as the single star in the services industry. For this reason, this study contributes, as the Weill´s study (1992) did, with cumulative evidence to the understanding of IT performance in different technological environments, adding an angle of analysis to the generalized perspective that deals with IT performance and IT value in the world of the service industry.

For firms with a mixed technological environment, IT use can represent a hidden advantage, especially when the core technology is in the mature stage of its life cycle and the technological advantage does not come from that source anymore. The situation illustrated by this case suggests that for manufacturing organizations, IT use is not only desirable, but it is also necessary. The introduction of IT may be a "strategic necessity" to help maintain current competitive advantage.

For MODELO Mexico Plant, which produces almost the 24% of the overall production of the leader in the Mexican beer industry, Information Technology can be considered as a strategic need due to the volume of its operations has to deal with large control requirements for inventories, purchases, accounting, and even human resources management. The core

technology for beer processing is complemented with IT as supportive technology to sustain its current competitive advantage.

In a combined technology environment, IT can be used in all the activities of the firm´s value chain such as production, through Computerized Integrated Manufacture (CIM) and Flexible Manufacturing Systems, financial transactions through On Line Transaction Processing (OLTP) or Electronic Data Interchange (EDI) and distribution through logistic planning systems. Technology Management literature provides a large number of examples.

While recognizing that it is important to replicate this study using different kinds of firms and industries, results of this investigation indicate that information technology is positively related to the overall performance of a core stable technology manufacturing firm.

2. How Information Technology is Used in a Firm with Competitive Advantage?

Descriptive analysis shows how IT is actually used, revealing that the predominant application of IT is identified with the transactional (or operational) type in all value chain activities. The survey of IT use (47 hands-on respondents) points to some clear conclusions: First, IT use is dominated by operational type, 31% of the responses declared operational type use as the only application of IT while the remaining 69% of the responses shows that the users are engaged in a combination of operational, strategic and informational use.

This high involvement in operational use stems from the nature of the organization as a production unit, part of an industrial Group with a Corporate level, which acts as a decision center. This is the traditional role of IT. These results suggest a predominant utility view of IT, which implies

that IT infrastructure is seen primarily as a way of saving costs, provides the primary justification for IT and guides top management in approving investments. IT is seen as a utility that provides a necessary and unavoidable service which incurs administrative expenses.

IT use of operational type in the procurement activities is consistent with the firm´s needs of suppliers control and of accounts payable control. IT use for informational purposes as registered in the outbound logistics activities is explained by the requirements of the areas basically dedicated to embarking orders on time, to support the firm`s market strategy. However, there is a tendency showing that the activities which combine the three types of use have a more intensive use of IT due to their tasks needs. Second, when IT influence is considered at an aggregate level, different influences of the value chain activities remain hidden. Descriptive analysis shows that not all IT use is alike along the value chain, and the complementary statistical analysis reveals that some influence could be negative.

The strategic applications, which implies an evolving role, are moderate and appears in the inbound logistics, human resources management and firm infrastructure, where IT use is oriented to support the organization`s strategy to enhance their market share through inmediate market supply and financial management. IT use as competitive tool, termed integral role, is not developed yet.

3. Is all IT use alike along the value chain activities?

• This case study allows to reach conclusions about IT use along each of the activities of an organization´s identified value chain activities, because it represents a unique opportunity to look into the relationship at disaggregated level. From the literature, several references can be recalled

(Dos Santos, 1993; Wilson, 1993; Booz Allen Report, 1993) about IT and value chain activities, but those sources do not provide any empirical evidence from this approach. What is learned from MODELO case is that literature concepts such as value chain (Porter, 1990), do not appear so straight-forward in the real world. The case provides an evidence that an organization configurates its own value chain according to its nature, to its needs, and to its management style and culture, as it was seen in the in the type of areas which configurate each activity of its value chain.

Results from the descriptive analysis lead to the conclusion that not all IT use is alike. In this study the organization uses IT more intensively when supporting procurement activities and less intensively when supporting marketing and sales activities because the Plant´s nature is production, and for such an activity it deals with a large and complex inventory and accounts payable systems, which cannot be possible to handle without computers and IT infrastructure. On the contrary IT use in marketing and sales is moderate, mainly in transactional applications, because the firm has gained a prestige and have developed brand loyalty in the country and worldwide. Therefore, the plant does not focus the attention on market development nor on intensive customers control.

4. Does IT use in each value chain activity has a different relative influence on competitive advantage?

The Case under discussion illustrates these differences with the following situation: inventories are so important that the requirements provoke the installation of a LAN for warehouses control, while local sales use only one computer. The influence of IT use in inventories on competitive advantage represented by sales volume is clear when the current market share is considered. To respond to such a demand volume, production needs

consume inventories eagerly, and replenishment is a strategic need for the business. The control of this key resource would be impossible without a customized software solution, and as the inventory´s requirements grow the same must happen with the IT infrastructure. This suggests that the organization could tend to react, instead of act, for controlling the situation through the definition and follow up of an IT strategy when facing this situation.

The statistical analysis reveals that some influence could be negative. A possible explanation for the negative influence is that the effects of IT can decline over time if the technology is not updated. In the situation of obsolescence, IT use satisfies a strategic need, but not in the most efficient way. A plausible explanation to these results can be obtained by studyng the complete difusion cycle in the business unit of analysis. The knowledge that a possible negative influence can exist, has tremendous implications to management, suggesting three posibilities: a) current IT infrastructure is obsolete, remember that the plant´s IT use is configurated around a mainframe, recommending that a new IT strategic plan must be developed; b) current IT use is not appropriate neither in quantity or quality, thus suggesting that more training and systems development are required; c) current IT infrastructure is not properly exploited, suggesting that operational use must be overcome encouraging strategic and informational use, and recognizing that there are instances of underinvestment as in the foreign sales area and underutilization as in the local sales area.

The author recognizes that this is a provocative finding, and also note that given the state of theory and data on this area is not possible to conduct direct tests of the causal links of this relationship. The results of this study therefore represent only an initial step in analyzing the potentially complex relationship between the use of IT and cornpetitive advantage.

5. Why IT use instead of IT investments or IT perceptions?

• MODELO case supports IT literature in which IT Use is a preferred criteria to use when analyzing the impact of IT on firm´s performance instead of on the investment perspective. When the impact of IT on firm´s performance is considered under the investment or expenditure perspective (Banker and Kaufman, 1988; Bender, 1986; Harris and Katz, 1988; among others) the financial thinking prevails and managers think in financial relationships between a certain type of investment and the profits obtained. This is a perspective of how much the firm is *paying* for IT, in search of financial information to justify the expenses. But to be effective, technology has to be used thus, the investment is required for the use, but by itself, it is hard to believe that it provides a support to competitiveness.

An illustration of a bad experience regarding the investment criteria rises from the following anecdote: Ten or twelve years ago, MODELO Mexico Plant hired a very famous international consulting firm to develop and implement the plant´s Information Systems. Investments in infrastructure were large, as well as the consulting firm´s fees. During two years the consulting firm worked in the project while the plant`s administrative processes continued in the old way. When the change was about to be made, the systems went down and the plant lived a tremendous crisis. After two years and such a large investments, IT was not able to be used and, therefore, could not provide support to competitiveness. The idea of firms making inefficient investments of IT is anathema to the neoclassical view of the firm as profit maximizer.

MODELO case provides evidences (as in Fuerst and Cheney, 1982; Culnan, 1983; Snitkin and King, 1986; Hogue, 1987) that when managers are concerned about the importance of IT for competitivenes, the

perspective of how much IT the firm is *using* provides more reliable information.

•It is generally accepted that IT brings benefits to an organization. This investigation shows that IT perceived utility is the same for the six value chain activities. Descriptive and statistical analyses comparing the activities confirm that all of them perceive IT as a "good thing" for the firm´s competitiveness. A good perception can lead to use a technology, but by itself, it is not a sufficient condition to provide an advantage. What is required is the use of IT as a means to achieve a better performance.

•From responses to survey questions in the MODELO case, it is clear that reported use rates are lower than the perception rates. While users and top managers agree in the importance of IT and its benefits due to speed and capability to deal with large data volumes, the rates obtained for reported use are contradictory to this statement in areas such as local sales and countrywide sales.

This finding is interesting while considering that the inmediate determinant of a person`s behavior is his/her intention to perform the behavior. The person`s behavioral intention is said to be determined by his/her attitude concerning the behavior. Here, IT use and users opinion are shown to be non congruent. The positive attitude is not reflected when analyzing IT reported use. Observing these results some conclusions about the relationships can be made. A good perception is a necessary condition to use a technology, but it is not sufficient to achieve an advantage, while the use of a technology is a necessary and sufficient condition to gain and sustain the advantage.

• This investigation shows that in MODELO Mexico Plant IT is perceived as an important means to be competitive, and that the largest rates of use come from those areas of the value chain in which an implicit or

explicit need for IT use exists, for transactional, operational or strategic purposes, depending on the nature of the tasks. The observation of this data leads to a novel Technology Use Theory, which states that Technology Use is only given in the presence of an explicit or an implicit need. This theory gathers ideas from the work of others, for example, it is drawn upon the ideas of IT use and firm performance from Miller (1987), and from Weill´s (1992) IT application types. Considering that technology use is the element that supports an organization´s advantage, and not technology investments or perceptions about it, Technology Use Theory has important implications for management, due to the magnitude of the investments required for technology acquisition and to the role of technology in the firm´s competitiveness.

An anecdote of the countrywide sales area of MODELO Mexico Plant provides an example of the Technology Use Theory: a middle manager with 25 years of seniority in the firm has to use a new computarized system to keep the sales records. This represent the need to use the technology for the area. As computers are not familiar to him and he wants to preserve his image as an authority, he does not want to go into training courses. To cope with the need, he hires two young new employees with broad experience in computers use. The general impression from the interviews, is that the users with more years of seniority emphasize the advantages of traditional forms of the processes, but they avoid addressing the problems that can only be solved by using IT, because this usually implies the displacement of old skills for new and in some cases the displacement of people.

Technology Use Theory is valid for other types of technology, as it is clear when a firm adopts new technologies due to its need to face market changes or by the pressure of the competitors´ innovations in technology. Technology Management literature provides many examples of situations of

the kind (Capon and Glazer, 1987; Teece, 1988; Fleming, 1991; Kodama, 1992).

6. What are the implications of this study ?

The results summarized in graphics and figures can be useful to suggest how an organization may move away from and improve on its current practice. For instance, the agressive plans that MODELO Mexico Plant is implementing for IT development can be programmed upon the basis of identified needs to expand or consolidate IT use. Plans for users training can be developed from the results obtained regarding users satisfaction issues, and the possibilities to increase interaction through IT use should be encouraged. The important feature of the research is that managers can identify where major points of underutilization occur and also the change factors which need to be managed if IT growth is to be acomplished. From the perspective of the firm`s executives, these findings should assist in developing a set of technology strategies that can potentially help their organization in optimizing IT use. The study`s findings suggest that management needs to consider whether: First, the firm is employing, in general a sufficient number of computers and updated equipment, asuming obsolesence in IT infrastructure, removing may have to be considered. Second, it has enough trained personnel in IT to cope with the organization`s needs.

The following recommendations result from some 15 interviews with hands-on users in the operational areas: First, a reliable systems support is required. System´s downing alters the rythm of the tasks, being especifically dangerous when the business cycle is on its peak and several legal commitments must be accomplished. Even though currently each of the key operational areas has a designated systems responsible, who acts as

a doctor with a pacient, more and more reliable support is needed. Second , there is a willingness for IT infraestructure enhancement among current intensive users, this recommendation provides to IS staff a great scope to innovate. Third, training in site must be enhanced and improved, users consider not to be up to date at the present, besides they are interested in receiving more information about the potential of their available equipment.

- For researchers, the result has deep implications considering the large amount of empirical research interested in demonstrating the relationship between IT and organizational performance under a positive perspective (Bender, 1986; Earl, 1989; McKeen and Smith, 1993; Wilson, 1993. To cite a few). These results call for caution when considering the general assumption that IT always affects positively the firm´s performance.

The literature revision carried out to select the measures to be used in the questionnaire survey, reveals that little agreement exists in relation to this issue, and that therefore, it should be included in the research agenda. It is observed that measures used to study the impact of IT on organizational performance have different criteria. Those better developed are the ones oriented to the relationship between investment and the firm´s value, the investment or expenditure perspective, the productivity perspective, and the IT use perspective, which can be categorized into two subsets : quantitative items and perceptual items. The use of both sets of measures to create independent variables at disaggregate level is an irnportant feature of this investigation.

Of wider interest is the observation of an aggregation bias due to the use of a set of measures composed by quantitative and perceptual items. Results show that an inflation effect emerges from the use of perceptual items due to the enthusiasm of users and from the general belief that IT is important for the firm´s competitiveness. The careful selection of measures

based on quantitative items is recommended for further research, when the purpose is to learn about IT effectiveness, or to include both types of analysis, the overall and the quantitative items to adjust the results.

The selection of a business unit of analysis to perform investigations of the kind, and to conduct the field work is a matter of extreme care due to the need of previous work to identify the firm for a case study, or the collection of firms in a multicase study, with an observable competitive advantage. For investigations of this nature, the fieldwork component of the research conducted in the workplace seems to be adequate. Interviews are a must to have a flavor of the environment in which IT is used, and the feelings of the users respect to the technology, and more important, to the management strategy developed to integrate IT to the daily tasks, although it can provoke an inconvenience for the respondents if long time observations are realized for long time periods. This brings a decisive point to the researcher, either giving priority to the research aims in spite of the inconveniences caused to the observed organization or being respectful with the host organization in detriment of the research results. We must remember that an analysis at disaggregate level involves most of the organization´s value chain activities.

The limitations of this study are its cross-sectional nature and its scope to a single organization. Further research on the impact of IT regarding its life cycle in competitive advantage is suggested to learn about the timing of IT effectiveness for an organization. Other case studies must be developed under the perspective of longitudinal studies to observe the relationship along the life cycle development. Both may be considered an advantage for the research process, but not for the results as they can not be generalized.

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APPENDIX A. MODELO CASE PROTOCOL

Purpose.- The aim of this work is to investigate the use of a dynamic technology to support competitiveness in a core stable technology organization. As it is a dynamic technology, Information Technology (IT) will be selected, and core stable technology will be a manufacturing process in the mature stage of its life cycle. Relevant reading: Technology Management literature, related especifically with the nature of technology, technology innovation, technology planning and technology strategy, and IT strategic value literature, specifically related to IT and competitiveness.

Key features of the case study method.- Real life context, a mixed technological environment. Interest in two levels of analysis, at aggregate and at dissaggregated level. Embedded design, using different data sources such as key respondents interviews, a survey, IT user´s interviews, and organization´s archivals. Look for quantitative and qualitative evidences.

I. Procedures

1.1.- Selection of the context of the analysis: the unit of analysis requires an organization with a visible competitive advantage, a core stable manufacturing technology, and an IT infrastructure to support the administrative processes.

1.2.- Review the configuration of different types of manufacturing industries in search of the requrements for the study. Use country´s statistics such as the GNP structure to discard industries with great number of firms, and reduce the feasible population to a few candidates. Look for

the leaders with a visible competitive advantage for a new reduction. Use Stock Markets reports for a broad perspective of leading organizations within an industry. Use the value of the firm criteria for the final selection. Address the research questions, operationalize them into a preliminary conceptual framework. Relevant literature: firm´s value literature.

1.3.- Verification of the access procedures.- Once the organization is identified, prepare a brief summary of the purpose of the study, estimated time of field work, methods to be used and expected results. Describe briefly the benefits of this project to the host organization. Look for the key Senior Executive involved with the area to be studied. Make an appointment and present the summary of the project. If the Senior Executive agrees to be the Champion of the investigation, upon the basis of the summary, ask for available documents to be familiar with the organization. Define the terms of the confidentiality agreement. Important document: the project´s summary, and an outline draft.

1.4.- Prepare a relational model to operationalize research questions and to indicate the relationships to be searched. Relevant literature: related to IT importance for firm performance and to competitive advantage.

1.5.- Determine where the IT users are. Ask for total population of users and position of the IT infrastructure in the organization. Define, with the Champion, the key persons to be interviewed and survey participants. A main source of information is the Systems Manager and the Finance Manager. Cross information with other key informants such as corporate level top executives and people from other facilities of the same

organization. Check the conceptual framework. Adjust conceptual framework for two levels of analysis: aggregate and disaggregate level.

* For CPU functions, IT infraestructure and availabe software, the source is the Systems Manager.

* For types of IT and area allocation of IT infrastructure, the source is the Finance Manager.

* For IT use at aggregate level, the source is mainframe registers and for disaggregate level computer direct users.

1.6.- Schedule interviews with key respondents (Corporate Finance Executive Officer, Distribution Agency Manager, Production Manager of a sister organization who acts as a supplier). Prepare a list of topics of interest for the study in search of information related with the research questions. Prepare the survey instrument. Define the data for the IT use reports and for the users opinions. Select the data analysis techniques and prepare the analysis plan. Important readings: IT measures literature and questionnaire configurations. Check the preliminary instrument with the Champion. Consider the proper time for administration and for interviews to cause the least inconvenience during working hours. Select the areas which represents the value chain of the organization.

II. The Field Work

2.1.- Schedule the time period of daily CPU monitoring, defining the criteria to be used (identificable peak hours). Determine relevant documental outputs (mainframe reports). Identify the designated junior executive to collect mainframe reports.

2.2.- Schedule the same time period for daily sales volume report. the source is Finance Management. Don´t ask for routinary sales reports to respect the confidentiality agreement

2.3.- Schedule the time period for the instrument administration and for the interviews. Be sure that the champion will do the presentation of the project to the survey participants. Select a proper period which includes the organization´s business cycle to have a full picture of IT use intensity (six weeks for MODELO Mexico Plant). Define the instrument assessment criteria (15% non response rate). Be very strict with the time schedule to respect the respondents working time. Take notes about all data and comments additional to the questions of users opinions. Organize with the users the modes for collecting the weekly reports of use. Ask the Finance Manager to prepare a daily sales volume report for the same period of use, as he does his report to the corporate level.

III. Data Process

3.1.- Prepare CPU´s data and sales volume data (37 observations). Observe pattern matching. Run regression for the first research question at aggregate level.

3.2.- Prepare questionnaire coding and data bases for user´s opinions (47 subjects) and one of each week of the reported use (47 responses x six weeks = 282 use reports). Organize data base by respondent, by week, and by value chain activity. Be sure to work at question level and at item level. Construct a weekly index for each value chain activity (six indexes available, one for each activity giving a total of 36 numbers for the total

period of six weeks) and correlate according to the research questions needs. Run quantitative analysis (regressions, ANOVA, ANCOVA, Correlation Analysis). Prepare data for descriptive analysis. Introduce additional qualitative data.

3.3.-Build tables and graphics with the results and prepare a report with the results of the analysis and findings. Build evidence tables and matrices for qualitative data.

IV. Gathering Information

4.1.- Establish relationships between outcomes of the quantitative analysis and from the qualitative evidences. Link them to build a mid range theory, if they are logically coherent. Look for parsimony (the simplicity of overall perspective) and for testability.

V. Prepare the Investigation Report

5.1.- Revise the preliminary outline and adjust into a new outline. Summarize the objectives and the flow of the investigation in a first chapter, which is supposed to be the motivation chapter. Provide a roadmap to the reader in chapter two. Summarize what the research questions are. Support with literature reviewed. Discuss the case study research strategy and the quantitative data gathering as much as the qualitative data gathering in a following chapter. Assess the validity and reliability of the quantitative and qualitative case data. Leave data analysis for the next chapter.

5.2.- Induct a theory for the research questions. discuss the implications and conclusions to the research questions using the case study

results and also based on the existing literature and triangulate the emergent theory with the existing research to put the investigation into the context of other studies and to suggest what the cumulative studies, including this, say about the research questions in a final chapter. Try to make it highly readable.

5.3.- Prepare references.

5.4.- Prepare Appendix for protocol, questionnaire structure and respondents profile. Be sure to keep confidentiality.

Appendix B.The Questionnaire

Table B.1 Questionnaire Structure

Structure	Application Form	Number of Items	Scale
Three Parts			
Part I: Respondents Profile	Single response, in the first week application, interview type	5	Four open questions One selection question
Part II: Use Report (quantitative items)	Six consecutive weeks administration. First week interview type, report filling afterwards	8	One report type Six Likert type One selection question
Part III: User´s Perceptions (perceptual items)	Single administration, in the first week application, interview type	8	Six Likert type Two selection type

B.2 Questionnaire Content

Part A. Respondent´s Profile
1. Allocation: Division, Department, Section
2. Official name of current position
3. Experience:
    a. In current position
    b. In the organization
    c. In the task performed
    d. In the use of computer equipment
4. Educational Background
5. Training hours in the last year
    a. General training programs
    b. Computers and systems training programs

Part B. Reported Use
6. From the following list of equipment and installations, mark the ones you used for your task during this week (personal assignment, shared use, time in hours of individual use)
7. From the following list of software, mark the ones you used for your task during this week
8. From the following list of special software, mark the ones you used for your task during this week. (oriented to specific activities, see coding)
9. From the following list of special software mark the ones you used for your task during this week (Oriented to other type of especific activities, see coding)
10. From the following list (11 items) rate the importance of the following reasons to use computers in your job position during this week
11. Rate the importance of IS in the Plant operations
12. Rate the performance of IS last week
13. Given a list, mark the number of your interactions using IS

Part C. Users Perceptions
14. Rate strategic importance for the firm´s competitiveness
15. Rate the importance to support BUA´s operations
16. Mark the role of IS in the firm
17. Mark the type of IT strategy the firm should follow
18. Rate the quality of IS support received for your daily tasks
19. Rate your satisfaction with IS training programs
20. Rate your satisfaction with IT performance
21. Rate the IT needs for the future

Table B. 3 Questionnaire Coding

PART I RESPONDENTS PROFILE	PART II QUANTITATIVE ITEMS	CODING	PART III PERCEPTUAL ITEMS	CODING
Allocation		*Question 1*	*Strategic*	
		Inbound Logistics (1)	*Importance:*	
		Marketing/Sales (2)	Orientation	*Question* 14 (%)
		Outbound Logistics (3)	(competitiveness)	
		Procurement (4)	Importance	*Question* 15 (%)
		Human Resources Mgmt. (5)	Strategic Integration	*Question* 16 (%)
		Firm Infrastructure (6)	Integrative Strategy	*Question* 17 (%)
Job Position		*Question 2*		
		management (1)	*Users Satisfaction:*	*Question 12*
		non management (2)	Needs and quality	*(aver.%)*
Job Experience		*Question 3 (years)*		*Question* 18 (%)
Education Level		*Question 4*	Infrastructure	*Question* 19
		Education level (*years*)	Support	*(aver.%)*
Training Hours		*Question 5 (hours)*	Training	*Question* 20 (%)
	Reported IT Use:			*Question* 21
	Use:		Performance	*(aver.%)*
	Equipment	*Question 6 (hours)* (a-e)	Plans to Use	
	Installations	*Question 6* (f-g)		
	Ops. System/ Software	*Question 7 (aver.%)*		

Table B. 3 Questionnaire Coding (Cont.)

PART I RESPONDENTS PROFILE	PART II QUANTITATIVE ITEMS	CODING	PART III PERCEPTUAL ITEMS	CODING
	Software Programs (Developed)	*Question 8 (aver. %)*		Equipment (a,b,c)
		Production (a-f)		Software (d,e,f)
		Inbound Logistics (g-l)		Installations (g,h,i)
		Procurement (m-n)		
		Question 9 (aver. %)		
		Sales (a-d)		
		Human Resources Mgmt (i,j,m)		
	Application Type:	Firm Infraestructure (e,f,g,h)		
	Operational	*Question 10 (aver. %)* (a-e)		
	Transactional	*Question 10* (f-j)		
	Strategic	*Question 10* (k-m)		
	Role:			
	Operations	*Question* 11 *(aver. %)* (a-c)		
	Strategy	*Question* 11 (d-e)		
	Interactions: Along Value Chain Activities	*Question 13 (aver. %)*		
		Sales (a-d)		
		Inbound Logistics (e-g)		
		Outbound Logistics (q)		
		Human Resources (t)		
		Procurement (u)		
		Firm Infrastructure (r,s,v,x)		
		Production (h-p)		

APPENDIX C. RESPONDENTS PROFILE

Some differences are observed from the composition of the respondents group, 30% of them are at the middle management level with higher levels in their responses than the average of the group, with the exception of the educational level (11.9 years) and the general training time (36.3 hours in 1994). Middle managers declare more experience using computers (10.0 years) than non-managers (6.6 years) and more hours of system training last year (40.8). This can be an indicator of a strategy for the introduction of computers in the different levels of the organization. Among the non-managers group, turnover seems to be higher in inbound logistics activity, but requiring personnel with a broad job and computer use experience. Other young non-managers profiles are identified in areas such as firm infrastructure, and marketing and sales.

The group of respondents´profile job experience is 8.5 years in average. Therefore, it is possible to assume that they have developed an expertice for their assigned tasks. It is possible to infer that the firm hires people already trained to be developed according to the firm´s policies and needs. An important issue is their experience using computational equipment (6.6 and 10 years average) that is previous to the expertice in the current position and to the expertice in the activity performed

The 9.6-year average within the firm of both sets of respondents leads to consider that they are already integrated to the Plant´s culture, feel comfortable, and that MODELO Mexico Plant is a mature organization. The implications of this job profile is that it facilitates management, but

represents a hurdle for change. Habits are hard to be changed and changing the ways of doing things can be considered as a threat for their stability and confidence.

The education levels of 14 and 12 years in average, represent one year more than high school for the Mexican educational system. The reported training hours seem to be priorized resulting in 46.7 average hours for general training programs and 36.9 hours per person for system training programs in 1994. These data are consistent with the results obtained in the rating of user's satisfaction and with issues such as integration of Information Technology to the work environment, although there are still remaining questions related to the number of hours required. And to their distribution among a major number of employees.

The data results indicate that for managerial level, the strongest stability in job position (14 years), and job experience (22.5 average years), are in the outbound logistic activities, while in procurement the higher experience with computers (17 years) is reported. Data reflect as well, different stages of experience with computers, going to 2.9 years in average in the marketing and sales area. Inbound logistic reports more hours in system training (73.4 hours in 1994), followed at a distance by marketing and sales (45.4 hours).

Table C.1 Respondents Profile

VALUE CHAIN ACTIVITY	AREAS INCLUDED	N	JOB EXPERIENCE (yrs. average)	EDUCATION (yrs. average)	TRAINING (hs. last year) General	TRAINING (hs. last year) Systems
IBLOG	Inventories	7	6.96	16	146.4	73.4
M/SALES	Exports	6	7.98	12.9	36.0	45.4
OBLOG	Local Sales National Sales	7	11.49	9.2	10.5	40.4
PROC	Distributors control Suppliers, Accounts Payable	6	11.81	12.7	30.0	15.0
HRM	Payroll (Payments, Social Security, Retirement insurance, discounts, bonuses, additional working time, taxes,	7	6.07	13.7	2.5	5.9
Firm Infrastructure	savings, etc.) Accounts receivable, Information Systems	14	6.39	13.8	54.6	41.7
TOTAL Total yrs/hours Average		47	8.46	13.1	46.7	36.9

Table C.2 Respondents Profile Non Management Level

Value Chain Activity	N	Experience in Current Position yrs/av	Experience in the Firm yrs/av	Job Experience yrs/av	Computer Use Experience yrs/av	Education yrs/av	General Training hs/yr.	Systems Training hs/yr.
IBLOG	1	.5	.5	.5	10.0	17	240.0	40.0
MSALES	6	5.3	7.8	5.4	2.9	13.7	36.0	42.7
OBLOG	5	6.6	11.4	5.3	3.4	12.4	6.0	43.2
PROC	4	10.3	11.1	.9.8	10.1	13.3	-	30.0
HRM	6	3.6	9.1	5.7	7.8	15.3	5.0	11.7
FIINF	1	1.1	4.8	2.7	5.1	13.1	55.4	30.8
TOTAL	33	4.6	7.5	4.9	6.6	14.1	57.1	33.1

Table C.3 Respondents Profile Management Level

Value Chain Activity	N	Experience in Current Position yrs/av	Experience in the Firm yrs/av	Job Experience yrs/av	Computer Use Experience ysrs/av	Education yrs/av	General Training hs/yr.	Systems Training hs/yr.
IBLOG	5	5.5	7.8	13.0	8.8	15	52.8	106.8
MSALES	1	9.0	11.0	11.0	8.0	12	36.0	48.0
OBLOG	2	14.0	17.5	22.5	8.0	6	15.0	37.5
PROC	1	6.0	15.0	15.0	17.0	12	60.0	-
HRM	1	2.0	8.0	2.0	8.0	12	-	-
FIINF	4	5.0	8.5	10.5	10.3	14.5	53.8	52.5
TOTAL	14	6.9	11.3	12.3	10.0	11.9	36.3	40.8

VITA

Victoria Eugenia Erosa Martín was born in Mérida, Yucatán, México, on August 26, 1944. The daughter of Enrique Erosa and Ana María Martín. She entered the Universidad Nacional Autónoma de México, where she studied from 1962 to 1966, and received the degree of Bachelor of Arts (Economics) in 1970. In 1979 she entered the Universidad La Salle in México City and in 1982 she got the degree of Master of Sciences (Education). In June 1992, she entered the Doctoral Program in Business Administration offered by ITESM with the collaboration of the University of Texas at Austin. Since 1965 she has worked for public institutions and as a consultant for several Government Institutions and private firms as well. From 1989 to 1995 she was designated National Researcher by the National Research System of Mexico. She has written several books on Technology and Education issues, and participated extensively in international forums. Her papers have been published in a large number of refereed proceedings. She is the Academic Director of the Program of Technology Base Enterprises Creation and Entrepreneurship in Central America, sponsored by the Programa Bolivar/Interamerican Development Bank. From 1991 to August 1996, she was a Professor of the Graduates and Research Division of ITESM, State of Mexico Campus.

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