INFORMATION TECHNOLOGY, WORKPLACE ORGANIZATION AND THE CASE OF ŞİŞECAM

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ABSTRACT

INFORMATION TECHNOLOGY, WORKPLACE ORGANIZATION

AND DEMAND FOR NEW KINDS OF SKILL

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This study examines the relations among information technology (IT), workplace organization and the demand for skilled labor. Recently, demand for skilled labor has relatively increased. One of the causes of this great increase is skill-biased technical change. Firms that are intensive users of IT tend to adopt a complementary set of organizational practices that include: decentralization of decision authority and a greater reliance on skill and human capital. I have explored the affects of IT on skill and organizational architecture of firm by using a detailed data which was collected from the Şişecam Group of Company. I have tested that IT usage is complementary or substitutionary to a new workplace organization which includes broader job responsibilities, more decentralized decision-making and more self-managing teams together with IT and new organization are complements with worker skill measured in variety of ways.

Keywords: Information, Technology, Fordism, Mass Production, Flexible Specialization, Skill, Computerization, Demand for skill, Skill-biased Technical Change, Organizational Change, Glass Industry, Şişecam.

ÖZ

ENFORMASYON TEKNOLOJİSİ, İŞYERİ ÖRGÜTLENMESİ

VE YENİ VASIF ÇEŞİTLERİNE TALEP

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Bu çalışma, enformasyon teknolojisi, işyeri örgütlenmesi ve kalifiye işgücü talebi arasındaki ilşkileri incelemektedir. Son zamanlarda, kalifiye işgücü talebi nısbi olarak arttı. Bu büyük artışın nedenlerinden biri vasıf-eğilimli teknik değişimdir. Yoğun IT kullanıcısı olan firmalar, karar verme yetkisinin dağıtımını ve vasfa ve insan kaynaklarına büyük şekilde bagımlılığı ihtiva eden örgütlenme uygulamarının tamamlayıcı biçimlerine uyum sağlama eğilimidedirler. IT'nin vasıf ve firmanın örgütsel mimarisi üzerindeki etkilerini Şişecam Şirketler Topluluğu'ndan topladığım detaylı verileri kullanarak araştırdım. IT ve yeni örgütlenmenin birçok değişik yolla ölçülmüş olan işçi vasıfları ile tümleyen oluşu ile birlikte, IT kullanımının geniş iş sorumlulukları, daha fazla dağıtılmış karar mekanizması ve daha yetkili takımları içeren yeni bir iş örgütlenmesini tamamlayıcılığını veya ikame etkisini sınadım.

Keywords: Enformasyon, Teknoloji, Fordism, Kitle Üretimi, Esnek Üretim, Vasıf, Bilgisayarlaşma, Vasıf Talebi, Vasfa Dayalı Teknik Değişim, Örgütsel Değişim, Cam Sanayi, Şişecam.

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INTRODUCTION

As the digital technologies become powerful, plentiful and inexpensive, we start to live with microprocessors in which almost all parts of our life such automobiles, aircrafts, and telephones, controlling such functions as antilock brakes, automated landing systems, and cellular call processing, designing, presenting…etc. In recent years, we have seen the transitions of computers. Advances in the computer industry, coupled with those in telecommunications, have created the new information technology (IT) industry. For instance; computing advanced from stand-alone systems to batch processing, from batch processing to time-sharing, from time-sharing to personal computers, and now from personal computers to information appliances connected to the Internet. Today, many different kinds of companies and businesses are using information technology to become more efficient through better coordination of services and more effective planning. They have been able to reduce costs and increase productivity. For example, international firms maintain a web site for a part of distribution or a link their design centers in different countries to create international design teams. Briefly, information technologies are affecting every business today; retail, banking, farming, teaching, transportation, manufacturing, publishing, services and most other industries. It means that almost every job will have considerable IT components. For instance, in the financial services sector, customers are able to do electronic money transfer, online stock trading or checking also they can operate automatic teller machines, in the travel industry, a growing number of people are examining their bookings, flights and accommodations, the health industry now offers remote consultation…etc.

On the other hand, all these improvements in information technology have required inevitable structural changes in organization associated with new forms of demand for workforce skill. It can be claimed that technology, in general, has assumed to have two effects on jobs. First, it creates new jobs and tasks. Second, some jobs and tasks are removed by technological opportunities. It is easy to see a significant growth in new jobs and activities with the destruction of older jobs. The net effect on jobs depends on workers' skill, employers' attitudes and the nature of new technology.

There are many studies exploring how technology that refers to broad changes in production systems drives job creation. Some of them argue that technological change has tended to increase skill requirements by reducing physical works and production function has changed as raising skill requirements (Bound and Johnson, 1992).

Despite the fact that frequent changes in technology in terms of process and equipment expose firms to continually retrain their employees, training is expensive for employees who live difficulties to give training. As a result, firms may replace employees whose training is expensive with labor saving technologies or they are probably to shift their workforce from those with high-cost training to those with low-cost training (Bartel and Sicherman, 1998). Alternatively, firms can hire workers who have high training cost to suppose that relative utilization of skilled workers is positively correlated with capital intensity and the use of technology.

In this study, rather than examining how technology affects job market, I will take in the account the mechanism of IT and workplace organization by considering from early IT applications to today's business. Starting with Leavitt and Whistler (1958), which IT creates business value has been discussed for over 40 years. For early IT applications, the value was generally viewed as labor savings by using computers to conduct routine transaction processing, improve organizational communication, automate data storage…etc. It is resulted that reducing number of clerks, accountants and middle managers whose functions are performed by computers. Then massive use of IT especially in the equipment-intensive service operations transformed the value as reducing the need for capital. Many repetitive and routine works was carried into computer-based systems and was started to use more effectively. Later, IT usage has shifted the value from cost saving towards driver of new technologies and services. IT investments carried firms to some abilities such as improving market, quality, customer services. In that point, firms had to follow some strategies for most effective structure with increasing IT investments. Firms, especially large scale ones, have generally found that computer-integrated manufacturing system is more productive than traditional systems. Information technologies that support production systems represent complex and systematic activities in modern enterprises. In order to increase the success in markets, firms upgrade themselves to adopt flexible production system and attempt decentralization, delegate decision-making power and be flexible in process and procedures. This strategy gave a central role to supervisory staff and lower levels of management for an alternative channel for the control of workers.

During organizational transformation, while computers are generally complemented with skilled and empowered workers, they are substituted with less skilled workers and clerks. It is argued that computers are complements to skilled, empowered workers, customer-focused strategies and flexible production process (Breshanan, 1997; Drucker, 1988; Applegate, Cash and Mills 1988, Brynjolfsson and Hitt, 1996). According to these arguments, instead of being a substitution factor for other factors of production, computers are complement to traditional production factors such as capital, labor in organization that have flexible production system, empowered workers and skilled staff.

I will analyze the effects of IT on demand for skilled labor in this study. To explore organizational transition with IT usage, I will focus on a firm, Şişecam Group of Companies, which is almost monopoly in Turkish glass industry. Choosing a company to test the hypothesis is an important criterion for accessing the right results. Şişecam is one of the best opportunities to examine the applicability of my hypothesis. Today, as a result of specialization, highly competitive operations, consolidated sales reaching US$ 1 billion, exports US$ 400 million and a workforce of 12,400, Şişecam has taken its place as one of the leading glass manufacturers in the world. The size of the businesses within the Group rank from third to tenth position globally, demonstrating the best evidence of its strength. With a contemporary management style, strong adherence to the principles of industry and professionalism and its focus on the market and R&D activities, The Group’s vision, "to become the leading glass manufacturer in its immediate geographical region" will be achieved on these foundations. Recent investments in Bulgaria, Georgia and

Egypt, also initiatives taken in a number of other countries, still in the planning stage, constitute significant steps toward actualizing this vision that is conformity with the general trends observed in the global economy. Current attempts, especially with regard to joint ventures and strategic partnerships with other reputable enterprises in similar business lines, should be perceived as stepping-stones toward a prosperous future. Shares of Group companies, Trakya Cam, Anadolu Cam, Denizli Cam, Soda Sanayii and Camiş Lojistik, as well as those of Şişecam are traded on the Istanbul Stock Exchange. One of the main targets of Şişecam is to go public for all of its operations and expand the capital base of the Group (Şişecam, 2002). Detailed information about the Turkish Glass Industry and Şişecam group of the company will be presented at 5^{th} chapter titled as Case Study.

As a starting point of the analysis, I am going to deal with some helpful explanations about the information technology regimes and organizations together with the concept of information technologies and its workers. I will inspect mechanism of IT from establishment of first IT to today's business. The main sense of this inspection is to clarify how information technologies substitute or complement other factors of production. The next part of the study will present detailed approaches on skill-biased technical change as a main driver of demand for skill. Many authors have argued that increase in demand for skilled labor resulted from skill-biased technical change. In fact skill-biased technical change is not only reason of this increase. Supply of educated workers, changing demand type and manufacturing systems can be shown as other causes of increase in skilled labor demand. This section also includes some human capital theories and it is important to point out the shift in skill-biased technical change during 1980s. Then I will consider in computerization and its relations with information technology to enhance kinds of organizational changes by the way of being information technology-intensive firm.

In the final part, the case of Şişecam Group of Companies will be represented and the results of the surveys will be discussed. The survey was based on human capital and workplace organization, identified by theoretical discussions in the previous chapters, with questions addressing various types of determinants for skill, modes of delegating decision authority, the extend of computerization, the effects of computers on various organizational dimensions and other characteristics of workplace organizations. In the glass industry, organizational management, work-sharing and associated visions have great importance together with the necessity to diffusion wider markets. The changes in the composition of demand have considerable repercussions on the organization of work and production. This necessitates a continuous updating of business strategies in Şişecam. Considerable basic development tendencies, as well as the development through foreign markets, are created by being basic industry, being firstly established industry, being primary sector for investment to develop other national industries and especially the relations between state and industry in the glass industry. In this context, how companies' general tendencies through the technology have affected the organizational structure of the company will be discussed in this study. To the best of our knowledge, there are no similar studies which are about the relations between organizations and information technologies hold by examining the real situations in terms of a case study in Turkey. Therefore, this study will also be present a detailed observations on firm-level data related with workplace organizations in Turkey. I have tried to find some evidence about the complementarities between IT and work organization rather than simply and solely assuming substitutability between technology and labor. According to the many researchers, having higher IT investment is not enough to be more productive and more successful company in the absence of related organizational changes. Human Capital and Work Organization is greatly important factor which needs to be taken into consideration for effective use of IT. It will also have an interesting point of the study how Şişecam adopts IT and how it works to change their workplace organization. The difficulties and possible limitations about the transition of the company will be discussed in chapter 5. This chapter will present relationship among information technologies, human capital and work organization variables. I will analyze these relations by establishing cross tabulations among the measures of these factors. Finally, the study will discuss with general implications and concluding remarks. The final chapter, as usual, devoted general conclusions.

CHAPTER II

INFORMATION TECHNOLOGY REGIMES AND ORGANIZATIONS

A remarkable clustering of innovations in information processing technologies took place in the US between the 1870 and 1900. The new technologies gave birth to a new industry, the office appliance industry, revolutionized office work and supported the rise of management by means of formalized information processing.

A starting point for an analysis of the production systems and related workplace organization was suggested by Schumpeter (1947) who pointed the problems of co-ordination within the evolution of large business firm in the US. It is argued that the establishment of first IT regime developed out of the process which led to formation of large business enterprise and to the associated development of formalized hierarchical systems of business administration. (Hoelzl, 1999)

Hoelzl (1999) has located one of the primary historical roots in the exceptional position of American Economy and its tendency towards mechanization mass production which created a specific logic of the American System of Manufacturers emphasizing standardization, mechanization and modularization. The establishment of the First IT Regime is linked to the rise of the modern large business enterprise in the United States, which set up on mass production system.

The information structure of manufacturing enterprises in the US in the period of dominance of the American System of Manufactures was simple. Firms were single activity units specializing in production and they remained relatively small, information was available in an informal way at virtually no cost. Larger manufacturing firms relied on a decentralized and distributed form of shop-floor control called inside contracting where the plant manager contracted internal craftsman’s to organize the production. The contractor managed his own workforce and organized work. Inside contracting system, there was an efficient factor of indirect control (Hopper and Armstrong, 1991 in Knauss, 1998). In the period between 1870 and 1900, the competitive pressure intensified due to the development of continues process technologies and extensions of transportation and communication networks and patterns of demand changed unexpectedly by the way of large urbanization of the US then depression occurred in the 1870s and early 1880s (Fullerton, 1988 in Knauss, 1998) These changes in the market carried American Manufacturers through technological and organizational bottleneck. Finally, managers realized that tendency towards mass production of the American Manufacturing System with capital intensity required a large, steady and predictable demand. They started to pursue market segmentation strategies through new product design, advertising and geographical diversification and to co-ordinate production and distribution that is integrated vertically (Hoelzl, 1999).

This part of the study will include detailed analysis of IT regimes and organizations start with the exploration of Fordist mass production then historical process of large business enterprises will be explored. All these examinations will be outlined with workplace organizations from Fordist mass production to Post-Fordist flexible specialization.

2.1. Information and Information Technology; IT concept and IT workers

Many different types of information are used in organizations in which persons have ability to process and communicate. Information accumulation provides top management with more of the data needed to make decision, it can also provide lower level workers with the information they need to make decision without direction of top management. Otherwise, information accumulation provides workers have complementary skills and appropriate incentives to act on their private information.

Hayek (1945) has distinguished information as between "general" and "specific" knowledge; this distinction was elaborated and applied to organizations by Jensen and Meckling (1992) and further analyzed by Anand and Mendelson (1997).

Specific knowledge is difficult to convey to others and is possessed by a limited number of individuals. As Jensen and Meckling (1992) has cited, "The more costly knowledge is to transfer, the more specific it is, and the less costly the knowledge is to transfer, the more general it is", Knowledge is specific in part because individuals know more than they can state (Hitt and Brynjolfsson, 1997) and also because information can be expensive to communicate and process. Jensen and Meckling (1992) have argued that decision rights should be arranged by the necessary knowledge. Organizations should have been structured so that actors with specific knowledge have the decision rights, and complementary general knowledge is made available to them.

Information technology can lower the cost of some types of knowledge transmission, enabling firms to take previously specific knowledge and reallocate it throughout the firm. As a result, the optimal allocation of decision rights will be determined by the relative importance of the knowledge that still cannot be transferred even with an information system. While information at top of the organizational hierarchy enables that information systems will facilitate more centralized decision making, information at all status of organizational hierarchy leads to decentralized even sometimes more centralized control. Organizational changes i.e. skill biased organizational changes by information systems will be examined next. Now concept of IT and IT workers should be clarified before starting to detailed examination.

Information technology (IT), in other words, computer and communication technology is generally used in office productivity enhancements, electronic commerce, entertainment, enterprise management, travel reservation systems, supply-chain management, distance learning, telemedicine, data mining and knowledge management, military command and control and electronic government. IT components can be classified in three main categories;

- First, IT includes hardware, from the semiconductor components named as “chips” that provide basic processing, memory, and other functions to the larger devices such as scanner, printer.
- Second, IT includes the software that makes the hardware to function.

- Third, IT includes communications networks, which may be small or large in scale, private or public in access and use, and supportive of not only data communication but also communication of voice, images, video, and their combinations. Networks involve equipment (hardware), software, and services. Networking businesses are service firms that own and/or operate hardware and software for customer applications, which range from communications, per se, to ancillary access to information resources and support for specialized communications needs. Customers for network systems have tended to be organizations, but a new market in household networks is growing; customers for network services have always included organizations, households, and individuals.

IT workers are those persons engaged primarily in the conception, design, development, adaptation, implementation, deployment, training, support, documentation, and management of information technology systems, components, or applications. In addition to "computer occupations" described by the (mostly software) job categories of the Bureau of Labor Statistics (i.e., computer programmers, computer scientists, and systems analysts), this definition includes persons who;

- design, install, upgrade, or maintain and support IT hardware, including computers, switches, routers, and chips with a digital aspect to their operation;
- design, author, adapt, test, implement, maintain, or support software or databases;
- install, configure, support, maintain, or utilize "back office" systems and applications for use by those who interact directly with these systems for business purposes;
- design, develop, document or train on, or implement computer-based business solutions for clients;
- undertaking software-based enterprise resource planning or just-in-time inventory control and systems integration;

- write software code for embedded systems such as hand-held, palm-top devices or equipment controllers;
- develop design tools, simulation, and IT-intensive systems for the delivery of electronic content;
- be responsible for testing, documentation, or configuration management; and
- directly manage IT workers.

2.2. Through the First Establishment of IT; Fordist Mass Production, Flexible Specialization

Fordism means a production system which produce long runs of standardized products by using specialized machinery with relatively low skilled workforce assigned to narrowly defined job classifications. The Ford Motor Company in 1910s and 1920s is often seen as primary example of large scale mass production. The impetus to large profits was the production of a high volume of standardized output which is produced using dedicated capital equipment unit. Despite the fact that labor requirements for work at Ford were relatively modest, the highly routinized labor process was sensitive to high levels of employee turnover (Pietrykowski, 1999). Ford's high wage policy had the effect of demonstrating the possibility inherent in combining mass production with mass consumption (Piore and Sabel, 1984). Mass production provided the goods that workers could afford with their expanded earnings. This is the foundation of Fordist mass production (Pietrykowski, 1999). The breakdown of Fordist mass production is attributed to supply-side shocks, the productivity slowdown, heightened labor conflict and the growing popularity of state policies premised upon macroeconomic austerity and free market ideology (Pietrykowski, 1999). At this point Piore and Sabel's argument was that shortages in labor, oil and wheat drove prices up. This effectively set the stage for decrease in demand due both to deficient levels of aggregate demand and increased uncertainty over transaction costs (Piore and Sabel, 1984). This confusion over the composition of demand and the trajectory of input prices led to a breakdown in the mass production system. It was no longer able to predict future demand for mass production and there was no certainty anymore about the future costs of resource inputs necessary to sustain long production runs (Piore and Sabel 1984). These historical developments reinforce the competitive pressure on mass production sectors and contributed to the search for alternative technological capabilities and organizational structures. Analyses suggested that the world economy had changed in fundamental ways, giving advantage to new forms of work organizations that achieved flexibility by using more skilled workers and two alternative ways were hypothesized. One of them was about low road strategies which rely on intensifying the existing Fordist order, engaging in work relocation and other union avoidance together with continuing competition with low cost competitors in the mass market. The another way was a high road strategy in which firms use advanced human resource management practices to create high performance work organizations. In these firms, highly skilled workers make use of flexible production process to manufacture high quality or specialized goods (Knauss, 1998).

When we analyze skill usage in Fordism, it is seen that Fordist labor market was premised upon the relative growth in demand for unskilled and semi-skilled labor. In production, skill are generally contains dexterity, physical strength, hand-eye coordination and the ability to comprehend directions. A set of additional cultural skills included high tolerance for rules and bureaucratic structure, conformity, personal autonomy, competitiveness and managerial decision making were also an asset on the shop-floor (Meyer, 1981). However, system of flexibilization required reconstruction of worker skills. This is one of the questions to ask in this study; "what factors required this reconstruction?".

2.3. American Mode of Mass Production under Fordist Hegemony

The characteristic of American Manufacturing System was to engage in series of production to promote and extend the division of labor, to embody knowledge into capital in order to overcome inelastic skilled labor supply and to allocate available unskilled workers from rural areas – also to urban or semi-urban areas - to simple activities. This system characterized by a much greater degree of vertical integration, a higher specialization of tasks of both engineers and workers and mechanization through the use of labor-saving machinery. American mode of production represented the source of control problems by the vertical integration of large enterprises into the market that caused a number of problems to achieve better co-ordination. Large companies relied on a form of decentralized and distributed systems of shop-floor control where the plant manager contracted internal craftsmen to produce a given number of items in a given period of time using the manufacturer’s factory, tools and materials. The contractors acted like owner of the company. This system was an efficient method of indirect control as avoiding administrative difficulties. With the modern large enterprises, the structure of the company with new management methods also change in demand, technology, and problems of co-ordination on the shop-floor are the primary causes of this transition. This systematic management increases the division of labor and its mechanization up to the extent to allow an extensive standardization of tasks. It is also based on control and co-ordination on record keeping and flows of written information up, down, and across the hierarchy. This allowed to monitor the performance of single workshops, reduce the variance of cost and to redistribute profits from the contractors to the manufacturers and led to the gradual demise of the insider contracting system. Salaried foremen replaced contractors. We can derive some implications from these new systems that led to the transfer of many of the foreman's functions and powers to centralized staff departments. Communication became formalized: the centralized staff department communicated downwards imparting the orders of the management, while foremen had to compile reports for the work office. Reporting methods, cost accounting, production scheduling, incentive plans and other measures, were set up in order to create an unrestricted flow of materials and information, to transfer authority from foremen to plant managers and force employees to pay greater attention to the management's goals. This gave rise to a number of new communication tools for downward communication. The systematic analyses of the labor process through time studies allowed stretching the division of labor much further, as it involved the decomposition and codification of craft knowledge. The direct personal control of foremen and the authority over definition of tasks by skilled labor was replaced by the impersonal and indirect control of the management. Finally, decision-making was decentralized while control and co-ordination were centralized, resulting with more efficient decision-making. However, the firms faced with new problems. For example, the volume of paper work grew enormously form a single piece for each customer order, to a piece of paper for each part of a product on a customer order and a separate written order for each operation performed in manufacturing each part of a product. New technologies for speeding up information processing were necessary to allow an efficient reduction of information and the delay of information flows (Hoelzl, 1999).

The problems that Fordism met in the 1960s were giving the signals of new crisis. It means that the technology of mass production and institutional structure reached their limits (Piore and Sabel, 1984). There four identified factors of the structural crisis of Fordism (Nielsen, 1991 in Arslan et.al, 2003); firstly because of reaching the social and technical limits of Fordism, productivity gains decreased. Secondly, the expansion at mass production caused to an increased global economic flows. It made the management of national economic too difficult. Thirdly, Fordism resulted in growing social expenditure. Inflationary pressures and distributional conflicts appeared since there is no applicability of mass production methods in this area. Finally, the consumption pattern has changed. New demand could not be satisfied with mass production methods. With this crisis, the demand for the standardized products sharply decreased, while the demand for the variety of customized goods increased. Piore and Sable (1984) make a simple conceptual distinction between mass production and flexible specialization. In the mass production, standardized goods are produced by the help of semi-skilled workers and product specific machines. However, skilled workers produce a variety of customized goods in flexible specialization. A tendency towards flexible specialization appeared with the help of new high technologies like microelectronic and the role of state in economy decreased (Arslan et.al, 2003).

2.4. Flexible Production Systems

Since the end of 1970s, the need for flexibility has come to dominate the market in the most of the advanced capitalist countries. Flexibility which is also called as “High Performance Work Organization” can be characterized by increasing importance of team work and job creation, decentralization of decision making, reduction in the number of hierarchical levels, the replacement of vertical communication channels by horizontal ones, the introduction of employee problem-solving groups or quality circles, Total Quality Management and a change from task specialization to task diversification (Bauer, 2002). In the literature, flexibility was analyzed under two heading as numerical and functional. The difference is that functional flexibility refers to the characteristics of jobs while numerical flexibility refers to the structure and distribution of jobs in the firm. Numerical flexibility associated with many of the new agile manufacturing systems makes many workers expendable during periods of slack product demand. The reliance on

a core group of workers,

a secondary group of workers employed by subcontractors,

a subsidiary group of regular part-time workers and

a tertiary group of temporary workers

increase the firm’s labor market flexibility (Harvey, 1989 in Pietrykowski, 1999). On the other hand, numerical flexibility inhibits the development of long-term employment/transaction relations, trust and interdependence that appear to be highly valued in team-oriented workplaces employing multi-skilled workers.

Most of the authors advocate the flexibility as flexible specialization used by Piore and Sabel refer to functional flexibility (Atkinson, 1987, Bover, 1988). Flexible specialization as opposed to numerical flexibility, combines techniques of craft production at several small batch production shops through a series of networks of association and mutual support (Pietrykowski, 1999). Flexible specialization depends on variety of customer needs by using flexible machines with skilled worker. Production is made by central firm whose inputs provided by satellite firms.

Another flexible manufacturing model is lean production which removes the negative effects of economies of scale and causes to new relations with subcontractors. Three main elements provide a system to work coherently (Arslan et.al,, 2003):

(I) Total Quality Control; each worker is responsible for quality of his work and following worker checks the quality of previous work done

(II) Just in Time production; to make savings from stock expenditures production time and other production factors by transfer of sustainable raw material to suitable machines at proper time.

(III) Quality Control Circles; meeting of workers voluntarily to remove defections and increasing efficiency.

Despite lean production provides job security, egalitarian character, shop-floor focus, pride in work and a carefully selected workforce, it results unlimited demands for performance, unbounded work time, little tolerance of work injures and the unbounded factory regime (Berggren, 1992 in Arslan et.al, 2003).

The workforce of this system acquired new features as multi-functionalty, non-hierarchical order and creative thinking. As a conclusion, with these developments at manufacturing system, the use of technological innovations become inevitable to get an adaption for changing market conditions and to survive.

2.5. Organizations from The Establishment of First IT Regime

Between 1870 and 1990, most information processing devices were invented and innovated paralled by complementary organizational innovations, new forms of distribution networks and marketing tools as well as innovations in organization of production. This new technologies which were typewriters, calculators dictating machines, cash registers, automatic mailing machines, etc. supported the establishment of new standards of practice in office. The build up of new organization consisted of two closely related distinction; standardization tasks and mechanization of activities. Table 1 shows the innovation characteristics of most important technologies (Hoelzl, 1999).

For several decades, the organization of work inside firms has gone with changes in skill composition of workforce, management techniques, information flows, production process, etc. There has been a general trend towards less hierarchy and more flexible organizational forms. This movement includes more autonomy and responsibility being awarded to workers and their performance towards wider range of tasks.

Organizational changes have led to more decentralization in work organization, Moreover, these changes require a higher level of human capital from individual workers since they need to deal effectively with increased uncertainty and responsibility. This part of the study will include a discussion to explore the evolution of organization and to provide some evidence on skill biased organizational change and the hypothesis that these changes are complementary with skilled workers.

Leavitt and Whisler (1958) have predicted the future's work in terms of management. In this study they hypothesized what the organization of the future would like in 1980s. Mainly, they have pointed the role and scope of middle managers would replace by the workers that their title is analyst. The top management would also take on more of the innovating, planning and creating. Another prediction of them was that the large organization would re-centralize.

It means that new information technologies would give the top managers more information and would extend top management's control over the decision of subordinates. Top executives chose to decentralize only because they were unable to keep up with the changing size and complexity of their organization. Their future was not far from our present. Information technologies has used to improve centralized control and to create new information channels. However, these improvements in centralized control did not continue to decentralized decision making. The companies reduced the number of middle managers and the computer systems assumed many of the communication, coordination and control functions that middle managers previously performed. Leavitt and Whisler (1958) had understood that technology would enable senior management to monitor and control large organizations effectively and that fewer middle managers would be needed to analyze and relay information. They did not anticipate that information technology would enable simultaneous improvements in decentralized decision making.

Applegate, et.al. (1988) have discussed the Leavitt and Whisler's predictions and they have compared these predictions with present conditions. According to them, IT, which had been, once been a tool for organizational expansion, has become a tool for downsizing and restructuring. In the past, managers had to choose between a centralized and decentralized structure. Applegate, et.al. (1988) have claimed "Today, there is a third option: technology-driven control systems that support the flexibility and responsiveness of a decentralized organization as well as the integration and control of centralized organization" (Applegate, 1988:132).

Applegate, et.al. (1988) has collected the certain titles about their own observations at below;

- Organizational Structure
  - Companies will have the benefits of small scale and large scale simultaneously.
  - Even large organizations will be able to adopt more flexible and dynamic structures.
  - The distinctions between centralized and decentralized control will blur.
  - The focus will be on projects and process rather than on tasks and standard procedures
- Management Processes
  - Decision making will be better understood
  - Control will be separate from reporting relationship
  - Computers will support creativity at all organizational levels
  - Information and communication systems will retain corporate history, experience and expertise.
- Human Resources
  - Workers will be better trained and more autonomous, and more transient
  - The work environment will be exciting and engaging
  - Management will be for some people a part time activity that is shared and rotated

- Compensation will be tied more directly to contribution (Applegate, 1988)

Drucker (1988), in another study related with the substitution of managers with the specialist, has argued that the information-based organization requires far more specialist than command and control companies. Furthermore, these specialists are found in operations. This approach has close resemblance with Applegate et.al (1988). According to Drucker (1988), a good deal of work will be done differently in the information-based organization. Traditional departments will serve as centers for training and the assignment of specialists; they will not be where the work gets done. That will happen largely in task-focused teams. Another requirement of an information-based organization is that everyone takes information responsibility. Everyone in an organization should constantly be thinking through what information he/she needs to do the job and make a contribution. Drucker (1988) has divided the organizational revolution into three categories; first has taken place in the ten years between 1895 and 1905. Management is distinguished from ownership and established management as work and task in its own right. The second evolutionary change has been taken place 20 years later. This is the command-and-control organization with its emphasis on decentralization, central service staff, personal management and the important distinction between policy and operations. The last period of change has taken in 1980s, the shift from the command-and-control organization, the organization of departments and divisions, to the information-based organization, the organization of knowledge specialists. On the other hand, Osterman (1986) has investigated how the increasing use of computers affects clerical and managerial employment. The author has hypothesized the displacement effect - computers taking over clerks. Osterman (1986) has found that the net effect of computers in 1972-78 was to depress the employment of clerks and managers substantially. Increasing number of clerical and managerial employment followed the period of larger displacement effect in the first few years of 1970s. Osterman (1986) has determined several channels through which computers might influence the employment of clerks. (i) Computers and clerks are substitutes and increase in computers, ceteris paribus, will reduce the employment of clerical labor. (ii) Some clerks work directly with computers. Data entry clerks and clerical workers who assist in maintaining documentation are good examples. In addition data processing department of a firm must itself employ some clerical labor. (iii) Computers and clerical workers may cooperate in accomplishing a function within the firm and that as computers become more common and more powerful the function itself becomes more important and the demand for clerks increases.

When we turn back to managerial side of the organizational process again, we should point out the term “cluster organization” which is originally named by Mills (1989). The logic is that some large companies choose to adopt new organizational form by behaving like they are many small companies to achieve the benefits of both. In the cluster organization, groups of people work together to solve problems by defining the process. Although team members are geographically dispersed, information and communication systems enable those with complementary skills to work together.

Briefly, there has been a shift in the internal organization of many large firms away from hierarchical structures toward a greater reliance on decentralized authority, teamwork and supporting incentives. Despite the fact that this shift has been discussed since the organizational changes associated with earlier industrial revolutions, its underlying causes are not well understood. One possibility is that the exhaustion of mass markets may have undermined the traditional organizational form to the extent it depended on sustained growth. Other possible causes include the emergence of new competitive pressures that eliminate the slack required by the old system or the appearance of a growing supply of educated workers willing and able to take on the demands of information work. Alternatively, the new system may represent a “workplace innovations” that had not been discovered in the past (Hitt, 1997).

A number of recent studies have examined the diffusion of work practices collectively termed "high performance work systems" (Ichniowski, 1995) using case studies, industry studies (Ichniowski, 1995), and broad-based cross-industry comparisons (Lawler, 1995 in Hitt 1997). These practices can be grouped into three areas; decision authority, which includes teams and individual decision rights as well as related cultural practices (team building); knowledge work and skills, which includes skills, training and supporting practices (incentives for training and education, pre-employment screening); and incentives, which includes various aspects of performance-based pay increases and promotions (Hitt, 1997).

There are at least three reasons why information technology is potentially related with this organizational transition (Brynjolfsson, 1994). First, growth in information technology investment is of a large enough magnitude to be economically significant. Currently, over forty percent of new capital equipment investment in the United States is spent on information technology, resulting in a tenfold increase in its share of total capital stock since 1970. In addition, the quality-adjusted price of computers has declined 6,000-fold in the past thirty years. Second, the recent advances in information technology are both novel and largely exogenous. Most of the fundamental technological breakthroughs that have enabled today's vast information infrastructure were made in the past three decades and were driven more by progress in physics and engineering than by business demand. The ever lower prices for IT are consistently delivered by the computer industry without any unusual effort on the part of computer users. Furthermore, the rapid accumulation of IT is primarily driven by these price declines and thus is relatively exogenous to other events in the economy. Interestingly, the period of greatest growth in the acquisition of computer equipment (from 1982 to the present) coincides with the emergence of new work systems, which suggests at least circumstantial evidence of a link (Hitt, 1997). Third, a number of authors have proposed a direct link between the diffusion of information technology and changes in the economics of organizations. To the extent that IT reduced coordination and transaction costs, it would differentially favor market-based coordination over hierarchical organization. Milgrom and Roberts (1990) have also discussed the differences between mass production and lean production, they have cited the exogenous price decline of IT as the primary driver in the shift from "mass production" to "modern manufacturing". Ichniowski and Kochan (1995) argue that one possible reason why many of the new ways of organizing have not diffused rapidly, despite large economic benefits, is that they must be coordinated with changes in information technology. Brynjolfosson et.al. (1997) have introduced a new tool, the "matrix of change," that can help managers to anticipate the complex interrelationships surrounding change. The matrix of change presents a way to capture connections between practices. It graphically displays both reinforcing and interfering organizational activities and highlights interactions and complementary practices. They have also provided direct comparison of hierarchies and networks. Table 2 lists elements from these two sources and illustrates the strong differences between these methods for organizing work. According to the authors, although advanced information technology is typically associated with modern manufacturing more than with traditional mass production, it can complement practices in both systems. In the network organization, if IT is used for coordination and decision support, it can complement cross-functional teams and flatter management, as in the vertical interference matrix. By providing everyone with the same data, however, it can also undermine authority. In the hierarchical organization, if IT is used for monitoring and automation, it can complement narrow job descriptions and rank-based authority, as in the transition matrix. These varied effects of IT have been observed in the literature. If an organizational feature has multiple attributes, a helpful rule is to split it into discrete practices, such as disaggregating IT into monitoring, decision support, and automation (Brynjolfosson et.al.1997).

Table 2: Different Work Organization

Hierarchical Organization	Network Organization
Mass markets	Customized production
Fewer models/longer lives	Broader offering/shorter lives
High vertical integration	Low vertical integration
Specialized high-volume machinery	Flexible machinery
Large WIP and FG inventories	Low JIT inventories
Vertical communication	Direct communication
Competing arm’s-length suppliers	Fewer, more trusted suppliers
Function-based work groups	Cross-functional teams
Multitiered management	Flatter management
Narrow job descriptions	Local autonomy/decentralized decisions
Fixed wages for output	Residual claim incentives
Rank-based authority	Expertise-based authority

2.6. Conclusion

In this part of the study, I have outlined theories which are about organizational forms related with information technologies. In short, information technology can be hypothesized that it would be associated with decentralized organizational form. In other words, IT is broadly associated with a work system that includes decentralized authority, incentives that account for decreased observability and the increased importance of knowledge for workers. The history can be supposed as a proof of this hypothesis. American mode of mass production under Fordist hegemony was obliterated by flexible specialization because of the changing market and demand conditions. This new production system includes teamwork and job creation, decentralization of decision making, reduction in number of hierarchical levels and horizontal communication channels. Flexible systems met the necessities of new market and demand conditions. Together with this transition, organizational forms of companies began to show substitution of clerks with IT components, to delegate decision authority by empowered workers and to use more intensively team working activities.

The next section will offer an analysis on the reasons of the shift towards relatively skilled workers shift in industry. Is “skill biased technical change” only reason of this shift? What are the other factors? Which one is more significant; the supply side or demand side?

CHAPTER III

CHANGES IN DEMAND FOR SKILLED LABOR

Production process in many workplace has been changed with the rapid development and diffusion of new information technologies such as computers and networks. Along with these fundamental changes in the physical capital of firms, it is also widely believed that the introduction of these new technologies has altered the structure of employment. Specifically, it is argued that many of these new technologies increase the demand for skilled workers (Doms, 1997).

This part of the study will investigate the demand for skill from the beginning with 1980s when significant shift has favored more skilled and educated workers. In the last twenty five years or so dramatic changes in labor market inequalities have been observed in some countries. Key to this has been the improving labor market position of relatively skilled workers and the collapsing labor market for unskilled workers. In most advanced countries skilled workers have improved their labor market position as compared to their less skilled counterparts in at least one dimension of relative wages, employment and unemployment. In some countries, most notably the US and UK, all of these labor market outcomes moved in favor of the skilled. In these two countries there were very large rises in wage inequality that combined with employment shifts in favor of the skilled to generate large rises in overall labor market inequality (Machin, 2002).

Table 3 shows changes in the employment share of non-production workers in twelve countries in the 1970s and 1980s. The Table shows increases in the employment share of non-production workers to occur in almost all cases. Interestingly, while the relative wage of non-production workers together with those of production workers fell slightly in the 1970s it rose in most cases in the 1980s, despite the observed shifts in relative employment. However, differently, during the

1980s simultaneously rising employment and wages for the non-production workers can be seen.

Despite the fact that skill differentials have been analyzed by many scientists (Murphy and Welch 1993), it is difficult to get a clear idea for the determinants. The determinants of skill differentials can be grouped as branch of new technologies, supply of educated and/or skilled workers, globalization, and sectoral shifts in employment and changes in labor market institutions. However, a large body of empirical

Table 3: Patterns of International Skill Upgrading in the 1970s and 1980s

	1970-80			1980-90			
Country	Change in % non production (annualized)	% within	Change in wage ratio (%)	Change in % non production (annualized)	% within	Change in wage ratio (%)	Note
US	0.20	81	-2	0.30	73	7	
Norway	0.34	81	-3	.	.	.	1970,80,n/a
Luxembourg	0.57	90	6	0.30	144	12	
Sweden	0.26	70	3	0.12	60	-3	
Australia	0.40	89	-17	0.36	92	2	1970,80,87
Japan				0.06	123	3	n/a,81,90
Denmark	0.44	86	-11	0.41	87	7	1973,80,89
Finland	0.42	83	-11	0.64	79	-2	
W.Germany	0.48	93	5				1970,79,n/a
Austria	0.46	89	7	0.16	68	7	1970,81,90
UK	0.41	91	-3	0.29	93	14	
Belgium	0.45	74	6	0.16	96	-5	1973,80,85
Average	0.40	84	-1.8	0.28	91.5	4.2	

Source: Machin, 2002, p.25.

studies concentrated on “Skill Biased Technical Change” as a primary explanation for the increased returns to education and the increased wage differential between skilled and unskilled workers (Bound and Johnson, 1992; Berman, Bound, and Griliches, 1994; Johnson, 1997).

For the purpose of the study, I will examine how information technology could cause skill biased technical change. It is argued that the effects of IT on labor demand involve far more than simple automation and substitution (Bresnahan, et.al. 2000). According to Bresnahan (1997, 2000), employers adopt IT-based production processes to improve service quality or increase efficiencies and thereby increase profits. In either case, effective use of IT involves changes to organization. Examination of the form of the organizational changes suggests a theory of why IT-based technical change is skill-biased (Bresnahan, 1997). First in service-producing sectors like finance, then in the service parts of goods producing industries, firms have found ways to take advantage of new production processes that use IT intensively (Barras, 1990). They have found it very difficult to profit by just replacing other factors with computers and telecommunications gear while making the same products. Often, the benefit of the new production process is new services or improved service quality. Further, the new production process involves global changes to the organization. These often involve replacing low-skill human workers (automation), while passing on to humans an increased variety of tasks related to the higher level of service. A similar pattern holds for the attempts to achieve IT-based efficiencies in production. Only with organizational change, typically of a kind that involves complementarity with high skill as well as substitutability for low skill human work, do employers get the benefit they seek from IT (Bresnahan, 1997).

Finally, these observations require an analysis based on a cluster of complementarities that it is seen as at the heart of recent changes in labor demand. Intensive use of IT, higher service levels for customers and organizational change simultaneously go together with demand for higher-skilled labor. These form a mutually reinforcing cluster of inventions for employers. Critically, the organizational changes associated with IT-based service improvements are skill-using. The key skill-biased technical change of the present can thus be seen to consist not only of IT, but of the complete cluster of associated complements. The "technical" side of this cluster is the large, ongoing declines in IT prices and large, ongoing improvements in IT performance. It is tightly linked to labor demand through its organizational side. Investments in the complete cluster, including the money, time, and effort associated with the organizational change are likely to be substantially larger than the IT investments themselves, even if they are more difficult to quantify.

3.1. Skill-Biased Technical Change

Skill-biased technical change (SBTC) means technical progress that shifts demand toward more highly skilled workers relative to the less skilled. It also tends to be something of a residual concept, whose operational meaning is often "labor demand shifts with invisible causes." Not all technological revolutions increase the demand for skilled labor. For instance, the movement from skilled artisans to factory production in the 1800s probably reduced the demand for skilled labor, reflecting a complementarity between the new technologies and unskilled labor (Goldin and Katz, 1998).

According to Goldin and Katz (1998), most of the technological advances in 1800s substituted physical capital, raw materials and unskilled labor. Far from complementing to skill, these advances were a relative complement of raw materials and unskilled labor. They have argued that technology skill complementarity emerged in manufacturing early in 1900s as a method of production. They have pointed that manufacturing production began in artisanal shops then shifted to factories to assembly lines, to robotized assembly lines. The distinction between artisanal shops and factory is mainly the degree of division of labor. Continuous-process methods are technologies that require modern robotized assembly line. The robotized assembly line appeared using relatively fewer less skilled operatives and more skilled machine-crewman. The transition from the artisanal shop to factory production probably increased the capital output ratio, but most likely, decreased the demand for skilled labor relative to unskilled ones in manufacturing. The technological advances that later shifted production from the factory to continuous-process methods not also raised the capital-output ratio but also served to increase the relative demand for skilled labor. (Goldin and Katz, 1998)

From the view of another typical approach, SBTC is assumed to alter the production technique such that the elasticity of output with respect to a highly educated (or white collar) worker increases, while the elasticity with respect to a poorly educated (or blue collar) worker decreases (Nickell and Bell, 1995). An alternative interpretation of skill-biased technological change is that such changes tend to magnify existing skill differentials among workers that perform the same (or similar) tasks (Roed, 1999). Additionally, SBTC can also be linked to the organization of innovative activities and production at the firm level and having of technologies like the computers. Moreover, the size, breadth, and timing of the recent labor demand shift have led many to seek SBTC in the largest and most widespread technical change of the current era, information technology (IT). IT is likely to be particularly important as computing technology increased in power and expanded its scope beyond back-office support to its current pervasive role in large firms (Bresnahan et.al. 2000).

In that case, SBTC especially changes in the computer usage, have increased demand for skilled workers by enhancing their productivity. Furthermore, these changes have reduced the demand for unskilled workers because of that they do not have the ability to use new technical advances. Bartel and Lichtenberg (1987) support this view. They have studied the effects of technical change on the educational composition of employment in industrial sectors extending to manufacturing and to the whole economy and showed that as new technology is adopted the demand for highly educated workers increases relative to the demand for less educated workers. The authors suggest that the more educated workers' advantage derives from problem-solving ability and receptiveness to change in the working environment rather than from specific skills acquired in school. A simpler explanation holds that computers and other advanced machinery have replaced less skilled workers in the performance of certain tasks. Highly educated workers have also a comparative advantage with respect to learning and implementing new technologies and hence that the demand for these workers relative to demand for less educated workers is a declining function of experience. Bartel and Lichtenberg’s hypothesis is focused on differences in the way educated and uneducated workers in that environment. They have argued that educated workers have a comparative advantage with respect to the implementation of innovations. Education causes individuals to adopt earlier so that the adoption of an innovation causes increased relative demand for educated workers (Bartel, et.al. 1987). On the other hand, Berman, et.al. (1994) have analyzed the US manufacturers and they have found that explanation of the shift in demand from unskilled to skilled labor is labor-saving technological change. Their conclusion was that the increase in demand for skilled workers relative to unskilled workers within manufacturing industries during the 1980s could be linked to investment in computers and in research and development. According to them, there is a positive correlation between skill upgrading and investment in computers and R&D expenditures. The impact of computerization on the demand for skills depends on whether this form of capital complements or substitutes for skills. They have emphasized this fact by an example. "Computerized sorting and handling replaces low skilled production workers in the newspaper industry, while computerized design replaces drafting personnel in the automobile industry" (Berman, et. al. 1994).

Berman and Bound have also established a correlation between production or non-production labor and skill upgrading as examining the trends in manufacturing sector by classifying the employment into two categories; production and non-production workers. Production workers, whose works on fabricating, processing, assembling, inspecting and manufacturing, are accountable up to foreman level. Non-production workers are personnel who engaged in supervision, installation, servicing, sales, delivery, professional technological administrative. They are accountable above the foreman level. At first, Berman and Bound have analyzed the move toward non-production labor in the industry. They have showed that increasing number of non-production labor in employment under the shift in demand for skilled labor that occurred during the 1980s for two reasons: First, the increase in the relative wages of non-production workers cause to substitution away from non-production labor. Second, the increase in the number of non-production labor will underestimate this shift to skilled labor. Another measure of changes in the demand for skilled labor is the change in the non-production labor's share in the wage bill. Then they have concentrated on the move toward non-production labor as skill upgrading. The production non-production worker distinction closely reflects the distinction between blue and white-collar occupations. They have pointed that these two categories rise together and they concluded that a large part of the skill upgrading, which occurred in manufacturing during the 1980s, could be accounted for by the shift to white collar or non-production labor. Finally, they have argued that skill-biased technological change has been the major cause of skill upgrading in manufacturing. Industry upgrading which has both R&D investments and the increase in computer investments provides direct evidence for the importance of biased technological change (Berman, et. al. 1994).

In order to develop a better understanding of SBTC, Machin (2002) has investigated the evidences that have been proposed to test this hypothesis. Some is rather indirect, and some relates the observed changes to direct measures of technology. According to Machin (2002), the SBTC hypothesis requires that technology introduction and diffusion drives shifts in skill demand. Therefore, one should see variations in skill demand shifts occurring where employers have more to gain from new technology and consequently there should be systematic differences in the extent of relative demand shifts within particular workplaces, firms and industries (each of whom is likely to differ in the extent of their use of new technologies). Decomposition of aggregate changes in skill demand (usually measured by wage bill or employment shares of skilled workers) is an argument which is a first indirect test of relevance to the SBTC.

A second piece of indirect evidence on SBTC comes from considering whether one can identify common patterns of cross-country change. In particular, if one sees faster skill demand shifts occurring in the same sorts of industries in different countries one may view this as informing the SBTC hypothesis (to the extent that similar industries in different countries utilize similar technologies). Berman et.al. (1998) looked at country by country pair wise correlations of industry skill demand shifts for the same industries in different countries. They found that most industrial demand shifts vary positively across countries. In fact they report that 31 out of 36 , calculated pair wise comparisons are positive and a sizable number of the correlations are statistically significant (13 of them). This suggests a tendency of similarly sized skill demand shifts to be clustered in the same sorts of industries across different countries (OECD Countries). One can read this as an indirect evidence that SBTC has been pervasive in changing labor market outcomes across the developed world.

A third piece of indirect evidence comes from extending the cross-country evidence to the developing world. In fact, by this way so it is possible to find evidence of demand shifts in favor of the more skilled going on in low income countries. Some work has noted that one sees skill upgrading occurs in the more technologically advanced industries of some developing countries (Hanson and Harrison, 1999). This is entirely consistent with SBTC altering relative wage and employment outcomes globally.

Furthermore shifts in skill demand in the developing world appear to be correlated with the shifts seen in the developed world. Berman and Machin (2000) extend the analysis of Berman et.al. (1998) to look at industry skill demand shifts in 28 high, middle and low income countries.[1] They present evidence that patterns of industrial skill upgrading in some developing countries are similar in some respects to those seen in the higher income countries. They present pair wise correlation coefficients testing whether one sees common industry patterns and hidden patterns of similarity, certainly for the middle income countries (the evidence is more ambiguous for the low income countries[1]).

As a summary, SBTC, described as changes in using IT components, have resulted in increased demand for skilled workers by enhancing their productivity while reducing demand for unskilled workers. Adoption process to new technologies is an important criteria for workers while they are demanded by companies. Unskilled and lower educated workers are relatively have less ability to use new technical advances.

3.2. Skill Biased Technical Change, Wages and Supply of Skilled Labor in Brief.

As I noted previously, the skill-biased technological change hypothesis is founded upon the notion that employers' demand for more skilled workers has been shaped by the kinds of new technologies that are prevalent into modern workplaces. The critical idea is that these new technologies lead to a higher productivity, but that

[1] High income countries are the 12 in Table 3. The middle income countries are Colombia, Cyprus, Czechoslovakia, Greece, Guatemala, Hungary, Ireland, Malta, Portugal, South Korea, Spain and Turkey and the low income countries are Bangladesh, Egypt, Ethiopia, India, Nigeria and Tanzania. The sample of countries considered is entirely driven by data availability on industry skill demand shifts over time from the United Nations Industrial Statistics database.

only some workers possess the necessary skills to use them. As such employers are prepared to increase the wages of the skilled workforce who are complements with the new technology. However, at the same time less skilled workers do not possess enough skills to operate the new technologies and their wages are lowered or they lose their jobs.

Wage differentials increased in 1980s between educated and less educated workers, young and experienced workers. There is a general view that recent developments in the wage structure reflect an increase in the relative demand for skilled workers. Demand is growing for workers with exceptional talent, training, autonomy, and management ability much faster than for workers in low and middle-wage occupations (Bresnahan, 1999). Unfortunately, wage inequality and educational wage differentials have occurred since the late 1970s. A possible driving force behind these changes has been a large increase in the gap between the rate of growth of the relative demand for more skilled workers and the rate of growth of supply of such workers (Autor, et.al.1997). Autor, et.al. (1997) concluded that skill demand grew more rapidly in the 1970s and 1980s than in the 1960s. While the demand for skill may have accelerated as early as the 1970s, its effect on the education premium was not apparent until the slowdown in the entry of college graduates in the 1980s (Autor, et.al. 1997).

Under the ceteris paribus, supplying more skilled and educated workers generates higher relative wages for skilled labor in response to an increase in skilled labor's share of the workforce. An increase in the share of skilled workers in the economy leads to an increase in the number of jobs firms create that match skilled workers and result can be higher wages for skilled workers in response to an increase in the supply of skilled labor.

Kiley (1999) has analyzed the supply of skilled or educated labor and SBTC by testing the effectiveness of endogenous and exogenous SBTC models. The model of endogenous technology choice, an increase in the supply of skilled labor leads to a temporary fall in the skill premium, followed by an expanding gap between the wages of skilled and unskilled workers as technologies adjust towards the more skill-intensive mix appropriate for greater skill of the workforce. The model of exogenity is reflected in the fact that the attribution of rising inequality to skill-biased technological change basically amounts to assigning the residual, unexplained increase in inequality to skill-biased technology, rather than examining the factors that contribute to the adoption of skill biased technologies and relating these factors to rising inequality. Kiley (1999) has illustrated the potential usefulness of a model with endogenous technology choice by considering two historical episodes. In the 1970's, the supply of college educated labor surged, accompanied by an initial fall in the skill premium. It can be seen at Figure 1A and 1B (Source: Kiley, 1999:709)[2] One popular explanation of this swing in relative wages is that the initial increase in skilled labor depressed the relative wages of skilled labor, but then exogenous skill-biased technological progress increased demand for skilled labor in the 1980's, raising skilled wages (Bound and Johnson, 1992, 1995; Mincer, 1991). Kiley's another data to support this dynamic can be seen at Table 4 and Table 5 (Source: Kiley, 1999: 710). Table 4a presents some data on earnings differentials across educational groups among men in Japan, Sweden, and the United Kingdom from the early 1970's to the late 1980's, while Table 4b presents data on the percentage of workers in each of these countries with a college education.

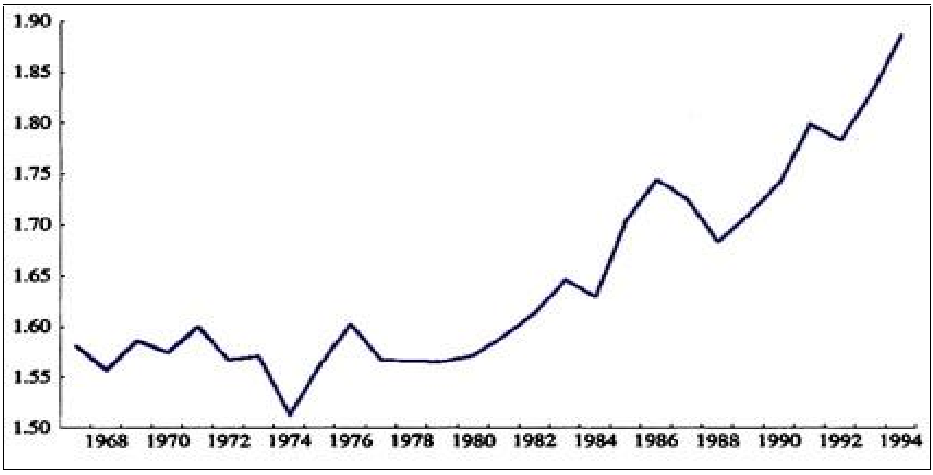

Figure 1a: College/ High School Wage Differential

[2] Kiley (1999) has briefly described how Figure1 was constructed. These explanations can be found at Appendix

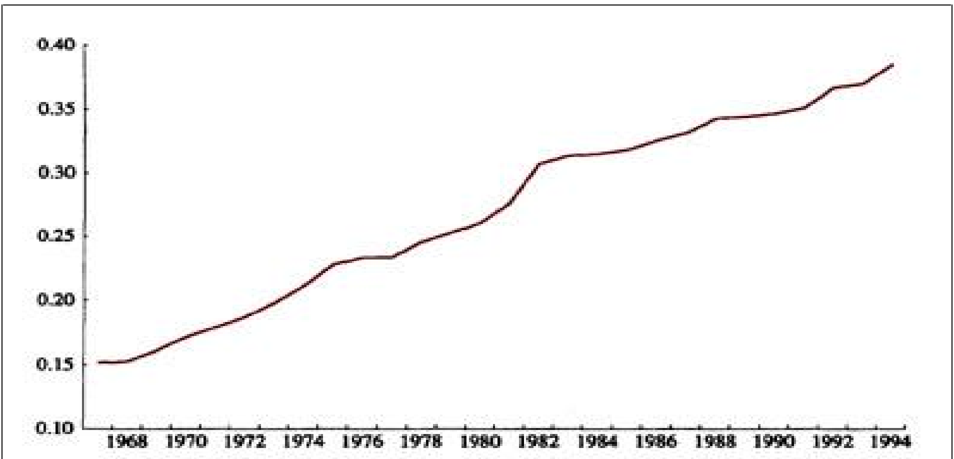

Figure 1b: Relative Supply of Collage Graduates

Table 4a: Earnings Differentials by Education Group Among Men

Country	Education Groups	Ratio value 1970's	Ratio Value early 1980's	Ratio Value late 1980's
Japan	College/Upper high school	1.33 (1970)	1.26 (1979)	1.26 (1987)
Sweden	University/Post-Secondary	1.40 (1968)	1.16 (1981)	1.19 (1986)
United Kingdom	University/No qualification	1.64 (1974)	1.53 (1980)	1.65 (1988)

Source. OECD Employment Outlook (1993). (In Kiley, 1999, p.710)
Note. Year in parenthesis is the year of the observation. The ratio values are the ratio of the earnings of college educated to those of the less-educated group.

Table 4b: Relative Supply of College Educated Workers

	Percentage of population or labour force with college education		
Country	1970's	early 1980's	late 1980's
Japan	12.0 (1971)	17.9 (1979)	22.5 (1990)
Sweden	8.1 (1971)	16.6 (1980)	23.1 (1990)
United Kingdom	8.0 (1973)	12.0 (1979)	18.3 (1989)

Source: OECD Employment Outlook (1993) (In Kiley, 1999, p.710).
Note. Year in parenthesis is the year of the observation.

The supply of college educated workers grew rapidly in each country over the period; Table 1 reveals that the earnings premium for college educated workers fell in each country over the 1970's, and stabilized or rose over the 1980's. The experience in the United Kingdom is very similar to that of the United States, with the relative earnings for college educated workers reaching levels above those of the early 1970's by the end of the 1980's (Kiley, 1999).

The simple economic explanation for both of these developments offered in the applied labor literature relies on a basic supply and demand model; the increased supply of more skilled workers depresses wages, but then for some exogenous technological reason, increased demand for skilled workers offsets the depressing effect of relative supplies on relative wages. These models can be examined in some related studies such as Acemoglu (1996, 1998) and Machin and Manning (1997). In these studies, firms and workers must find matches between skilled workers and skilled jobs, and between unskilled workers and unskilled jobs. An increase in the share of skilled workers in the economy leads to an increase in the number of jobs firms create that match skilled workers - and the result can be higher wages for skilled workers in response to an increase in the supply of skilled labor.

The primary objective of these econometric studies was to analyze the structure and determinants of factor demand in case of labor demand. Moreover, human capital theories also bring explanations to the issue. Human capital plays an important role in the process of economic growth and a stock of knowledge as a source of innovation which is a basic determinant of economic growth (Mincer, 1989). This view implies that the marginal contribution of human capital to output is greater than the volume of physical capital. As a result of this view, physical capital is more complementary with skilled labor than with unskilled ones. They have pointed out the importance of Solow's growth theory. According to this theory, growth in output comes from growth in physical capital, growth of labor and improvements in technology (Mincer, 1989). However, in today's business, investing in human capital to complement physical capital is perceived as adding to shareholder value (Greenspan, 2001). Greenspan (2001) has clarified the idea as;

> "The rapidity of innovation and the unpredictability of the directions may take imply a need for considerable investment in human capital. Workers in many occupations are being asked to strengthen their cognitive skills; basic credentials are not enough to ensure success. Workers must be equipped not simply with technical know-how but also with the ability to create, analyze, and transform information and to interact effectively with others. Such

learning will increasingly be a lifelong activity. Today's recipients of diplomas expect to have many jobs and to use a wide range of skills over their working lives."

3.3. Conclusion

Demand for skill has showed a significant shift in more skilled and educated workers from the beginning with 1980s. The number of non-production labors has increased relatively than the number of production labors. SBTC is a primary explanation of this shift. It is assumed to changes in production techniques such that the elasticity of output with respect to highly educated worker increases, while elasticity with respect to poorly educated worker decreases. SBTC have increased demand for skilled workers by enhancing their productivity together with reducing unskilled workers because of the fact that educated workers have relatively advantage with respect to learning and implementing new technologies. SBTC has also caused wage differentials that increased in 1980s between skilled and unskilled workers. Another possible driving force behind these changes which generated higher wages for skilled labor in response to an increase in skilled labor's share of workforce was the rate of growth in supply of such workers.

CHAPER IV

COMPUTERIZATION AND RELATIONS BETWEEN IT AND ORGANIZATION

4.1. Meaning of computerization

Just as the rise of large corporations coincided with a shift from handicraft to machine production and the development of new technologies such as the railroad and the telegraph , so the information-based organization coincides with the widespread diffusion of modem computing technology. Increasingly, computing technology can improve coordination and communications abilities throughout the firm. The development of the personal computer in the early 1980s shifted the location of computing power from large centralized "utilities" to workers' desktops. There has been a tremendous growth in technologies such as local area networks, databases, and "groupware." These changes have transformed computers from their traditional role as "back-office" support for accounting, finance, and logistics into tools that are fully integrated into all aspects of production. The development of decentralized computing technologies has also coincided with the emergence of business process redesign, which emphasizes radical changes in work organization supported by investments in information systems (Hitt, 1997). When we come to 1990s and 2000s, we have witnessed the explosion in using IT and spreading of those uses to more individuals, households, and different kind of organizations. Furthermore, commercialization of Internet[3] doubled this explosion by experiencing

[3] The Internet is typically defined as a network of networks or an internetwork. Internetworking means using special-purpose computers or hosts to connect a variety of autonomous networks for

in data networks. While we are in the age of digital convergence that is often used to characterize how IT can support many kinds of media and activity, new applications take advantage not only of increasing communications bandwidth but also of steady improvements in processing and memory or storage; the shape of an application depends on how all of these factors are traded off, depending on their relative cost. Consequently, falling relative costs, increasing capabilities, and constant experimentation argue for more and more IT products and IT use.

The digital revolution pointed above has enourmously influenced the modes of working. The most visible change has been the appearance of computers onto our working desks. The early computer generations have been replaced with increasingly powerful ones, a similar evolution has taken place in the software technology, and the individual computers are linked into a worldwide network. Although all people are not using computers at work even within the advanced industrial countries, computerization has significant indirect effects on the character of their work. It may influence relative labor demand in several ways. According to Bresnahan (1997), computer business systems often involve the routinization of many white-collar tasks. Simple, repetitive tasks have proved more amenable to computerization than more complex and individual tasks.

Microprocessor based technologies have similarly facilitated the automation of many production processes in recent years. Thus, direct substitution of computers for human judgment and labor is likely to have been more important in clerical and production jobs than in managerial and professional jobs. Computer-based technologies may also increase the returns to creative use of greater available information to more closely tailor products and services to customers' specific needs and to develop new products. Bresnahan (1997) has assumed that such an organizational complementarity between computers and workers who possess both greater cognitive skills and greater "people" or "soft" skills. The direct substitution and organizational complementarity channels both predict that an increase in the

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transmitting data, files, and messages in text, audio, video or graphic formats over distances (Iacono,1998,p.3).

relative demand for highly educated workers should be associated with computerization.

Bresnahan et.al. (1998), by using in firm-level data find that greater use of information technology is associated with the employment of more-educated workers, greater investments in training, broader job responsibilities for line workers, and more decentralized decision-making. They hypothesize that advances in information technology are complementary with organizational changes to improve service quality through the use of skilled workers with substantial individual autonomy. Their survey of human resource managers indicates that a majority of these managers believe computerization increases skill requirements and worker autonomy but also increases management's ability to monitor workers.

A detailed discussion about skill content of technical change as computerization has studied by Autor et al.(2001). They have contend that computer capital as - substitute for a limited and well-defined set of human activities those involved routine (repetitive), cognitive and manual tasks - and - complements activities involving non-routine problem solving and interactive tasks - . According to their analyses, computerization is associated with declining relative industry demand for routine, manual and cognitive tasks and increased relative demand for non-routine cognitive tasks. Autor et.al. (2001) has attempt to prove conceptual link explaining how computer technology complements skilled labor or substitutes for unskilled labor. Mechanism appears as; substitute for less educated workers in performance of simple tasks and/or complement the performance of more educated workers in complex tasks. At this point a nice example has been given. It is

> Playing a strong game of chess and writing a persuasive legal brief are both skilled tasks. Current computer technology can readily perform first task but not the second.(Autor et.al 2001, p.2.

Their implication was that neither high nor low skilled tasks are equally open to computerization. They have argued that present computer technology has quite specific applications and limitations that make it an incomplete substitute for both well-educated and less-educated workers. Authors' (Autor et.al 2001**)** study have complemented and advanced this line of research which reports a positive correlation between technology investments and educational upgrading. By conceptualizing job skill demands in terms of job tasks rather than the educational credentials of workers performing those tasks, their framework provides an account of how computerization and associated organizational changes alters the composition of job tasks. This framework rationalizes the observed correlation between computerization and increased use of educated labor and predicts pervasive shifts in workplace task structure that are not observable in conventional data sources.

These observations and studies shows that intensive use of IT, higher service levels for customers, and organizational change all go together, and together call for higher-skilled labor. These form a mutually reinforcing cluster of inventions for employers. However, the organizational changes associated with the IT-based service improvements are skill-using. Apart from all these approaches, the key skill-biased technical change of the present day can thus be seen to consist not only of IT, but of the complete cluster of associated complements. The "technical" side of this cluster is the large, ongoing declines in IT prices and large, ongoing improvements in IT performance. It is tightly linked to labor demand through its organizational side (Bresnahan, 1999). The next section will offer complementaries and basic correlations between IT and skill plus with implications about labor demand. These implications can be grouped as substitutions and information overload.

4.2. IT and Organization

Since IT has been becoming inevitable part of manufacturing industry as well as service sector, workers at all level of organizations are affected by IT based organizational changes. It is pointed that IT based changes requires good adaptation among technology, work process and organization (Benjamin and Levinson, 1993). In addition to this Malone and Rockart (1993) have determined that the improvements in IT direct to the development of new technology-originated organizational structures.

As mentioned previously, IT investment is increasingly directed toward organizational transformation rather than simple automation, computers are less substitute for other production inputs. Moreover, multiskilled, empowered production workers are less likely to be replaced by a computer than a file clerk.

Certainly, "intelligent" machines linked together in a computer-integrated manufacturing system (CIM) may be more valuable than these machines operated in isolation. Such systems have the capability of integrating information processing with physical tasks performed by programmable machine tools or robots also by the way of these systems some opportunities are available for manufacturers such as decrease in overhead costs, reduced inventories, reduced lead time for existing and new products, increase in utilization of equipment, accuracy of control over production, improvement in delivery performance and more accurate forecasting (Miles et al., 1988). It is possible to say that IT can be characterized as a new technological system in which fundamental changes in the trajectories of electronic, computer and telecommunication technologies convergence and offer a range of new technological horizons to almost all branches of the economy. IT-based systems offer organizations with functional integration, multiskilled staff, flexible decision-making process and greater delegation of responsibilities and greater autonomy of operating units to enable quick adjustment to changing environmental conditions (Piore and Sabel, 1984).

There are many studies which consider changes in factors of production, organization, human capital (Milgrom and Roberts, 1990, Brynjolfsson and Hitt, 1996, Hitt and Sinir, 1999). This section will explore the hypothesis that modern organizations exhibit less substitution between IT and traditional production factors, capital and labor. Numerous authors have argued that computers are complements to skilled, empowered workers, customer focused strategies and flexible production processes (Bresnahan, 1997; Drucker 1988; Applegate, et.al. 1988). Milgrom and Roberts (1990) have formalized and summarized many of these arguments in a mathematical model. They argue that computer-aided design and computer-controlled equipment are complementary to a set of organizational practices which include: faster product cycles, flexible machinery, short production runs, reduced inventories, empowered employees, highly skilled staff, and improved integration with suppliers and customers. That is, as the price of computers declines, as has happened for the last 30 years, organizations will increase investment not only in computers but in other complementary factors as well (flexible machinery, skilled workers). While their model attempts to illustrate the use of particular mathematical techniques to explain changes that are occurring in manufacturing, the types of organizational practices they describe are generally applicable across a wide range of organizations. Moreover, researchers are beginning to build links between the logic of complementarities and reengineering (Brynjolfsson et al.,1996; Barua, et al., 1996). For instance, Brynjolfsson, Renshaw and VanAlstyne (1997) describe a case where new flexible production technologies failed to meet expectations in terms of productivity improvements until they were coupled with increased delegation of authority and a team-based production structure. According to Brynjolfsson, Renshaw and VanAlstyne (1996), advances in information technology (IT) and rising competition have led to new modes of organizing work but flexibility relies not only on powerful new information technologies, as is commonly emphasized, but also on mutually reinforcing practices. Cross training, incentives, inventory policies, decision-making structures, and open-door communication, among other practices, must function as a coherent, stable system.

These studies can be grouped into three areas; decision authority, which includes teams and individual decision rights as well as related cultural practices (team building); knowledge work and skills, which includes skills, training and supporting practices (incentives for training and education, preemployment screening); and incentives, which includes various aspects of performance-based pay increases and promotions (Hitt, 1997). These arguments raise the possibility that computers may be less of a substitute and may even be a complement to traditional production factors such as capital and labor in organizations that have flexible production, empowered workers, and skilled staff. Although numerous number of these types of arguments exists, there are very few of the analyses on changes in work systems considering the role that technology may play.

Three reasons can be shown as answers for why information technology is potentially related to this organizational transition (Hitt, 1997). First, growth in information technology investment is of a large enough magnitude to be economically significant. Second, the recent advances in information technology are largely exogenous. The lower prices for IT are consistently delivered by the computer industry without any unusual effort on the part of computer users. Furthermore, the rapid accumulation of IT is primarily driven by these price declines and thus is relatively exogenous to other events in the economy. Interestingly, the period of greatest growth in the acquisition of computer equipment (from 1982 to the present) coincides with the emergence of new work systems, which suggests at least circumstantial evidence of a link. Third, a number of authors have proposed a direct link between the diffusion of information technology and changes in the economics of organizations. Hitt et.al. (1997) argue that, to the extent that IT reduced coordination and transaction costs, it would differentially favor market-based coordination over hierarchical organization. Milgrom and Roberts (1990) cite the exogenous price decline of IT as the primary driver in the shift from "mass production" to "modem manufacturing". With the Milgrom and Roberts (1990), most of the recent authors have recognized that information technology is a central source of modern manufacturing. Milgrom and Roberts (1990), have argued if flexible production technologies were not coupled with increased delegation of authority and team-based production structure, they would have failed to meet expectations in terms of productivity improvements (Brynojolfsson et al., 1997).

The idea that technological change, organizational change and skill may be joint determinants of firms' performance has been taken up in the empirical debate regarding the so-called productivity paradox (Caroli and Reenen, 2001). Caroli and Reenen (2001) has cited reason for the apparent failure of huge investments in computers to result in significant increases in productivity is that companies lack the necessary organizational structures that facilitate the introduction of new technologies. Without the organizational and skills infrastructure, technology alone is not enough.

Beyond these assumptions, there is no sufficient study which has given attention to organizational change because of little empirical evidence regarding the determinants and consequences of such organizational changes. Fortunately, recent studies have argued for some complementarity between technological change, organizational changes and skills (Capelli, 1996, Bresnahan et al.,1999, Caroli and Reenen, 2001). This part of the study will continue with two relationship between organizational change and skills in the light of the findings discussed until now.

4.3. Skill-Biased Organizational Change

As it is summarized that changes in work organization moves from mass production toward flexible systems of production. New work practices have been introduced, that are often characterized as "high performance" (OECD 1999). These new forms of organization are very diverse, ranging from Total Quality Management and Just-in-Time to job rotation, team working, and change in job design involving multitasking (Greenan and Mairesse, 1999). First of all, organizational changes involve some decentralization of authority, in accordance with "lean production" principles (Pietrykowski, 1999). New organizations are characterized by a shorter chain of command with some decision-making being transferred downstream. This benefits either individuals themselves or more formal teams of workers. Whatever the precise pattern of delegation, it leads to more responsibility being given to lower level staff. As authority is decentralized, the hierarchical structure gets flatter. Intermediate layers of control atrophy, and communication, hence efficiency, can be improved through de-layering (Boyer et al. 1998 in Caroli and Reenen, 2001).

4.3.1. Information Overload and Decentralization

Without IT usage, high communication costs affect the firms' degree of centralization. When communication is costly and central decision makers have an infinite capacity to digest information, it is often optimal to centralize decision making in order to economize on communications costs (Hitt and Brynjofolsson, 1997). Computerization of routine tasks causes to accumulating data intentionally. Together with this accumulation, complexity and organizing difficulties of data has shown tremendous enlargement. Companies are unwilling to fail to keep possession of organized and uncomplicated information database. For example; a firm can decide to retain a systematic record of all its interactions with a customer, or all of a given employee's interactions with customers. However, as more and more of the production process is computerized, both record keeping and database analysis become more sophisticated. On the other side, this offers some opportunities for higher level analytical decision-making. It can be characterized as a kind of management tool that has grown cheaper with the falling cost of computerization.

Despite computers are sometimes characterized as electronic brains that can replace mental effort, to use flood of low cost data effectively rely on the human intelligence and this raises the demand for cognitively skilled workers.

Information technology can also be used to bypass the human information processing bottleneck via increasingly automated communication and coordination among workers and groups. Since the information bottleneck will often be most constraining at the tops of hierarchies, computerization may also lead to greater reliance on lateral communications and decentralized decision-making (Brynjolfsson and Mendelson, 1993). Nevertheless, Jensen and Meckling (1992) have pointed out that, while decentralizing decision making may enable the firm to take better advantage of local information, it can also intensify agency problems. In the absence of an appropriate incentive system, workers will not necessarily use their decision-making authority in the interests of the firm. Information technology can be used to monitor work or aggregate information in ways useful for performance measurement, thus improving the quality of objective incentives. According to Hitt and Brynjofolsson (1997), a variety of incentive instruments can foster the effective use and dissemination of information, depending on the degree of observability. They have described observability with the following four categories:

1. If decisions and the information on which they are based are directly observable and verifiable to an outside party (or can be deduced from other data), and if the environment is not too complex, then an explicit contract can pre-specify appropriate actions and rewards. For instance, workers can be offered piece-rate performance incentives.
2. If the decision actions can be assessed by the decision maker's supervisor, but not pre-specified and verified by an outside party, then implicit contracts such as subjective performance bonuses and promotions can be an effective instrument. For instance, the possibility of promotion to a higher-paying job can be a powerful incentive.
3. When the appropriateness of actions is not observable by outside parties or supervisors but can be assessed by peers and teammates. Team-building exercises and cultural efforts to create a sense of group cohesion are needed. This will create a dynamic in which teammates punish shirkers and shirkers feel a sense of shame. For example, many Japanese firms rely on this type of peer pressure to encourage hard work.
4. Finally, when even teammates cannot observe the appropriateness of an agent's actions, one option is to try to improve goal alignment so that the agent internalizes the interests of the firm, perhaps by creating a sense of a shared vision through inspirational leadership. In addition, it may be possible

> in this situation to get agents to reveal their private information by offering them a menu of contracts. Agents with different information will choose different incentive schemes, revealing their knowledge but typically collecting an information rent in the bargain. For example, by offering multiple plans to sales agents involving different combinations of fixed salary and sales-related bonuses, a firm can learn which territories have the highest potential by observing which agents choose high-variable pay plans (Hitt and Brynjofolsson, 1997, p. 4).

IT makes formerly unobservable activities more observable; firms will tend to use more explicit contracts. However, team building and goal alignment are more likely to be found if IT leads to decentralization of decision making and greater reliance on team production because of the difficulties inherent in pre-specifying and monitoring information work, information sharing, and teamwork. While IT has automated and accelarated the chain of communication, human information processing abilities have changed and computerized firms have required highly cognitive-skilled labor by hiring more skilled and educated workers through investing in training of existing workers. Firms have also required non-hierarchical forms of organizing to the information overload bottleneck by forming self-managing teams. As a result, computerized firms should make greater use of self-managing teams and decentralized decision making (Bresnahan, 1999).

4.3.2. Limited Substitituion

Doubtlessly computerized firms are more effective in automating routine and well-defined tasks which permits substitution out of certain kinds of human effort. Firms systematically substitute computer decision-making for human decision-making in clerical (and similar routine) work. No matter how advanced IT is, the scope of this substitution is limited. Simple decisions, closely related to individual transactions or other operational actions, have been most amenable to computerization. More complex and cognitively demanding work, such as that of managers and professionals, has proved to be remarkably difficult to automate (Bresnahan et al., 1999). It is argued that computer automation of such work has been correspondingly limited in its scope. Computer automation of clerical and blue-collar work typically does not directly substitute for all of a worker's tasks, but instead for a subset of ancillary tasks. For instance, Murnane et.al. (1999) find that while computers excel at routine rule-based activities at a large bank they studied, they did not automate the tasks that required exception processing and other tasks for which humans had a comparative advantage. Authors' findings on limited susbstition can easily be understood with Figure 2 drafted by Bresnahan et al. (1999). Their analysis has based on short run and intermediate run production function as Y=F(L,K,X;Q,T,S) . While L and K are vectors of labor and capital, X measures the quantitiy of transactions with Q; refers degree of control, T; Technology, S; Structure. According to their analysis Q, T and S can be improved by firm by the way of complemantaries associated with C, C' and C". Otherwise, in the short run, while Q, T and S are fixed only flow of causation –E" – is available to change labor demand (Bresnahan et al.,1999 p.10). However, in intermediate run, improvements in T such as better software systems cause to better substitution for clerks. Additionaly, improvements in S such as improving delegation and teamwork activities make the computers complement for clerk. As a result, IT systems can be made limited substitutions for clerks without changes of S and even changes of S occurs positively, IT systems can only susbtitute simple human decision making not much.

At this point, it is impossible to finish this subsection without taking in action to the artificial intelligence. Despite, there is little computer technology that can perform such tasks; develop, test, and draw inferences from models, solve new problems, or form persuasive arguments (Author et al., 2001), there is no computer technology in terms of artificial intelligence that can perform decision-making as well as humans do.

> The goal of understanding intelligence, from a computational point of view, remains elusive. Reasoning programs still exhibit little or no common sense. Today's language programs translate simple sentences into database queries, but those language programs are derailed by idioms, metaphors, convoluted syntax, or ungrammatical expressions. Today's vision programs recognize engineered objects, but those vision programs are easily derailed by faces, trees, and mountains (Winston, 1999 in Autor et al, 2001).

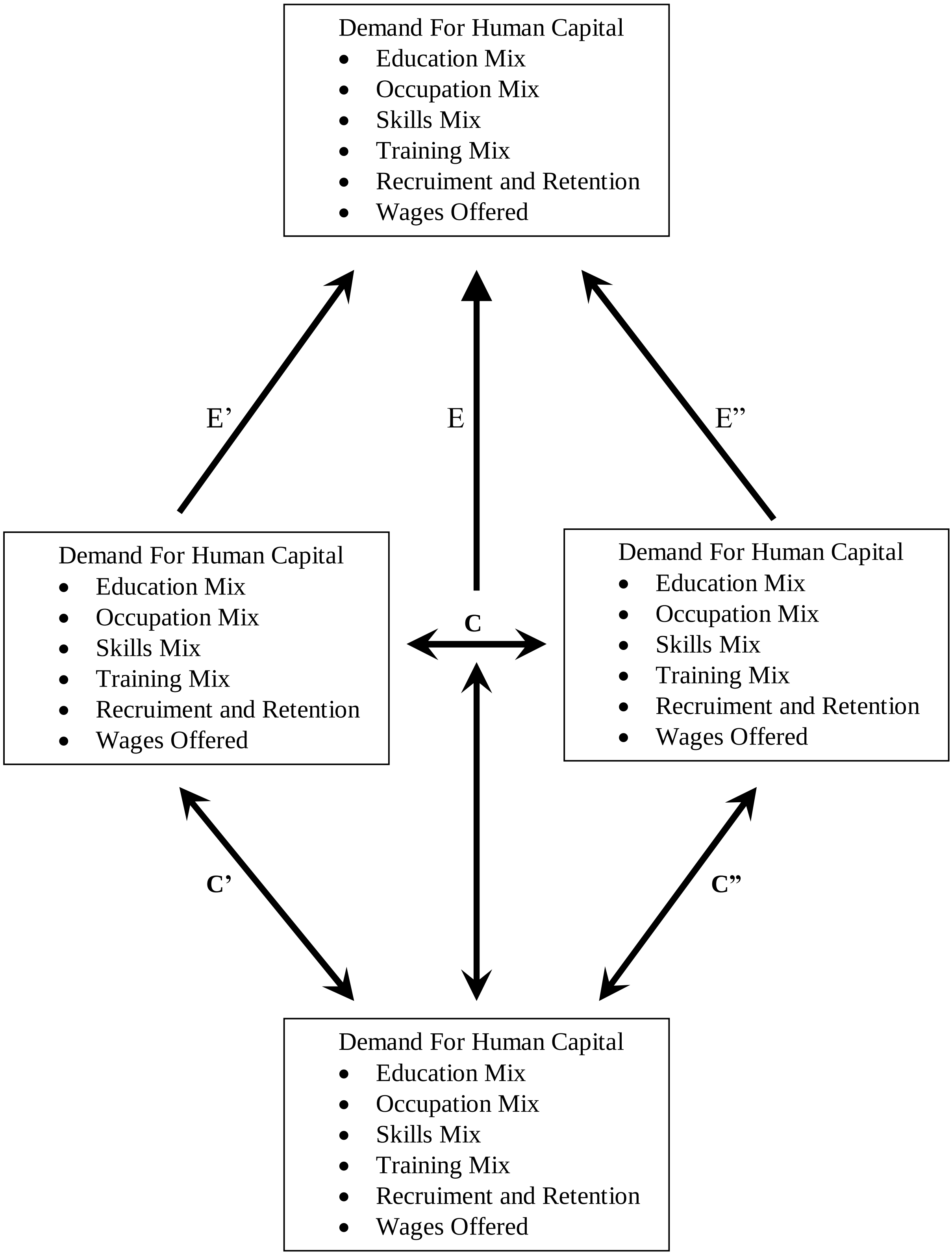

Figure 2: Casual Flows

Source: Bresnahan et al, (1999)

4.3.3. Complementarities

Research on complementarity between skill and technology have started from 80 years ago with the basic findins that sophisticated firms hired more educated workers (Goldin and Katz, 1995). Another related research on 1920s have accessed similar results that technological change increases training within firms (Bartel and Sicherman, 1995). Berndt and Morrison (1991) have found that investment in office equipment –actually they have meant IT- are associated with increased education among production workers and a shift toward more higly skilled non-production workers. It has argued that the level and rate of change in computer investments for manufacturing firm is a good proxy for their overall technological change and explains the shift toward higher skilled workers in some operations (Berman et al.,1994). Apart from these studies numerous authors (for example Autor et.al., 1998) have considered the notion of IT and skill complementarity. Meaning of a word 'Complement' can be characterized in such ways as complements tend to appear together as a system of practices rather than a single factor in isolation. Additionally, a decline in the price of a complementary factor leads to an increased use of both factor and its complement (Hitt, 1997). Existence of complementarities between organizational change and skills leads to three empirical predictions: (1) Organizational change should be followed by a declining demand for less skilled labor. (2) Falls in the relative cost of skills should increase the probability of organizational change. (3) Organizational changes should have a larger impact on productivity in workplaces with higher levels of skills (Caroli et.al, 2001). From another point of view, two possible explanations for a complementarity between decentralized organizations, skilled employees and IT can be shown. First, this arises from the need to better utilize specific knowledge (Hayek, 1945 in Hitt and Sinir, 1999). Communication and computerization enable that line workers can be provided the necessary information as well as analytical support to take action on specific information (Brynjolfsson et al.,1993). These systems can also enable managers to increase delegation of authority without losing management control (Hitt et al., 1999). Second computerization and communication results the increase in demand for information processing by creating information overload on key decision makers (Brynjofolsson, 1994). Both explanations emphasize that IT is more complementary to higher skilled labor that posses high levels of decision authority. It is implicated that IT can be use for automation, substituting for the use of labor.

Complementarity between IT and human capital lead to information-enabled decentralized workers as I noted above. In other words complementarity involves use of individual workers who are supported by analytical applications which provide necessary information to accomplish the task. Individual workers should be able to interpret the information that is provided. Quantitative and complex data provided by IT increases the demand for worker who can process this information that computers are failed to do. As it is seen, “The scarce resource is not information, it is the processing capacity to attend to information. (Simon, 1973 in Bresnahan et al., 1999)”. It means information overload bottleneck which have been explained above. Together with cognitive skill, these individual workers should be associated with autonomy because of that IT-based monitoring technologies are useful for moving responsibility and authority. The change in the mode of supervision calls for changed talents (Bresnahan et al., 1999). While improvements in computer technology enlarge the field of usage and it calls for managers who can think of ways to take advantage of the new production process offered by computers. This means call for new highly cognitive skills.

4.4. Conclusion

I have argued that the components of organizational architecture discussed above decision rights, knowledge work and inputs, and incentives and information technology (IT) are complementary. Information technology is complementary to decentralized authority when valuable specific knowledge that is not amenable to electronic transfer resides at the periphery of the organization, or when information overload creates potentially binding constraint on central decision makers. Since the key reason that authority is being decentralized is that workers may have knowledge that is needed to make an optional decision, decentralization should work best if workers are able to use their knowledge effectively or have complementary human capital. If workers have valuable knowledge and use private information, their effort will be implicitly difficult to measure. Appropriate incentive structures must accommodate decreased observability by moving down the "ladder of observability". As discussed above, when people have limited information processing capacity, information technology is likely to be a complement to knowledge work, and this work may be particularly difficult to measure and reward.

CHAPTER V

CASE STUDY

5.1. Definition and Concept: Turkish Glass Industry

Glass industry is evaluated as a critical sector in worldwide especially in USA and EU and it is stated that this industry has priority to policies for which preserving sectoral developments because this industry provides inputs to many other industries from construction to beverage. The glass industry consists of five main groups: flatglass, glassware, fiberglass and insulating glass, safety & security glass and mirror. Features of glass industry can be ordered such as technology intensive production, non-stop production, raw material dependence, unlimited investment and necessity of integration. One of the main features of the industry is based on melting technology. Glass raw materials are mixed by certain procedures and transferred to melting furnace which was tempratured nearly 1500-1600 C. This melting furnace always must be kept in these temperature levels during the drive time. For this reason, there must be non-stop production. In today's world, market size have been becoming smaller because of the globalization and quality has been becoming more and more important lead to producing raw materials as achieving total quality standards. Durability of glass melting furnace between 3-10 years causes non-stop investment in technology intensive glass industry (Şişecam, 2001)

Glass industry is a mature industry with a 2-4 per cent of growth rate of a year. The growth rate of the world flat glass industry is 3-4 per cent of a year. There are almost 200 production lines available for float technology. 6 firms have dominant role on 67 percent of float lines. Glassware production has showed 1-3 per cent of growth rate in world glassware market. 38 percent of world glass market has been shared by 6 main firms. Glass containers have 6 per cent of portion in other containers market. While substitute goods such as plastic, metal, and cardboard containers has been improving fast, glass containers show regression. Growth rate in glass containers is almost 2 per cent of a year. In the glass industry, since new products and applications have continuity, research and development expenses are high. High competition in glass manufacturer results to decline profit margins. Controlling and preserving market share has dramatically important for firms. Manufacturers concentrate on preserving and improving their competition advantages. Turkish market has entered the world-class competition with the promulgation of customs union treaty. Flat glass and glassware products which are important from Russia and Far-East with damping prices result in unfair competition and be harmful for the structure of market (DPT,2001).

Total glass production in the world is estimated as 108.5 million ton in which there are 53 per cent of glass containers, 29 per cent of flat glass, 5 per cent of glassware, 2 per cent of fiber glass and 1 per cent of other glass products. With the 1.6 million ton/year production capacity Turkish Glass Industry has reached 1.47 per cent of world glass production (DPT, 2001). The Turkish Glasswork, Inc. (Şişecam) which can be considered as a private monopoly in the Turkish glass industry, contributes 3.4 per cent to the Turkish GDP and constitutes 2 per cent of Turkish exports. The employment by this company alone reached approximately 12.400 (Şişecam, 2001).

The glass industry is amongst the important sectors of the Turkish economy since it is both internationally competitive and has high social and economic impact. It was formally founded in 1935 with the establishment of Pasabahce.

There are many firms which produce processed glass in Turkish Glass Industry however there are few important companies having an ability to large scale production such as Türkiye Şişe ve Cam Fabrikaları A.Ş., Konya Cam, Güral Cam, İzocam and İzotoprak. Türkiye Şişe ve Cam Fabrikaları A.Ş. (Şişecam) has manufacturing plants in the field of flat glass, glassware, fiber glass, glass containers, chemicals, oxyvit, metal, autoglass.

In recent year, Turkish Glass Industry has showed significant growth by the US$ 1.2 billion of investment of Şişecam and being an active of some other firms such as Güral Cam, İzotoprak and Marmara Cam.

5.2. Development of Turkish Glass Industry

The story of glassmaking in Anatolia goes back to ages of antiquity. Instead of going into detailed examination of these historical developments, I will briefly mentioning glassmaking tradition beginning with the foundation of Turkish Republic. In 1934, the government decided that one of the biggest banks in Turkey, İşbank, should be responsible for the construction of a factory that would manufacture bottles and glassware and then of a second one that would manufacture "window glass". The first factory, Paşabahçe Glassworks, was founded in 1935. It was at first administrated by the French company Stein but in 1936, the factory was transferred to Turkish Glassworks, Inc (Öz, 1999). Several private enterprises were built in the successive periods. For instance, the Gökyiğit Factory was built in 1944 in Istanbul for the manufacture of glassware and articles of illumination, The Bottle Factory in Çubuklu was also built in 1944, the Türkgenç Lamp and Bottle Factory was established in Cibali in 1950, the Net Glass factory of glassware and articles of illumination was built in 1958. Similarly during 1960s and 1970s, some other private enterprises as well as smaller workshops emerged in Istanbul and various cities of Anatolia (Bayramoğlu, 1976 in Öz, 1999)

There had been attempst to challenge the monopoly position of Şişecam in the 1970s as well, the most outstanding of which was Denizli Cam. Although the firm was established in 1973, it took some time until it actually started production in 1981. It produced glassware and glass rods for chandeliers. The company invested heavily in technological improvements in 1983 and increased its capacity when the second and third blast furnaces started operation in 1988 and 1989, respectively. In 1994, 51 per cent of Denizli Cam's shares were bought by Şişecam Holding reinforcing the latter's monopoly position in the industry. Currently, the Turkish Glassworks Inc. (Şişecam) clearly dominates the Turkish glass industry, owning all firms with the exception of a few in the glassware segment (Öz, 1999).

5.3. Sources of Advantage in the Turkish Glass Industry

5.3.1. Factor Conditions

Around 98 per cent of the raw materials used in the industry are domestic ones, and only some chemical materials like lead oxide and potassium carbonate are imported. The main reason for the apparent preference for domestic raw materials is the high cost of transportation, especially in the case of sand. Although raw materials are adequate in Turkey both in terms of quantity and quality, it is hard to say whether they are distinctive enough to provide a clear advantage to the Turkish glass industry. The costs of raw materials, however, are lower than those in the world market which probably owes a lot to the fact that Şisecam has its own supplier firm.

Avarage wages in the Turkish glass industry are relatively low compared to the main competitors. In fact, it is one of the lowest rates in the world as far as the glass industry is concerned (Öz, 1999). When taking productivity rates into attention, it is seen as the apparent wage advantage of Turkey, especially relative to the competitors in the EU, diminishes since the productivity rate in the Turkish glass industry is approximately one seventh of the corresponding rate for the EU (Şişecam, 1992). Despite this, it is supposed that Turkey has a cost advantage in the glass industry stemming from low wages relative to some important competitors in Europe. Here, it should be stated that average wages in the Turkish glass industry are in fact high relative to those in other Turkish industries.

This is reflected in the answers of glass industry workers have given to a survey conducted by Veri Arastirma A.Ş. When asked to priorities their expectations from the union, for instance, they put job security in firs place, improvements in the working conditions in second and training in third. Expectations of workers from the union regarding the increases in wages only took fourth place according to 1992 survey results, decreasing from the third place it captured in the 1990 survey (Kristal-ls, 1992a). This may partly be explained by the increasing trend in real wages after 1988, which, in the long-run, may threaten the advantage of the Turkish glass industry stemming from relatively low wages compared to major foreign competitors.

High wages in the glass industry relative to other industries in Turkey have been mainly achieved by the 'tough' union, Kristal-İş. There are several reasons for the strength of the union in the Turkish glass industry. One is the fact that the industry requires qualified employees who are usually more inclined to take part in the unions. Another reason is that there is practically only one employer and one union in the industry, which increases the bargaining powers of both parties. It is definitely argued that conflicts between managers and employees in the Turkish glass industry have been rather frequent and severe relative to the other industries.

Managerial levels consider increasing labor costs and the present attitude of the union as the most important obstacles for the long-term competitiveness of the Turkish glass industry. In fact, the share of labor costs in gross value added is gradually diminishing indicating that the response of management to increasing labor costs seems to be a parallel increase in the emphasis on automation. This also explains the shift of workers preferences from wage increases to job security since job loses have started to go hand-in-hand with increases in automation.

In summary, as far as the factor conditions are concerned, it can be said that the Turkish glass industry has a relatively advantageous position compared to its main competitors in basic and generalised factors with low-cost and good quality raw materials, a very favorable geographical position, low-cost unskilled and semi-skilled labor, and easy access to debt capital. The industry, however, faces severe disadvantages regarding the advanced and specific factors with inadequate infrastructure with specific properties, lack of specific research institutions, and difficulties faced regarding research and development. Given that, according to Porter (1990), advanced and specific factors are more important and sustainable sources of competitive advantage, this situation poses a threat to the Turkish glass industry in the long-run.

5.3.2. Demand Conditions

When it is examined the sizes of the major segments in the world market are investigated, it is seen that in terms of dollar value of production flat glass is the most important segment, followed by lighting , products of glass, fiber glass, glass containers and glassware, in order to importance, in terms of volume of production, however, the glass containers segment is the leading one, whereas flat glass and glassware segments come as the second and third, respectively (ICEF 1992 in Öz, 1999).

When we have a look at the situation in the Turkish glass industry, we see that it more or less resembles trends in the world market in some extent. In terms of volume of production, the flat glass segment comes first and glass containers are second. However, when we look at the value of production, it is seen that the glassware segment captures the first position and the flat glass comes second, the glass containers segment is in the third place (Table 5a and Table 5b).

Although demand for major glass products in the domestic market grows faster than it does in developed economies, this does not change the fact that most of the new product developments are taking place in the developed nations and it usually takes some time until new products reach developing countries like Turkey. Furthermore, it is hard to say that Turkish customers are anticipatory of the likely developments in the world glass industry.

In fact, Şisecam itself has to create demand in the domestic market for the new products that have emerged in the developed countries, although by doing so, it takes the risk of paying for all externalities involved. The Şisecam executives express some concern about that issue especially regarding the extremely cheap imports from Eastern Europe and Indonesia as well as unfair competition from small firms that have no unions and imitate the products of Şisecam.

Table 5a: Volume of Production in Turkish Glass Industry, 1995-1999 (1000 Tones)

		Years					Growth Rates (%)			
	Products	1995	1996	1997	1998	1999	1996	1997	1998	1999
1	Flatglass	457	595	570	605	549	30	-4	6	-9
2	Emprime	61	59	59	63	62	-2	-1	7	-2
3	Glasscontainers	309	378	448	402	473	22	19	1	-6
4	Glassware	195	232	310	302	270	19	34	-2	-11
5	Glass wool	15	21	25	29	29	37	18	16	-
6	Fiberglass	16	15	21	25	25	-9	44	20	0
7	Glass mosaic	11	9	9	9	9	-21	-	-	-
8	Safety glass	38	39	40	40	42	1	4	-	4
9	Doubleglass	21	22	23	23	25	3	5	-	9
10	Mirror	15	32	41	43	51	115	29	5	18
11	Others	25	25	28	28	28	-	12	-	-
	Total	1089	1334	1470	1514	1395	22	10	3	-8

Source : DPT, 2001

Table 5b : Value of Production in Turkish Glass Industry, (1.000.000.000 TL) 1995-1999

		Years					Growth Rates (%)			
	Products	1995	1996	1997	1998	1999	1996	1997	1998	1999
1	Flatglass	7.015	16.999	28.649	55.312	76.795	142	69	93	39
2	Colored glass	1.124	2.040	3.570	6.963	10.456	82	75	95	50
3	Glass containers	5.175	11.781	24.575	45.053	64.598	128	109	83	43
4	Glassware	14.405	24.729	58.203	103.168	141.052	72	135	77	37
5	Glass wool	855	2.176	4.505	9.525	14.580	155	107	111	53
6	Fiberglass	989	1.676	4.253	9.277	14.268	69	154	118	54
7	Glass mosaic	274	401	706	1.283	1.964	47	76	82	53
8	Safety glass	1.664	3.130	5.721	10.400	16.635	88	83	82	60
9	Double glass	1.081	2.063	3.796	6.900	11.480	91	84	82	66
10	Mirror	504	2.012	4.553	8.712	15.730	300	126	91	81
11	Others	1.050	1.954	3.851	7.000	10.714	86	97	82	53
	Total	34.136	68.962	142.379	263.594	378.270	102	106	85	44

Source : DPT, 2001

There are number of independent buyers in the Turkish glass industry eliminating the risk of being trapped into the comfort of serving one or two guaranteed customers only. When we compare the standards of foreign versus domestic customers in terms of product quality, product features and product-related services for the Turkish glass industry combined, we see that in the past some differences did exist with foreign customers having more sophisticated demands than the domestic ones. Since the late 1980s, however, this discrepancy has disappeared, and now, both foreign and domestic customers are equally demanding. We should, however, state that there is an exception to this -the glassware segment, where Turkish customers are traditionally very demanding.

In summary, as far as the home demand conditions are concerned, the Turkish glass industry has the advantage of having a large, rapidly growing and dynamic domestic-market. Domestic customers, however, are neither less nor more sophisticated than foreign ones. In other words, although this dimension of home demand does not create a problem for the Turkish glass industry, it does not suffice to provide a lead either. Finally, it is difficult to say that domestic customers are anticipatory of likely developments in the world glass market, which is apparently a disadvantage for the Turkish glass industry.

5.3.3. Strategy and Structure

It is important to remind the history of industry in the sense that Şisecam's dominance in the industry is undeniable, and it has been so throughout the history of the industry in the Republic of Turkey. Some firms have tried; in fact, some (the latest attempt is being made by Kütahya Porselen, a firm from the ceramics industry) are still trying to enter into the industry, but most of the time it has turned out to be the case that they have either ceased to survive or Şisecam has bought them after a while (e.g. Denizli Cam). Among the firms trying to enter into the industry, there are both totally new ones and the ones established by the companies operating in other industries such as the ceramics industry.

The case of the Turkish glass industry is, in other words, quite interesting in that it is still competitive, although there are hardly any domestic competitors, with one firm Şisecam holding more than 90 per cent of the market. Furthermore, it was even competitive when the domestic market was highly protected, although the company tremendously improved its competitive position in the international markets after liberalization. The possible explanation for this situation may be the nature of the industry. In particular, the existence of economies of scale, the continuous production requierement together with the necessity of a stepwise increase in capacity compels firms in the glass industry to compete in international markets as well. These structural characteristics of the glass industry, in a way, help to offset the problems stemming from the lack of domestic competition in the industry and, even to a certain extent, the effects of the presence of import protection measures. To be able to sell their products in the international markets they have to be competitive anyway. Even a large home market may not be sufficient under the circumstances, since firms probably prefer to diversify their risk by selling abroad as well, instead of relying solely on the domestic market.

Due to its above mentioned structure, large firms are dominant in the glass industry, both in Turkey and in the rest of the world. Şisecam is vertically (activities ranging from the supply of raw materials to the marketing of the final products) and partially horizontally (e.g. Istanbul Porselen is a firm operating in the ceramics industry) integrated. It is a privately-owned domestic firm. It prefers to organise its international activities in the form of an 'export department' though it has sales and marketing subsidiaries in several other countries.

As far as company policies are concerned, we can say that the long-term goal of the company is stated being the leader in the world -glass market in terms of quality and cost rather than sales volume or quantity produced Priority *is* given to the domestic market since the philosophy dominant amongst the top management is that it is crucial to be strong in the domestic-market before entering into international markets. This emphasis on the "domestic market is compatible with Porter's approach, which gives special importance to the attributes of the local market (like home demand) for a sustainable success in international markets (Öz, 1999).

Şişecam tries to overcome the previously mentioned research related disadvantages by its own investment in research; it has well-functioning and productive research laboratory, for instance, in the glassware segment where the need for innovation is especially high, the innovation rate for Şisecam is quite satisfactory with one innovation per day, but still lower than France's Duran's, the leader in this segment, which has an average rate of 1.6 innovations per day (Şisecam, 1992). Over time the emphasis on research and development programs has shifted from the improvement of management techniques to process and product development as well as the improvement of marketing techniques in accordance with the changing environment and customer needs. The company also finances research projects that may have direct or indirect impacts on the glass industry and sponsors students studying in the glass-related departments of universities. To compensate for the lack of specifically skilled personnel for the industry, Şişecam has developed on-the-job and off-the-job training programs; some workers are trained abroad if necessary.

In summary, the managerial capabilities of Şişecam executives can be considered as amongst the most important strengths of the Turkish glass industry. The existence of an active and adoptive management team, together with a strong union, for instance, has resulted in a company implementing the recent developments in participatory management such as quality circles and share-distribution schemes designed for the employees. The real advantage is that the strength of the company brings as far as the managerial capabilities are concerned, however, shows itself in the way it faces several challenges and deals with the problems caused by the inadequacies in the country infrastructure. Specific examples include its vertical integration strategy to compensate for the lack of internationally competitive supplier industries, its own attempts to promote recycling of glass products, its vigorous training programs and its attempts to create demand in the domestic market for new products.

To conclude, we can argue that managerial capabilities provide an important lead for the Turkish glass industry, whereas being a competitive industry despite the lack of domestic competition can be partly explained by exposure to international competition and the structural characteristics of the industry.

5.4. Şişecam in Specific

Türkiye Şişe ve Cam Fabrikaları A.Ş. (Şişecam) is the parent company of a Group of companies involved primarily in the production of glass and inorganic chemicals. The Group is one of the largest manufacturers specialized in all types of basic glass products such as flat glass, glassware, glass packaging, glass fiber and also sodium and chromium chemicals.

Şişecam has formally established by İşbank upon a directive issued by Atatürk in 1935. Şişecam set out initially to meet the requirements of the country in the field of glassware; in the 1960s, it turned its attention toward exports on the principle that "the whole world is our market." In the 1970s and 1980s, the Group diversified its activities and expanded further into global markets. Today, as a result of specialization, highly competitive operations, consolidated sales reaching US$ 1 billion, exports US$ 400 million and a workforce of 12,400, Şişecam has taken its place as one of the leading glass manufacturers in the world. The size of the businesses within the Group rank from third to tenth position globally, demonstrating the best evidence of its strength. With a contemporary management style, strong adherence to the principles of industry and professionalism and its focus on the market and R&D activities, Şişecam is set to continue growing well into the future. The Group's vision, "to become the leading glass manufacturer in its immediate geographical region" will be achieved on these foundations. Recent investments in Bulgaria, Georgia and Egypt and initiatives taken in a number of other countries, still in the planning stage, constitute significant steps toward actualizing this vision. Current attempts, especially with regard to joint ventures and strategic partnerships with other reputable enterprises in similar business lines, should be perceived as stepping-stones toward a prosperous future. Shares of Group companies, Trakya Cam, Anadolu Cam, Denizli Cam, Soda Sanayii and Camiş Lojistik, as well as those of Şişecam are traded on the Istanbul Stock Exchange. One of the main targets of Şişecam is to go public for all of its operations and expand the capital base of the Group. Some financial indicators of Şişecam can be found in Appendix X.

5.5. Empirical Results

The central hypothesis of this study is that IT can not replace human but rather it is a complement. Complementrarity relations between IT, HK and WO are tested by employing a data set collected through a structured questionnaire. At first, it is expected that firm has high levels of IT should hire more educated workers and train existing workers more intensively if IT is complement for HK. I tested this expectation by gathering educational composition of firm and the level of computerization. Similarly, if IT is complement for WO, it is expected that IT-intensive firm should organize production using self managing teams and delegated decision making. As I mentioned before complementarity between IT and HK leads to information-enabled decentralized workers. It is expected under these assumptions that complementarity involves use of individual workers who are supported by analytical applications to accomplish the tasks. Second, firms should substituted computer decision making for human decision making in routine task if it has higher levels of HK and IT. Finally, while IT enables better accumulation of knowledge, WO enable managers to increase delegation of authority without loosing management control. It is supposed that firms have high level of HK and high level of IT should have high level of WO.

5.5.1. Relations between HK and IT

Frequencies for the composite variables of HK in which educational levels of workers, level of importance attached to education, level of experience and level of participating training activities are measured, can be found in frequencies of variable in Appendix 2. While gathering the composition of educated workers, to include skilled ones, some extra questions about their past experiences have been asked to employees. I have analyzed relations between HK and IT in three subsection; relation between occupation and computerization, education and computerization, experience and computerization. First of all, classification of employment by job title is related with IT. Employees with managerial position in the firm have more likely to invest on IT while blue collar workers tend to have less IT. To reflect the statistical relation between occupation and the level of computerization, I have analyzed the data by making cross tabulation to count the intersect points of the factors and for assessing the significance of the results of survey I have used Pearson Chi Square method[4]. First the analsis for occupation and the level of computerization is to correlate between two measures as “occup” and “comprng”. Measures of key variables can be

[4] Pearson Chi Square (χ^2) provides a simple test based on difference between observed and expected frequencies.

found at Table 6. Table 6 and Figure 3 show that especially, professionals have very high level of computerization in their task and the second is clerk.

There are statistically significant differences in the level of computerization for different occupations. Despite the fact that high level of computerization in blue collar workers, managers have not shown tendency to use IT components intensively.

Table 6: Intersections between occupation and computerization

			COMPRNG						
			Very Heavily	Heavily	Moderately	Slightly	Almost any	Nothing	Total
OCCUP	Manager	Count	6		2		1		9
		% of Total	8,2%		2,7%		1,4%		12,3%
	Professional	Count	14	3	2				19
		% of Total	19,2%	4,1%	2,7%				26,0%
	Clerk	Count	9	2	3				14
		% of Total	12,3%	2,7%	4,1%				19,2%
	Labor	Count	3	2	5	1	4	16	31
		% of Total	4,1%	2,7%	6,8%	1,4%	5,5%	21,9%	42,5%
Total		Count	32	7	12	1	5	16	73
		% of Total	43,8%	9,6%	16,4%	1,4%	6,8%	21,9%	100,0%

Pearson Chi-Square Test for Association: χ^2=44.775 (p<.001)

The main reason can be illustrated as professionals and clerical workers provide much of the information which decision makers need. In other words, while IT department of the firm offers an ability to access much of the information by using computers and network, number of clerks is collecting these informations to present their managers. For the purpose of the corporate profile of the company, it is difficult to replace or displace workers. Most of the employees of the company work in the same position for a long time. At present, I will continue to examine the relation between HK and IT. Another one is based on the relations between the level of education and the level of computerization. Table 7 and Figure 4 illustrate that, employees whose educational level is less than undergraduate have lower computerization level in their task than especially whose educational level is more than technical school. It is attractive point that 13.7 per cent of employees who graduated from technical school have not any computerization in their task.

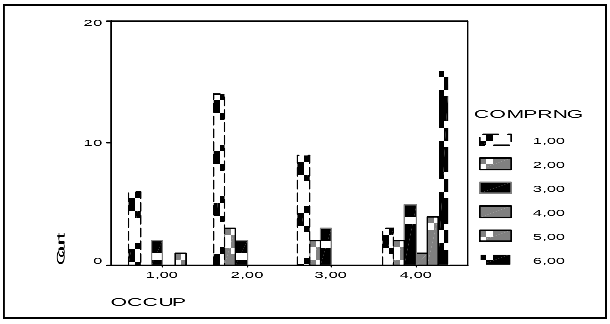

Figure 3: Intersections between occupation and computerization

Table 7 : Intersections between education and computerization

			COMPRNG						
			Very Heavily	Heavily	Moderately	Slightly	Almost Any	None	Total
EDUC	Graduate	Count	11		1				12
		% of Total	15,1%		1,4%				16,4%
	Undergraduate	Count	14	4	5		1	1	25
		% of Total	19,2%	5,5%	6,8%		1,4%	1,4%	34,2%
	Technical School	Count	3		3	1	3	10	20
		% of Total	4,1%		4,1%	1,4%	4,1%	13,7%	27,4%
	High School	Count	4	3	3			4	14
		% of Total	5,5%	4,1%	4,1%			5,5%	19,2%
	Less than High School	Count					1	1	2
		% of Total					1,4%	1,4%	2,7%
Total		Count	32	7	12	1	5	16	73
		% of Total	43,8%	9,6%	16,4%	1,4%	6,8%	21,9%	100,0%

Pearson Chi-Square Test for Association: χ^2=46.733 (p<.001)

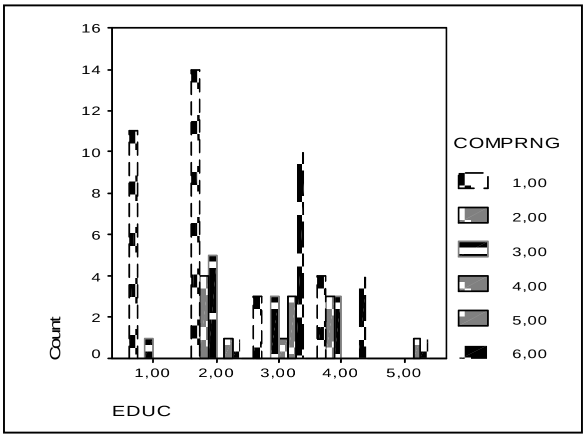

Figure 4 : Intersections between education and computerization

There are statistically significant differences in the level of computerization for different education levels. The results reflect that most of those employees' works require specific skill to accomplish their task also their tasks are generally far from including repetitive and routine works. In other words, IT components have no effect on these workers job in terms of substitution or complementarity. To understand these relations more accurately, I have analyzed the relations between the level of attaching importance to education for performing the task and the level of computerization. It can be justified as routine and repetitive works do not require high level of education to perform the task anymore because of the software technologies which have an ability to achieve these types of tasks. Under this assumption, I should expect that the tasks including high level of computerization in clerical works would have lower level of importance for education. As I emphasized in the second chapter, before the innovation of related computer technologies these workers were classified as skilled workers and their wages were high in the firm as well as in the sector.

Table 8 : Intersections between importance of education and occupation

			OCCUP				
			Manager	Professional	Clerk	Labor	Total
SCNED	Extremely important	Count	4	9		8	21
		% of Total	5,5%	12,3%		11,0%	28,8%
	Very important	Count	4	9	9	14	36
		% of Total	5,5%	12,3%	12,3%	19,2%	49,3%
	Somewhat important	Count		1	4	3	8
		% of Total		1,4%	5,5%	4,1%	11,0%
	Not too important	Count			1	2	3
		% of Total			1,4%	2,7%	4,1%
	Not important	Count	1			4	5
		% of Total	1,4%			5,5%	6,8%
Total		Count	9	19	14	31	73
		% of Total	12,3%	26,0%	19,2%	42,5%	100,0%

Pearson Chi-Square Test for Association: χ^2=19.572 (p>.05)

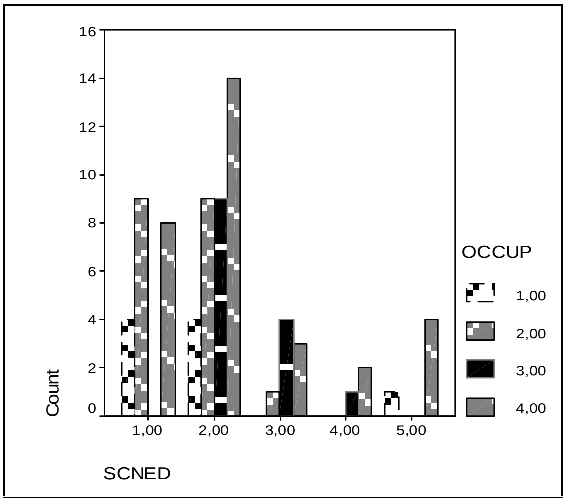

Figure 5 : Intersections between importance of education and occupation

According to this result, there is no statistically significant difference in the attitudes of different occupations to education. When computers become a capable factor to perform the task, these skilled person's abilities are substituted by kinds of software. As a result, skilled workers found themselves in a process thorough to be unskilled. Related statistical analysis about the relation between the level of importance taking into education and classification of occupations can be found in Table 8 , Figure 5. It is seen that especially professionals and workers in which 26 per cent graduates from technical school - think as their education have important for their task while managers think opposite for themselves. It means that managers in other words decision makers use their creative and cognitive skills to accomplish their task instead of skills gained from educational background. It can also be supposed as the reason for relatively lower level of computerization than those in expectations. After these assumptions, it will be more explanatory to illustrate the relations between importance of education and computerization. Table 9 and Figure 6 present these relations. As it is seen, the high level of computerization has occurred in the tasks in which educational background is treated to be important to perform by employees.

Table 9 : Intersections between importance of education and computerization

			COMPRNG						
			Very Heaviliy	Heaviliy	Moderately	Slightly	Almost any	None	Total
SCNED	Extremely important	Count	12	1	3		1	4	21
		% of Total	16,4%	1,4%	4,1%		1,4%	5,5%	28,8%
	Very important	Count	16	3	6	1	3	7	36
		% of Total	21,9%	4,1%	8,2%	1,4%	4,1%	9,6%	49,3%
	Somewhat important	Count	2	3	2			1	8
		% of Total	2,7%	4,1%	2,7%			1,4%	11,0%
	Not too important	Count	1		1			1	3
		% of Total	1,4%		1,4%			1,4%	4,1%
	Not important	Count	1				1	3	5
		% of Total	1,4%				1,4%	4,1%	6,8%
Total		Count	32	7	12	1	5	16	73
		% of Total	43,8%	9,6%	16,4%	1,4%	6,8%	21,9%	100,0%

Pearson Chi-Square Test for Association: χ^2=19.101 (p>.05)

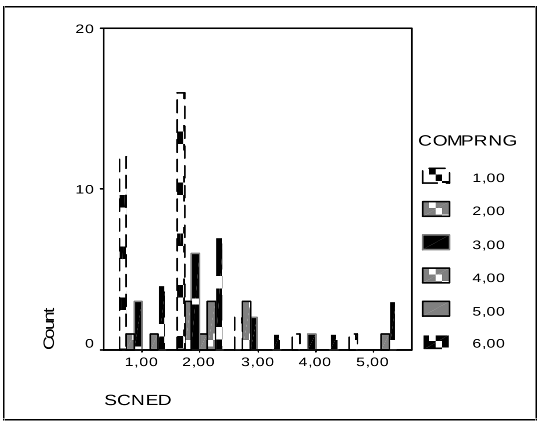

Figure 6 : Intersections between importance of education and computerization

According to this result, there is no statistically significant difference in the attitudes of different occupations to education. While computerization range is higher in professionals who attach importance to their education, it is none for labors who graduated from technical school. To proceed to the next variable, I will show the relation between one of the measures of human capital named “exp” (experience) and the level of computerization. It can be concluded from the statistical analysis that computerization have considerable affects on jobs whatever they are. Persons have more experience in firm are effected more by computerization by the length of time. There is a linear increase both in experience and computerization (Table 10 and Figure 7).

Table 10: Intersections between experience and computerization

			COMPRNG						
			Very Heavily	Heavily	Moderately	Slightly	Almost any	None	Total
EXP	1-5 years	Count	14	1	6		3	7	31
		% of Total	19,2%	1,4%	8,2%		4,1%	9,6%	42,5%
	6-10 years	Count	7	3	2	1	2	4	19
		% of Total	9,6%	4,1%	2,7%	1,4%	2,7%	5,5%	26,0%
	11-15 years	Count	6	2	1			3	12
		% of Total	8,2%	2,7%	1,4%			4,1%	16,4%
	16-20 years	Count	2	1	2			2	7
		% of Total	2,7%	1,4%	2,7%			2,7%	9,6%
	21-25 years	Count	3		1				4
		% of Total	4,1%		1,4%				5,5%
Total		Count	32	7	12	1	5	16	73
		% of Total	43,8%	9,6%	16,4%	1,4%	6,8%	21,9%	100,0%

Pearson Chi-Square Test for Association: χ^2=12.915 (p<.05)

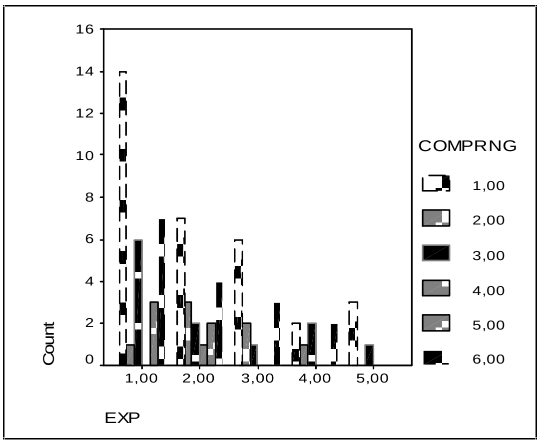

Figure 7: Intersections between experience and computerization

According to this result, there is no statistically significant difference in the attitudes of different levels of experiences to the range of computerization. Finally, I will consider firms, human capital policies as human capital investments of the firm. One of the indicators of human capital investment is training activities of firms. Rather than hiring highly educated and skilled workers firms choose to train the current workforce. In that case, training activities of firms should be part of re-skilling process for workforce. I have expected that after joining to training activities of the firm, workers who are retrained would be complemented by computers instead of substituted. Table 11 and Figure 8 has illustrated the results of statistical analysis.

Table 11: Intersections between training activities and computerization

			COMPRNG						
			Very Heavily	Heavily	Moderatel y	Slightly	Almost any	None	Total
TRAIN	Yes	Count	16	3	5	1	5	12	42
		% of Total	21,9%	4,1%	6,8%	1,4%	6,8%	16,4%	57,5%
	No	Count	16	4	7			4	31
		% of Total	21,9%	5,5%	9,6%			5,5%	42,5%
Total		Count	32	7	12	1	5	16	73
		% of Total	43,8%	9,6%	16,4%	1,4%	6,8%	21,9%	100,0%

Pearson Chi-Square Test for Association: χ^2=9.024 (p>.05)

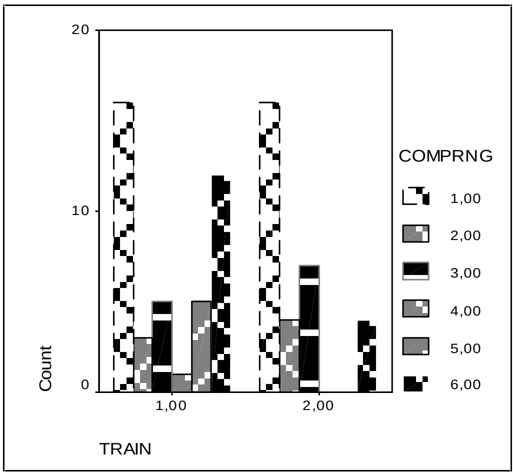

Figure 8: Intersections between training activities and computerization

According to results of my survey, it can be seen that firms behavior is far from expectations because they have been trying to retrain skilled blue collar workers more than white collar or unskilled blue collar. This causality results no change in the level of computerization of retrained workforce who already do not need to IT components to perform their tasks. The cross tabulation between the level of computerization and occupation is shown by Table 12. There are statistically significant differences in the level of computerization for different education levels.

Table 12: Intersections between training and occupation

			OCCUP				
			Manager	Professional	Clerk	Labor	Total
TRAIN	Yes	Count	3	10	7	22	42
		% of Total	4,1%	13,7%	9,6%	30,1%	57,5%
	No	Count	6	9	7	9	31
		% of Total	8,2%	12,3%	9,6%	12,3%	42,5%
Total		Count	9	19	14	31	73
		% of Total	12,3%	26,0%	19,2%	42,5%	100,0%

Pearson Chi-Square Test for Association: χ^2=4.959 (p>.05)

Consequently, the relations between HK and IT can be summarized as follows: IT is strongly complement especially for professionals and clerks however professionals' tasks can not be substituted by computers, clerical works can easily be performed by computers. Despite this substitution, firm continues to hire clerks for some reasons. One of them is that hiring clerks has provided an advantage for the tasks such as problem solving ability, creative thinking ability, etc. On the other hand, professional are becoming more creative, more reliable and faster when their skills coupled with computer's abilities. Finally, while mangers and especially professionals are more likely to use IT components, blue collar workers tend to have less IT.

5.5.2. Relations between HK and WO

Before examining the relations between WO and IT, it is important to analyze the relations of HK and WO because to understand WO completely, we should have enough information about the interactions between WO and HK. The important point is that measures of WO have defined as the level of participation into teams and employee involvement groups. It is also important to underline employees who have answered my questions for determining the more accurate relations between IT and WO by classifying workforce as their occupations and educational backgrounds.

Frequencies of composite variables used for measuring WO can be found at frequency tables and figures in appendix 2. To gather measures of work organization, I have pre-determined some indicators such as joining the self-managing team and being a participant in employee involvement groups. WO can be defined as a variable reflecting the use of teams, delegation of decision rights and activities to support the use of teams such as promotion, quality circles. These variables have also clear interpretation as measures of decentralization. With the conceivable assumption, if IT is complement for WO, I should expect IT-intensive firms to be more likely to organize production using self managing teams and delegated decision making. On the other hand, I have also treat action some other factors as indicators of organizational structure of firm; these are autonomy, standard regulations and monitoring. I will present the relations between these factors and IT at the end of this section.

First , I have started to analyze the relations between occupation and participating team by illustrating cross-tabulation with the association of chi-square statistical test then I have presented the same relation for the case of employee involvement groups. Table 13 and 14 with Figure 9 and 10 are about these relations.

Table 13: Intersections between team and occupation

			TEAM				
			Very heaviliy	Heaviliy	Moderately	Slightly	Total
OCCUP	Manager	Count	3	2	3	1	9
		% of Total	4,1%	2,7%	4,1%	1,4%	12,3%
	Professional	Count	6	11	1	1	19
		% of Total	8,2%	15,1%	1,4%	1,4%	26,0%
	Clerk	Count	3	5	5	1	14
		% of Total	4,1%	6,8%	6,8%	1,4%	19,2%
	Labor	Count	9	11	10	1	31
		% of Total	12,3%	15,1%	13,7%	1,4%	42,5%
Total		Count	21	29	19	4	73
		% of Total	28,8%	39,7%	26,0%	5,5%	100,0%

Pearson Chi-Square Test for Association: χ^2=8.030 (p>.05)

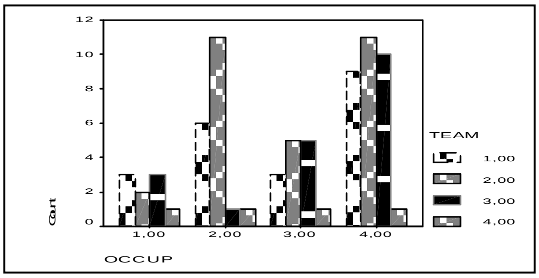

Figure 9 : Intersections between team and occupation

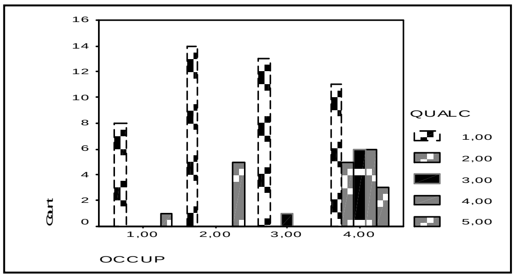

Figure 10: Intersections between quality circles and occupation

Table 14: Intersections between participation in quality circles and occupation

			QUALC					
			Never	Always	Usually	Sometimes	Rarely	Total
OCCUP	Manager	Count	8				1	9
		% of Total	11,0%				1,4%	12,3%
	Professional	Count	14				5	19
		% of Total	19,2%				6,8%	26,0%
	Clerk	Count	13		1			14
		% of Total	17,8%		1,4%			19,2%
	Labor	Count	11	5	6	6	3	31
		% of Total	15,1%	6,8%	8,2%	8,2%	4,1%	42,5%
Total		Count	46	5	7	6	9	73
		% of Total	63,0%	6,8%	9,6%	8,2%	12,3%	100,0%

Pearson Chi-Square Test for Association: χ^2=32.694 (p<.01)

There are statistically significant differences participating team for different occupations, however, there is no statistically significant differences participating quality circles for different occupations. I have expected that firms with high level of human capital should have greater use of teams and employees in the company and tend to be participant in team and team building activities. It is also related with the intensive use of IT in firms.

It is difficult to interpret the behavior of the firm in the case of workplace organization because of the fact that firms' policies for supporting team building activities have not presented a considerable effort. While it is seen at Table 14 and Figure 10 in which most of the employees, whoever they are, have not been participant in employee involvement groups, it is impossible to say similar comment for being a participant for team. It is resulted from two distinct reason, first, I have surveyed different number of workers who are selected by classifying into occupations, it is affected by the expected dispersion of the case study however, various types of relation can be deducted by following the frequency tables and cross tabulations which are already illustrated. One of them is cross tabulation between educational background and participating employee involvement groups. For better understanding of the relation between education and employee involvement groups, we should first look at the intersections of education and occupation (Table 15, and Figure 11).

Table 15: Intersections between education and occupation

			OCCUP				
			Manager	Professional	Clerk	Labor	Total
EDUC	Graduate	Count	4	5	3		12
		% of Total	5,5%	6,8%	4,1%		16,4%
	Undergraduate	Count	5	14	4	2	25
		% of Total	6,8%	19,2%	5,5%	2,7%	34,2%
	Technical School	Count			1	19	20
		% of Total			1,4%	26,0%	27,4%
	High School	Count			6	8	14
		% of Total			8,2%	11,0%	19,2%
	Less than High School	Count				2	2
		% of Total				2,7%	2,7%
Total		Count	9	19	14	31	73
		% of Total	12,3%	26,0%	19,2%	42,5%	100,0%

Pearson Chi-Square Test for Association: χ^2=63.325 (p<.01)

There are statistically significant differences levels of education for different occupations. As it is seen from the Table 15, all the managers and professionals have graduate or undergraduate degree; on the other hand almost all of the labors' educational background is less than undergraduate degree. This is important in to analyzing the cross tabulations between workplace organization and human capital in terms of persons' qualifications who are participant for team or employee involvement groups.

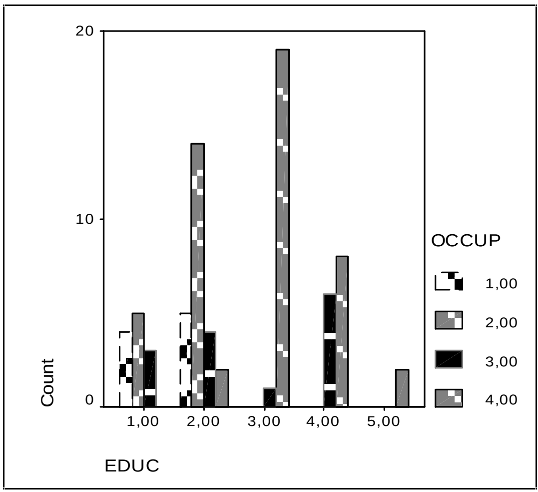

Figure 11: Intersections between education and occupation

Then, I have analyzed the relation between the importance of education to perform the task and participating team. It is expected that there should be positively strong relation between them in the case of importance of education which reflects the method of work. In other words, workers whose tasks are not repetitive and routine attach importance to their educational background and they show tendency to be participant in team and employee involvement groups. Table 16 and Figure 12 illustrates these relations.

Table 16 : Intersections between importance of education and participating team

			TEAM				
			Very Heaviliy	Heaviliy	Moderately	Slightly	Total
SCNED	Extremely important	Count	8	10	1	2	21
		% of Total	11,0%	13,7%	1,4%	2,7%	28,8%
	Very important	Count	10	14	10	2	36
		% of Total	13,7%	19,2%	13,7%	2,7%	49,3%
	Somewhat important	Count		3	5		8
		% of Total		4,1%	6,8%		11,0%
	Not too important	Count	2	1			3
		% of Total	2,7%	1,4%			4,1%
	Not important	Count	1	1	3		5
		% of Total	1,4%	1,4%	4,1%		6,8%
Total		Count	21	29	19	4	73
		% of Total	28,8%	39,7%	26,0%	5,5%	100,0%

Pearson Chi-Square Test for Association: χ^2=17.728 (p>.05)

There is no statistically significant difference in importance for education for participating team. According to result of my survey, in the firms, most of the employees who are participant for team attaché importance to their educational background within performing their task. As I have mentioned before it is closely related with the type of work. We can connect these relations into the level of using IT component by referring that It components have been used relatively more by workers who are participant for team and who attaches the importance to education. I will represent the cross tabulations about these relation later.

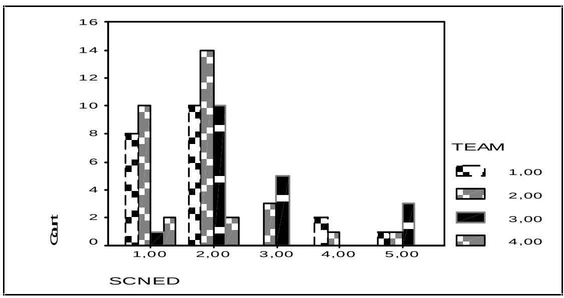

Figure 12 : Intersections between importance of education and participating team

While the similar cross comparison can be done for the quality circles i.e. employee involvement groups, it is impossible to make similar declaration on it. Table 17 and Figure 13 shows that there are dispersed distribution in participating quality circles. Moreover most of the employees do not participate to these meeting. There is no statistically significant difference in importance for education for participating quality circles.

Table 17 : Intersections between importance of education and participating quality circles

			QUALC					
			Never	Always	Usually	Sometimes	Rarely	Total
SCNED	Extremely important	Count	13	3		3	2	21
		% of Total	17,8%	4,1%		4,1%	2,7%	28,8%
	Very important	Count	22	1	5	2	6	36
		% of Total	30,1%	1,4%	6,8%	2,7%	8,2%	49,3%
	Somewhat important	Count	7				1	8
		% of Total	9,6%				1,4%	11,0%
	Not too important	Count	3					3
		% of Total	4,1%					4,1%
	Not important	Count	1	1	2	1		5
		% of Total	1,4%	1,4%	2,7%	1,4%		6,8%
Total		Count	46	5	7	6	9	73
		% of Total	63,0%	6,8%	9,6%	8,2%	12,3%	100,0%

Pearson Chi-Square Test for Association: χ^2=20.742 (p>.05)

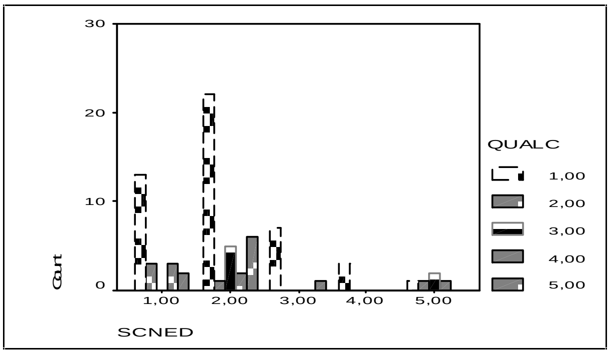

Figure 13: Intersections between importance of education and participating quality circles

The next analysis on HK-WO relations is on the relations between pace/method of the work and level of education/experience. These two measures concern the allocation of decision authority between workers and managers. Table 18, 19, 20, 21 and Figure 14, 15, 16, 17 shows these relations.

Table 18: Intersections between importance of education and pace

			PACE				
			Exclusively Managers	Mostly Managers	Equally	Mostly Workers	Total
EDUC	Graduate	Count		2	9	1	12
		% of Total		2,7%	12,3%	1,4%	16,4%
	Undergraduate	Count	4	4	14	3	25
		% of Total	5,5%	5,5%	19,2%	4,1%	34,2%
	Technical School	Count	10	5	4	1	20
		% of Total	13,7%	6,8%	5,5%	1,4%	27,4%
	High School	Count	6	7	1		14
		% of Total	8,2%	9,6%	1,4%		19,2%
	Less than High School	Count		2			2
		% of Total		2,7%			2,7%
Total		Count	20	20	28	5	73
		% of Total	27,4%	27,4%	38,4%	6,8%	100,0%

Pearson Chi-Square Test for Association: χ^2=32.675 (p<.01) * There is no person who answered section 5 as "exclusively workers"

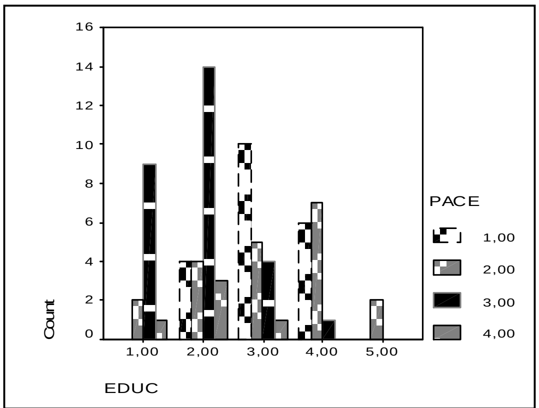

Figure 14: Intersections between education and pace

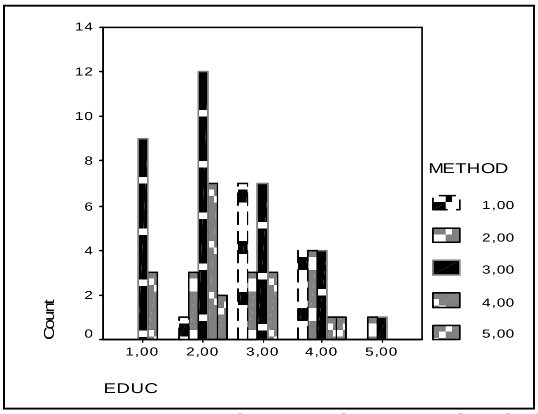

Figure 15: Intersections between education and method

Table 19: Intersections between education and method

			METHOD					
			Exclusively Managers	Mostly Managers	Equally	Mostly Workers	Exclusively Workers	Total
EDUC	Graduate	Count			9	3		12
		% of Total			12,3%	4,1%		16,4%
	Undergraduate	Count	1	3	12	7	2	25
		% of Total	1,4%	4,1%	16,4%	9,6%	2,7%	34,2%
	Technichal School	Count	7	3	7	3		20
		% of Total	9,6%	4,1%	9,6%	4,1%		27,4%
	High School	Count	4	4	4	1	1	14
		% of Total	5,5%	5,5%	5,5%	1,4%	1,4%	19,2%
	Less than High School	Count		1	1			2
		% of Total		1,4%	1,4%			2,7%
Total		Count	12	11	33	14	3	73
		% of Total	16,4%	15,1%	45,2%	19,2%	4,1%	100,0%

Pearson Chi-Square Test for Association: χ^2=24.586 (p>.05)

Table 20: Intersections between experience and pace

			PACE				
			Exclusively Managers	Mostly Managers	Equally	Mostly Workers	Total
EXP	1-5 years	Count	8	9	12	2	31
		% of Total	11,0%	12,3%	16,4%	2,7%	42,5%
	6-10 years	Count	8	6	3	2	19
		% of Total	11,0%	8,2%	4,1%	2,7%	26,0%
	11-15 years	Count	3	3	6		12
		% of Total	4,1%	4,1%	8,2%		16,4%
	16-20 years	Count	1	2	3	1	7
		% of Total	1,4%	2,7%	4,1%	1,4%	9,6%
	21-25 years	Count			4		4
		% of Total			5,5%		5,5%
Total		Count	20	20	28	5	73
		% of Total	27,4%	27,4%	38,4%	6,8%	100,0%

Pearson Chi-Square Test for Association: χ^2=13.356 (p>.05)   * There is no person who answered section 5 as "exclusively workers"

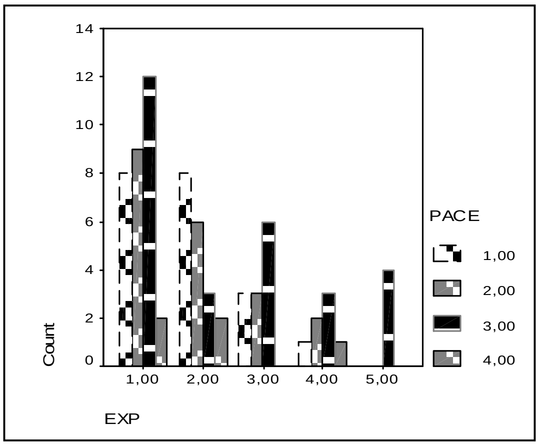

Figure 16: Intersections between experience and pace

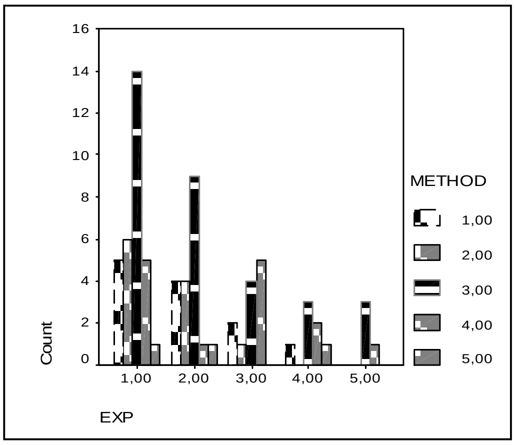

Figure 17: Intersections between experience and method

Table 21: Intersections between experience and method

			METHOD					
			Exclusively Managers	Mostly Managers	Equally	Mostly Workers	Exclusively Workers	Total
EXP	1-5 years	Count	5	6	14	5	1	31
		% of Total	6,8%	8,2%	19,2%	6,8%	1,4%	42,5%
	6-10 years	Count	4	4	9	1	1	19
		% of Total	5,5%	5,5%	12,3%	1,4%	1,4%	26,0%
	11-15 years	Count	2	1	4	5		12
		% of Total	2,7%	1,4%	5,5%	6,8%		16,4%
	15-20 years	Count	1		3	2	1	7
		% of Total	1,4%		4,1%	2,7%	1,4%	9,6%
	21-25 years	Count			3	1		4
		% of Total			4,1%	1,4%		5,5%
Total		Count	12	11	33	14	3	73
		% of Total	16,4%	15,1%	45,2%	19,2%	4,1%	100,0%

Pearson Chi-Square Test for Association: χ^2=13.129 (p>.05)

As it evident from the Tables 18, 19, 20, 21 and Figures 14, 15, 16, 17 more experienced workers are more likely to have initiation about the pace and the method of work. It means that delegated workplace organization has been established on experienced in other words skilled workers. As I expected, a linear relation has seen in the case of having initiation on pace and method of work. To test the monitoring and monotony of workplace, I have also analyzed the measures of obeying the level of supervision. These cross tabulation have been illustrated at Table 22 and Figure 18. There are statistically significant differences in having initiation for different occupations.

Table 22: Intersections between having initiation and occupation

			INIT					
			1,00	2,00	3,00	4,00	5,00	Total
OCCUP	Manager	Count	1	7	1			9
		% of Total	1,4%	9,6%	1,4%			12,3%
	Professional	Count	2	8	9			19
		% of Total	2,7%	11,0%	12,3%			26,0%
	Clerk	Count	1	4	7	2		14
		% of Total	1,4%	5,5%	9,6%	2,7%		19,2%
	Labor	Count	12	3	11	3	2	31
		% of Total	16,4%	4,1%	15,1%	4,1%	2,7%	42,5%
Total		Count	16	22	28	5	2	73
		% of Total	21,9%	30,1%	38,4%	6,8%	2,7%	100,0%

Pearson Chi-Square Test for Association: χ^2=27.811 (p<.01)

INIT;

1. Exclusively I have
2. Mostly I have
3. Seldomly I have
4. The task that I have initiation has no importance for me.
5. Never I have

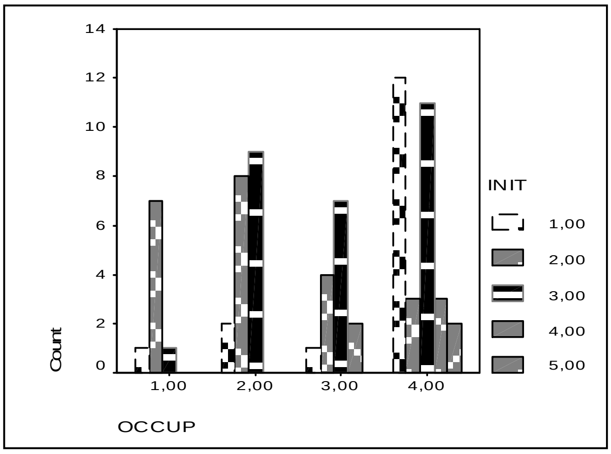

Figure 18: Intersections between importance of education and participating quality circles

It is interestingly cleared at the Table 22 and Figure 18 that having initiation among employees distributed symmetrically. It may result from the skill diffrentiation of labor. Skilled labor who are graduated from Technical Scholl and/or who are experienced having initiation more than unskilled labor. Most of the manager have strong initiation while professinals do not.

As a conclusion, IT use tends to require more skilled workers and more decentralized decision making. The results present significant evidence on the workplace organization of firms and its relation with human capital. Decentralization in decision making and centralization of control are dominant characteristics of my sample. Now, I will examine the final point of my survey as the relations between IT and WO.

5.5.3. Relations between IT and WO

Frequencies for the composite variables of IT can be found in Appendix 2. To measure the composition of IT, I have determined some variables such as, level of computerization and purpose of using computer. There should be expected that there are significant relation between IT and HK and between IT and WO whichever measure of IT was used. Measures of IT show strong relation for the measures of WO while it shows relatively slight relation for the measures of HK. In addition, purpose of using computer is a strong indicator of workplace organization. For example; e-mail use is an important indicator of teams and related practices as well as high level of human capital. This suggests an important role of communication as opposed to automation in driving skill upgrading.

The relationship between participating team and computer usage reflects the distribution for the frequencies of participating team among the persons who use computer or not. Table 23 and Figure 19 include these cross tabulations.

Table 23: Intersections between team and computer usage

			COMPUSG		
			Yes	No	Total
TEAM	Very Heaviliy	Count	16	5	21
		% of Total	21,9%	6,8%	28,8%
	Heaviliy	Count	23	6	29
		% of Total	31,5%	8,2%	39,7%
	Moderately	Count	11	8	19
		% of Total	15,1%	11,0%	26,0%
	Slightly	Count	4		4
		% of Total	5,5%		5,5%
Total		Count	54	19	73
		% of Total	74,0%	26,0%	100,0%

Pearson Chi-Square Test for Association: χ^2=4.441 (p>.05)

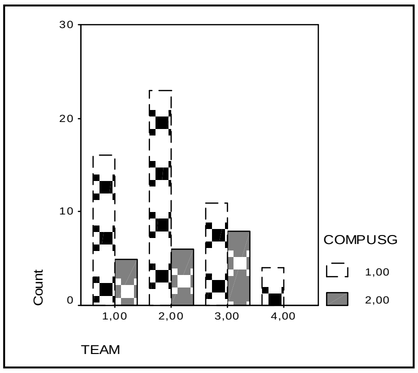

Figure 19: Intersections between team and computer usage

There is no statistically significant difference among groups. It is already expected that using computer as a communication tool is an important part of the team-working activities. As it has been illustrated in the Table 24, 39 per cent of computer users are participant for team working heavily and more than heavily while only 19 per cent of these users are moderately and slightly join to team working activities. It is one of the proof of the complementarities between Information Technology and Workplace Organization. When we look at another comparison between participating team and range of computerization in task, we enhance these complementarities. There is no statistically significant difference between participating team and range of computerization while it is significant for quality circles.

Table 24: Intersections between participating team and range of computerization

			COMPRNG						
			Very Heavily	Heavily	Moderately	Slightly	Almost None	None	Total
TEAM	Very Heavily	Count	9	2	4		2	4	21
		% of Total	12,3%	2,7%	5,5%		2,7%	5,5%	28,8%
	Heavily	Count	13	3	5		3	5	29
		% of Total	17,8%	4,1%	6,8%		4,1%	6,8%	39,7%
	Moderately	Count	7	2	2	1		7	19
		% of Total	9,6%	2,7%	2,7%	1,4%		9,6%	26,0%
	Slightly	Count	3		1				4
		% of Total	4,1%		1,4%				5,5%
Total		Count	32	7	12	1	5	16	73
		% of Total	43,8%	9,6%	16,4%	1,4%	6,8%	21,9%	100,0%

Pearson Chi-Square Test for Association: χ^2=10.538 (p>.05)

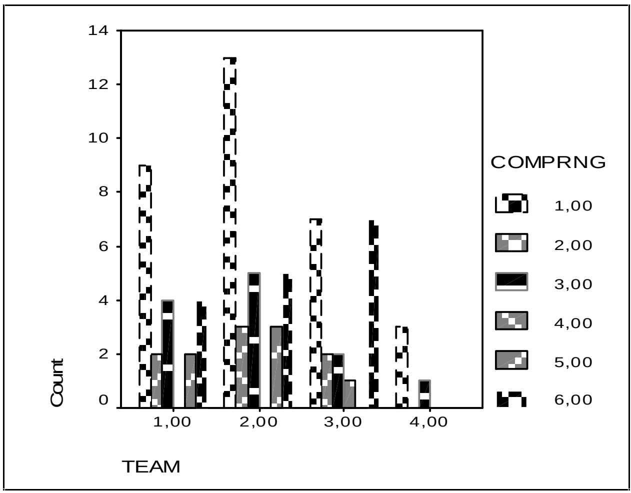

Figure 20 : Intersections between participating team and the range of computerization

36.9 per cent of workers who have computerization in their task very heavily are participant for teamwork activities heavily or very heavily, however there is only 16.4 per cent of workers who are participant for teamwork activities moderately or/and slightly. On the other hand, there is only 19.1 per cent of workers has no or almost none computerization in their task while they are participant for teamwork activities heavily or very heavily. Table 25 and Figure 21 shows these analyzes. Similar descriptions can be held for participating employee involvement groups. Table 26 and Figure 22 at below represent these descriptions.

Table 25: Intersections between participating quality circles and computer usage

			COMPUSG		
			Yes	No	Total
QUALC	Never	Count	41	5	46
		% of Total	56,2%	6,8%	63,0%
	Always	Count	2	3	5
		% of Total	2,7%	4,1%	6,8%
	Usually	Count	3	4	7
		% of Total	4,1%	5,5%	9,6%
	Sometimes	Count	2	4	6
		% of Total	2,7%	5,5%	8,2%
	Rarely	Count	6	3	9
		% of Total	8,2%	4,1%	12,3%
Total		Count	54	19	73
		% of Total	74,0%	26,0%	100,0%

Pearson Chi-Square Test for Association: $\chi^2=17.403$ ($p<.01$)

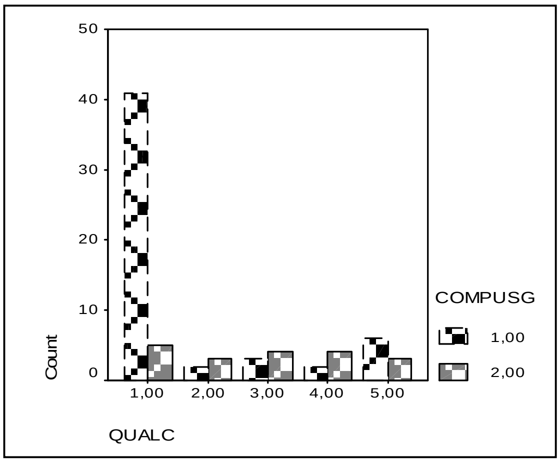

Figure 21 : Intersections between quality circle and
and computer usage

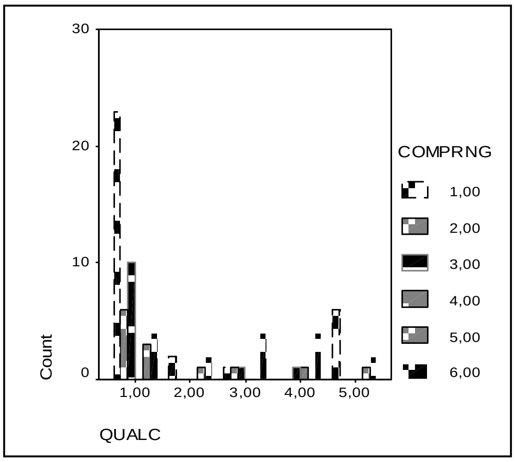

Figure 22: Intersections between quality circle
range of computerization

Table 26: Intersections between participating quality circles and range of computerization

			COMPRNG						
			Very heavily	Heaviliy	Moderately	Slightly	Almost None	None	Total
QUALC	Never	Count	23	6	10		3	4	46
		% of Total	31,5%	8,2%	13,7%		4,1%	5,5%	63,0%
	Always	Count	2				1	2	5
		% of Total	2,7%				1,4%	2,7%	6,8%
	Usually	Count	1	1	1			4	7
		% of Total	1,4%	1,4%	1,4%			5,5%	9,6%
	Sometimes	Count			1	1		4	6
		% of Total			1,4%	1,4%		5,5%	8,2%
	Rarely	Count	6				1	2	9
		% of Total	8,2%				1,4%	2,7%	12,3%
Total		Count	32	7	12	1	5	16	73
		% of Total	43,8%	9,6%	16,4%	1,4%	6,8%	21,9%	100,0%

Pearson Chi-Square Test for Association: χ^2=38.695 ($p<.01$)

Interestingly, it is deficient to make declaration about the distribution of workers who are participant for employee involvement groups within the range of computerization. Most of the workers are not participant for these employee involvement groups. It is negatively affected my expectations on the relationship between IT and WO. It should have been reflected that more decentralized decision making have required more intensive use of computer in terms of IT component to become more communicative and to have sufficient information accumulation. Together with these missing points, to tackle with information overload that resulted from high level of IT capital and HK, employee involvement groups should be useful tool for the managers who are in information bottleneck. In the light of this assumption, I can argue that, workers whose task includes high level of computerization should have exhibited more tendencies to be participant of employee involvement groups.

5.6. Conclusion

I have hypothesized that the demand for skilled labor is related with the cluster of technological change involving not only increased use of IT but also changes in the workplace organization. To test this hypothesis, I have analyzed a company by filling a questionnaire on the attitudes of employees. My analysis suggests that IT use is related with increases in demand for skilled and educated human capital, it is also related with the pattern of work organization involving more decentralized decision making and use of team working activities. On the other hand, it is observed that while IT is a complement for the professionals and managers, it substitutes clerks. Production workers have not presented close relation with IT components. In my sample, any kind of IT has affected the task of production workers, however some workers, especially who are graduates of technical school have shown slight tendency to use IT to accomplish their task in that it requires some type of specific skills. According to Bresnahan (2000), firms which implement only one complement without the others are often less productive than firms which implement none at all. Firms with high levels of some complements are more likely to invest in other complements (Bresnahan et.al. 2000).

Analysis on Şişecam show that firm has high level of IT and high level of human capital especially in recent years. It is impossible to declare similar assumption for the firms' workplace organization policies. When we look at the IT investments of the Şişecam Group of companies, main IT components can be ordered as, CAMNET which is a big network of the company provides to access any kind of permitted information, to access internet, to communicate persons with each others. GROUPWISE is a software for internal exchange of letter and personal agenda at the beginning but in recent year persons in Şişecam use groupwise for e-mail, documentation and shared agenda. Apart from internal ones, 10.000 e-mails are sent in a day while 25.000 e-mails are received. Furthermore, to eliminate the time and location limitations, it is possible to access groupwise by using personal mobile phones. IFOLDER is a program provides the opportunity that person have an ability to access their official computers in the firms where ever they are. EGUIDE is an electronic phonebook which include variety of information about the persons' works in the company together with their e-mail, http, and numerical IP addresses. PHONE system are directly connected to the personal phone book and this system has some functions for proper using such as receiving call identifier and automatic answering machines. FAXES and SMS sending are also possible by using groupwise. TV and VIDEO networks are also established in the company. It is possible to watch video conferences and TV by using personal computers. CALL CENTER provides support for all kinds of problems in IT in the company.

Considering these opportunities provides by IT departments of the company it expected that the range of computerization should be higher for all white collar tasks in terms of communication networks supported by IT. However, especially because of the corporate profile of the company, it is difficult to be flexible in terms of replacement and displacement of workers. For example, the number of the middle managers and clerks in the departments do not show any decrease, although IT components can perform their tasks and are able to substitute them. Much of the tasks are already done by manually despite the fact that it is so easy by using the networks systems. The company gives training to adapt their workforce for using IT opportunities of the firm completely, but habits of the experienced workers have generally showed a tendency through performing the task manually. As a consequence, having high IT investment in the absence of flexible workplace organization does not enough to meet the expected productivity increase of the firm. On the other hand, one of the main indicators of the workplace organization is participating teamwork and employee involvement groups. Higher participation reflects higher delegation and decentralized decision making. In my sample, participating to these activities is lower than I expected. In the absence of empowered workers, it is difficult to displace or replace the workforce for the requirements of the company because of the monotony and rigidity. Another indicator of the workplace organization is about the pace of work and method of work. Results of the survey present workers and managers decided equally pace and method of work. (Statistical data can be found Table 18, 19, 20, 21 and Table F15 and F16 in Appendix V.) Higher empowerment of workers brings together ability for decision making for their own tasks both pace and method of work. As a result, firm might gain an empowered and flexible worker.

Consequently, I found that some empirical evidence is, broadly in conformity, with my hypothesis as well as prior theoretical and empirical work on IT and organization. Related analysis (Bresnahan et.al, 1999) on this subject suggests that IT use is correlated with the increases in the demand for various indicators of human capital and workforce skills. IT use is also correlated with a pattern of work organization involving more decentralized decision-making and greater use of teams. Increases in firms' IT capital stock are associated with the greatest increases in output in firms which also have high levels of human capital or decentralized work organization, or both. However, firms which implement only one complement without the others are often less productive than firms which implement none at all. Firms with high levels of some complements are more likely to invest in other complements.

CHAPTER VI

CONCLUSION

Especially in recent years, microelectronic technology has showed tremendous improvements together with software technology which led to many service operations of firms started to perform by computers. Today, almost all sectors of the economy are using these technologies to achieve successful organizational structure and to survive in competition. Wide spread use of high technologies beginning with the end of 1960s when capitalist economy is in crisis of decreasing profit rate and productivity bring new capital accumulation pattern in order to adopt to changing market conditions. The mass production of Fordism left its place to new flexible systems. Large scale of mass production was not sufficient to provide elastic demand of customers. It was difficult to continue profitability while lacking of supplying customer needs. Flexible systems could be a possible solution for this malfunction. Moreover, vertically integrated mass production systems have lots of control problems to achieve better co-ordination. Production was made by subcontractors and distributed systems of shop floor control where the plant manager contracted internal craftsmen to produce given number of items in a given period of time by using manufacturer’s factory, tool and materials. New technologies have provided some opportunities for controlling and monitoring. It has allowed downward communication and division of labor. Consequently, for most of the large scale firms, decision making was decentralized while control and co-ordination were centralized and flexibility has become a dominant production process by the end of 1970s.

There has been a significant shift towards employing more skilled and educated workers since the beginning of 1980s. It is known that the introduction of a new technological advancement while serving to solve particular problems creates further new ones. Most of the firms experience difficulties to adapt new technologies and associated new systems. The computers, which have an ability to accomplish the repetitive and routine tasks, challenge workers whose tasks are similar by a threat of losing their job and more dangerously their qualifications. On the other side, firms' demand for worker shows a tendency to skilled and educated ones from low skilled workers. These unavoidable changes in the structure of demand cause firms to expense for educated persons with their higher wages. Organizations with higher skilled staff, newer capital, and decentralized work practices have much greater degree of complementarity between IT and Capital. However, most of the technological advances have substituted with physical capital and unskilled labor. Firms consider that technology can also be treated as a complement for labor in the early on 1990s. In many firms, technological advances have shifted production from the factory to continuous process methods. This technical progress that shifts demand towards more highly skilled workers is termed as skill-biased technological change (SBTC). SBTC has founded on demand for more skilled workers who are able to process information. In general, the situation also becomes an increase in wages of these workers.

In this study, rather than affects of SBTC on wages, especially on organization and relations between IT and capital has offered. It is observed that intensive use of IT and organizational changes go together with highly skilled labor. IT investment is directed toward reciprocal organizational transformation. While multi-skilled and empowered production workers are less likely to be replaced by a computer, low skilled workers as a file clerk are more. On the other side, IT is a complement for skilled workers rather than substitute them. I have analyzed the changes in organization in the sense of skill-biased organizational changes with reference to information overload limited substitution and complementarity. Information overload can be described as a bottleneck for processing a great flow of information. Firms needs cognitively high skilled decision makers and well-structured decentralization to process these information productively. Limited substitution basically means that firms can substitute all routine and repetitive tasks with computers apart from decision making. Finally, complementarity includes complementarities between IT - human capital and IT work organization. While complementarity between IT and human capital is generally based on skill and educational composition of workers, complementarity between IT and organization is generally based on delegation of authority and decentralization.

Empirical analysis of this study is based on Turkish Glass Industry. The glass industry is evaluated as a critical sector in worldwide and it is stated that this industry has policy priorities for which preserving sectoral developments because this industry provides inputs to many other industries from construction to beverage. Companies in the glass industry work for increasing productivity, reducing production costs and producing higher value added products to maintain their competitive advantages in the global market. Glass industry is one of the important sector for Turkish Economy with its employment conditions, production capacity and export-oriented abilities, as well as it is in most other countries. Glass industry which is in a faster development trend has always to save for the future to increase production capacity, modernization and investment for innovation. This cause to greater depreciation costs for the firms in glass industry. In Turkish Glass Industry, Şişecam Group of Companies, was formally founded in 1935 with the establishment of Paşabahçe, is the most important producer of glass products. Human capital policies of the firm show a tendency to employ more educated and skilled workforce. High wages in the glass industry relative to other industries in Turkey have been mainly achieved by the 'tough' union, Kristal-İş. One of the reasons for the strength of the union is the fact that the industry requires qualified employees who are usually more inclined to take part in the unions because of the technology-intensive production. As I mentioned in the study, more skilled and more educated workers adapt easily to new technologies than unskilled ones. Moreover, Turkish glass industry has a relatively advantageous position compared to its main competitors in basic and generalized factors with low-cost and good quality raw materials, a very favorable geographical position, low-cost unskilled and semi-skilled labor, and easy access to financial markets. Turkish glass industry has also the advantage of having a large, rapidly growing and dynamic domestic-market. Domestic customers, however, are neither less nor more sophisticated than foreign ones. These conditions in the sector expose firms continually develop their organizational structures and human capital together with improving their technologies in production and service. These characteristic of the glass industry can be assumed as a reason for choosing case to test my hypothesis. Şişecam Group of Companies also reflect the basic characteristics of the contemporary firms in terms management style, strong adherence to the principles of industry and professionalism and its focus on the market and R&D activities.

The main hypothesis of this study is that IT is a complement rather than substitute for other factors of production. In order to establish effective complementarity relations between IT and other factors of production, firms upgrade their workplace organization through a more flexible and more dynamic structure. I believe that having greater use of IT necessitates greater transition in workplace organization and greater level of human capital in order to easily adapt new IT components. To analyze the relations between IT, HK and WO, I have determined some variables which measure the level of these three related factors. Level of IT is reflected by the level of computerization; HK is reflected by the level of education, the level of experience and the level of skill composition; finally WO is reflected by the level of delegation decision-making, the level of empowerment, the level of team-work activities and the employee involvement groups. Detailed formulation can be found at Appendix IV.

I classified my observations in three sections as relations between HK and IT, relations between HK and WO and relations between IT and WO. First of all, the relations between IT and HK should be positively correlated. Firms which are dealing with IT-intensive service operations should employ more educated persons to gain the maximum ability in using IT with all functions. Complementarity between IT and HK leads to information-enabled decentralized workers. In addition to this, complementarity involves use of individual workers who are supported by analytical applications to accomplish the tasks. On the other hand, substitution effects of IT exist in most of the middle managers and clerical workers whose operations can be substituted with computer decision making for human decision making in routine tasks. According to results of the survey and my observations, Şişecam is an IT-intensive firm in terms of having greater investment of IT and well-designed and developed networks for proper use of IT established in the company. At the same time, Şişecam has been trying to renew their workforce with educated and skilled workers and by offering training, firm wants to gain fluent users of IT from its workforce. However, most of the persons work in departments use IT for a narrow and specific works, while they have a chance to get the any kinds of information they need by the way of networks of the company. Although having training for adapting new technologies, experienced workers in the firm has still continue to perform their task by using old styles and habits instead using new opportunities. For example, while it is possible to access the data about the workforce statistics of the company in 1991 by using group network and online databases of the company, workers continue to use phone to contact the other workers in human resources department of the company to ask for the data on papers. The firm experiences some difficulties to reduce the number of workers in departments to be more productive since the workers are not well-suited for multi-tasking. According to my view, new generations of workforce especially who lives in information-age change this sequence because they have great tendency to perform their work by using IT components.

The second analysis is about the relations between IT and HK. To enable better accumulation of knowledge, firm has been investing in the IT components with the expectation of faster and delegated decision-making capabilities. Transition of workplace organization is supposed as only way to achieve this decentralized decision making and empowerment. According to statistical outputs of measures of workplace organization, firm should attach more importance on this transition considerably by promoting for team-work activities, extensive use of empowered workers to delegate decision making. Although the results of the survey show that decisions on pace and method of work has been given equally between managers and workers, it is not totally reflecting the real situation of firm. Workers perform their tasks automatically through the favorable procedures as if they work in the Fordist production system.

In summary, investing one complement (IT, HK, WO) without the others might be wrong choices for some firms demanding increase the productivity. Increases in firms' IT capital stock are associated with the greatest increases in output in firms which also have high levels of human capital or decentralized work organization, or both. Firms with high levels of some complements are more likely to invest in other complements. When recent tendencies toward skill-biased technical change have been continuing, IT prices will continue to fall and IT performance will continue to improve.

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APPENDICES

APPENDIX A

The relative supply of college graduates

The data used in this paper come from the March Current Population Surveys for the years 1968 through 1997. Individuals within the datasets were assigned to cells defined by education (less than 12, 12, 12-15, and 16 or more years of schooling) and the year of the survey.

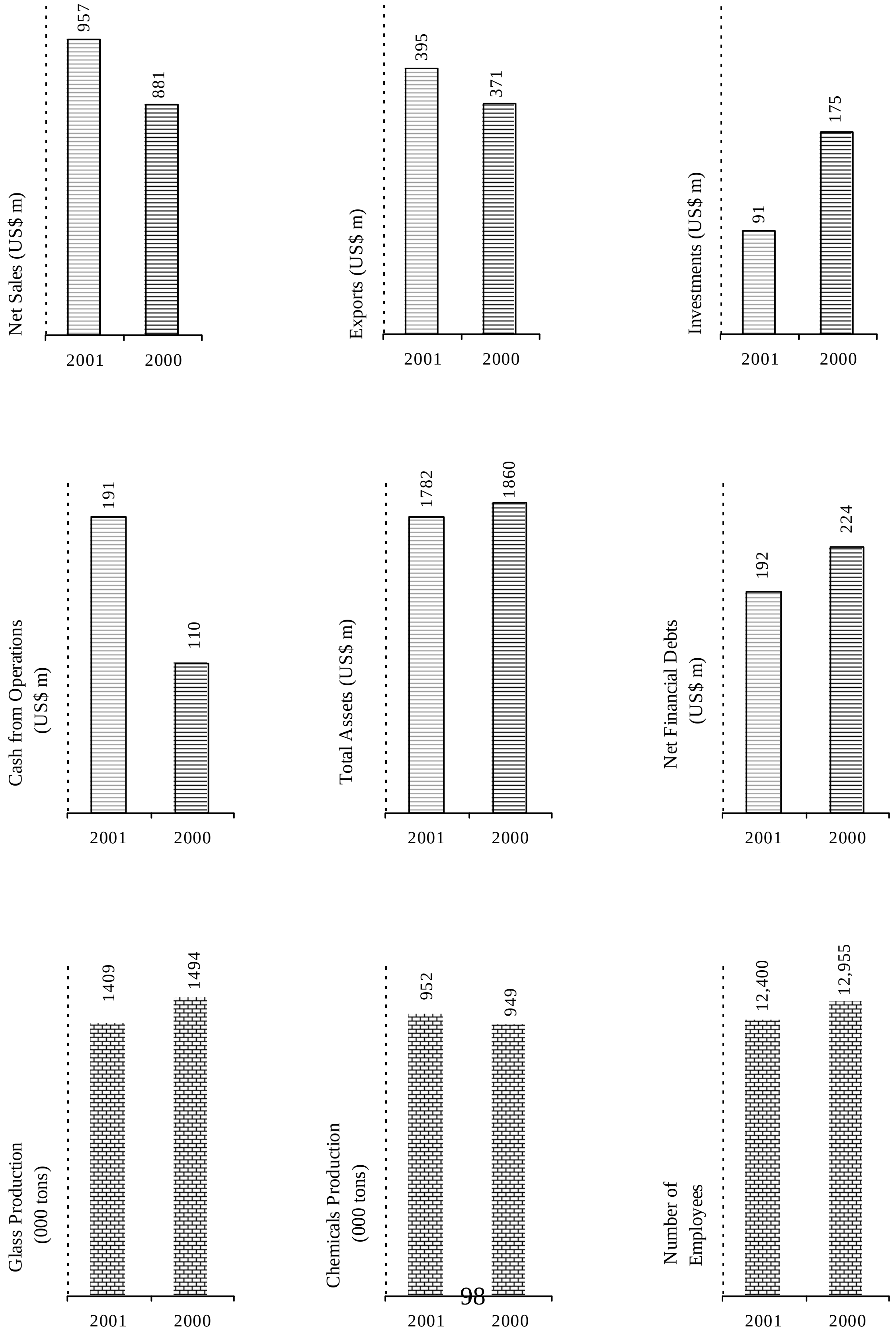
The weekly wage data are constructed from a subset of the entire sample consisting of employees who worked at least one week in the preceding year, were in the labour force for at least 39 weeks, and were full-time employees. Workers whose real weekly earnings were below $67 in 1982 dollars were excluded. Survey respondents who were self-employed or worked without pay were also removed. The average weekly earnings was found by dividing total earnings by weeks worked last year. For the years 1964 to 1975 the number of weeks worked was recorded in seven brackets. To impute the weeks worked for these years, the mean of the weeks worked for the later years was found for a total of 14 cells defined by sex and the seven brackets used in the earlier survey years. These means were then applied to the corresponding cells in the 1964 to 1975 survey years.

Total hours worked was computed for each cell by using a subset of the entire sample which includes all employees who worked at least one week in the preceding year. There were no restrictions in this sample for the self-employed or for those who worked without pay. Total hours is equal to the product of weeks worked, usual weekly hours, and the March supplement sample weight for each individual. For the survey years 1964 to 1975, the usual weekly hours variable was not available. Hours worked last week was used as a substitute for usual hours for all individuals who worked during the previous week. For those who did not work during the week preceding the survey, the mean of hours worked last week for individuals with the same sex and full-time/part-time status who worked at least one hour during the previous week in the same survey year were substituted.

The relative supply of college graduates in Figure 1a is the ratio of those with 16 or more years of schooling to those with less schooling.

APPENDIX B

Financial Highlights of Şişecam (Source: Şişecam, Annual Report, 2001)



APPENDIX C

Measures of Key Variables

	N	Range	Maximum	Variable	Mean	Std. Deviation
Level of Education	73	1 - 5	5	EDUC	2,575	1,0661
Screen for Education	73	1 - 5	5	SCNED	2,110	1,0873
Experience in Sector	73	1 - 5	5	PREEMP	2,685	1,2119
Experience in Company	73	1 - 5	5	DUREMP	2,479	1,1798
Classification of Emloyees	73	1 - 4	4	OCCUP	2,918	1,0898
Experience in Task	73	1 - 5	5	EXP	2,096	1,2152
Level of Promotion	73	1 - 2	2	PROEXP	1,260	0,4418
Level of Work-related Training	73	1 - 2	2	SPTRAIN	1,329	0,4730
Screen for Education	73	1 - 2	2	TRAIN	1,425	0,4977
Having Specific Skill	73	1 - 2	2	CSKILL	1,630	0,5139
Level of Teamwork	73	1 - 4	4	TEAM	2,082	0,8780
Promote by Teamwork	73	1 - 2	2	PROTEAM	1,288	0,4558
Level of Employee Involvement Groups	73	1 - 5	5	QUALC	2,000	1,4814
Screen for Obeying Standard Regulations	73	1 - 5	5	STDREG	2,000	0,8333
Screen for Deciding Pace of Work	73	1 - 4	4	PACE	2,233	0,9649
Screen for Deciding Method of Work	73	1 - 5	5	METHOD	2,795	1,0667
Screen for Having Initiation	73	1 - 5	5	INIT	2,384	0,9948
Screen for Using Computer to Accomplish the Task	73	1 - 2	2	COMPUSG	1,260	0,4418
Level of Computerization	73	1 - 6	6	COMPRNG	2,836	2,0345
Level of Differentiation in the Way of Performing Task	73	1 - 5	5	COMTSK	3,438	1,3843
Level of Differentiation in the Repetitive Tasks	73	1 - 5	5	COMPRPT	3,671	1,0281
Level of Differentiation in the Need for Controlling	73	1 - 5	5	COMPND	3,425	1,3836
Level of Differentiation in the Ability for Controlling	73	1 - 5	5	COMPABL	3,096	1,5381
Level of Monotony	73	1 - 5	5	COMPMON	3,548	1,1907
Level of Automation	73	1 - 3	3	TASKLFT	1,890	0,6138
Level of Supervision	73	1 - 3	3	CONTCHCK	1,767	1,0072
Level of Computer Usage for Data Input	73	1 - 2	2	COMPDATA	1,603	0,4927
Level of Computer Usage for Supervising Stock	73	1 - 2	2	COMPCHK	1,918	0,2766
Level of Computer Usage to Communicate	73	1 - 2	2	COMPMAIL	1,671	0,4730
Level of Computer Usage to Design	73	1 - 2	2	COMPDSG	1,932	0,2543
Level of Computer Usage to Accumlate Information	73	1 - 2	2	COMPNET	1,726	0,4491
Level of Computer Usage for General Purposes	73	1 - 2	2	COMPGEN	1,699	0,4620
Level of Computer Usage for Other Purposes	73	1 - 2	2	COMPOTH	1,918	0,2766

APPENDIX D

Definition of Composite Variables

Human Capital	HK	preemp + duremp + exp + cskill + educ + educ + scned + train + sptrain
Workplace Organization	WO	proexp + team + proteam + qualc + pace + stdreg + method + init + tasklft + contchck
Information Technology	IT	compusg + compdata + compchk + compmail + compdsg + compnet + compgen + compoth + comptsk + comprpt + compnd + compabl + compmon

APPENDIX E

Frequenceis of Variables

Variable name: ***educ***

Level of Education

1. Graduate Degree
2. Undergraduate Degree
3. Technichal School
4. High School
5. Less than High School

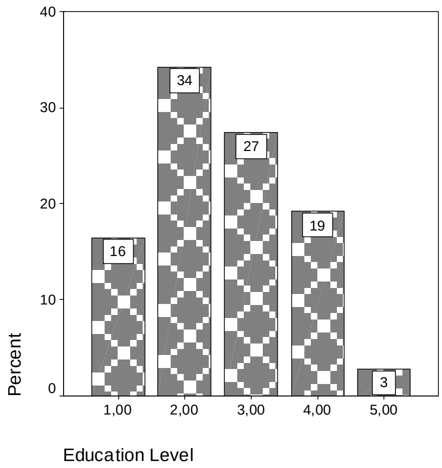


Figure F1 : Frequencies for the level of education

Table F1 : Frequency table for the level of education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	12	16,4	16,4	16,4
	2,00	25	34,2	34,2	50,7
	3,00	20	27,4	27,4	78,1
	4,00	14	19,2	19,2	97,3
	5,00	2	2,7	2,7	100,0
	Total	73	100,0	100,0	

I have classified employees in such categories as their occupation and subcompanies for which they work. These categories will be given detailed later but it is important to remember the number of employees who ansvered my questions (Table FFFX) for each classification. Despite the fact that this variable (educ) does not reflect the level of education for Sisecam Group of Companies, it reflects the level of education for my sample. It should be taken into considerition that more than 50 per cent of employees have higher education.

Variable name: ***scned***

Importance of education for task

1. Extremely important
2. Very important
3. Somewhat important
4. Not too important
5. Not at all important

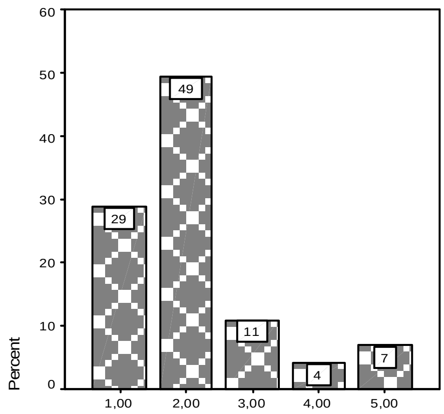


Figure F2 : Frequencies for the importance of education

Table F2 : Frequencies for the importance of education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	21	28,8	28,8	28,8
	2,00	36	49,3	49,3	78,1
	3,00	8	11,0	11,0	89,0
	4,00	3	4,1	4,1	93,2
	5,00	5	6,8	6,8	100,0
	Total	73	100,0	100,0	

Higher level of importance of education to accomplish the task refers that rather than learning by doing, employees use their past knowledge and experience together with their skill in terms of using their own creative capacity. When their capabilities coupled their working conditision in firm, workers shows higher tendency to have some responsiblities.

Variable name: ***preemp***

Preemployment screen for the sector

1. 1-5 years
2. 6-10 years
3. 11-15 years
4. 16-20 years
5. 21-25 years

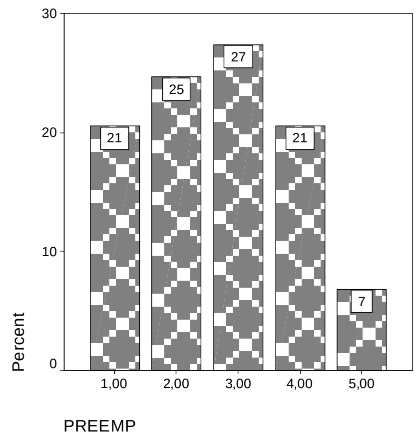


Figure F3 : Frequencies for preemployment screen for the sector

Table F3 : Frequencies for the importance of education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	15	20,5	20,5	20,5
	2,00	18	24,7	24,7	45,2
	3,00	20	27,4	27,4	72,6
	4,00	15	20,5	20,5	93,2
	5,00	5	6,8	6,8	100,0
	Total	73	100,0	100,0	

The answers for this question represent both the avarege for past experiences of workforce and the skill composition which resulted from working the same sector. According to my observations and to my face to face interviews, I have founded that the most of the workers whose past experience in this sector is less than 5 years has started to work for Şişecam newly as being first reputable work in their working life.

Variable name: ***duremp***

Screen for experience in the company

1. 1-5 years
2. 6-10 years
3. 11-15 years
4. 16-20 years
5. 21-25 years

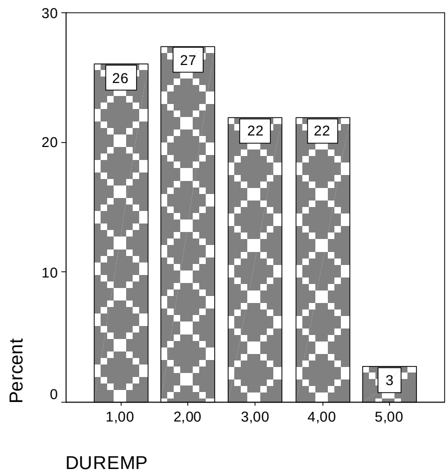


Figure F4 : Frequencies for the experience in the company

Table F4 : Frequencies for the experience in the

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	19	26,0	26,0	26,0
	2,00	20	27,4	27,4	53,4
	3,00	16	21,9	21,9	75,3
	4,00	16	21,9	21,9	97,3
	5,00	2	2,7	2,7	100,0
	Total	73	100,0	100,0	

Variable name: ***occup***

Screen for occupation

1. Manager
2. Professional
3. Clerk
4. Worker

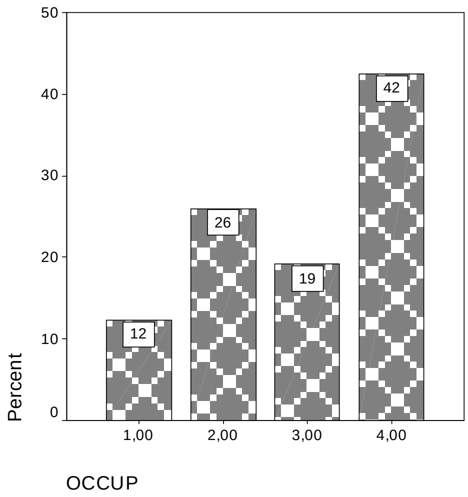


Figure F5 : Frequencies for occupation

Table F5 : Frequencies for occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	9	12,3	12,3	12,3
	2,00	19	26,0	26,0	38,4
	3,00	14	19,2	19,2	57,5
	4,00	31	42,5	42,5	100,0
	Total	73	100,0	100,0	

Variable name: ***exp***

Screen for experience in task

1. 1-5 years
2. 6-10 years
3. 11-15 years
4. 16-20 years
5. 21-25 years

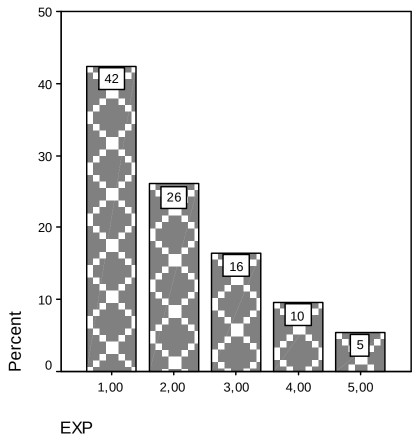


Figure F6 : Frequencies for experience in task

Table F6 : Frequencies for experience in task

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	31	42,5	42,5	42,5
	2,00	19	26,0	26,0	68,5
	3,00	12	16,4	16,4	84,9
	4,00	7	9,6	9,6	94,5
	5,00	4	5,5	5,5	100,0
	Total	73	100,0	100,0	

Variable name: ***proexp***

Screen for promotion

1. Yes
2. No

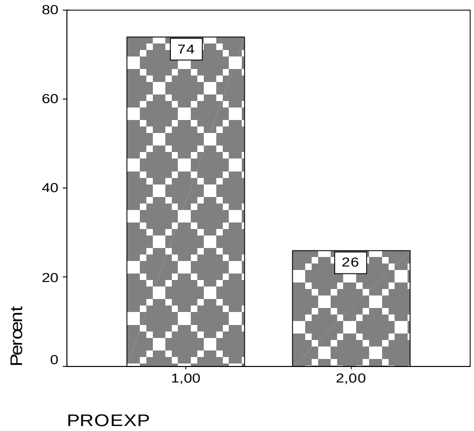


Figure F7 : Frequencies of screen for promotion

Table F7 : Frequencies of screen for promotion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	54	74,0	74,0	74,0
	2,00	19	26,0	26,0	100,0
	Total	73	100,0	100,0	

Variable name: ***sptrain***

Screen for level of work related training

1. Yes
2. No

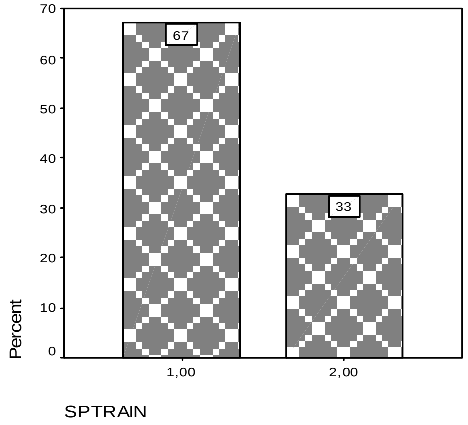


Figure F8 : Frequencies of level of work related training

Table F8 : Frequencies of level of work related training

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	49	67,1	67,1	67,1
	2,00	24	32,9	32,9	100,0
	Total	73	100,0	100,0	

Variable name: ***train***

Screen for level of training

1. Yes
2. No

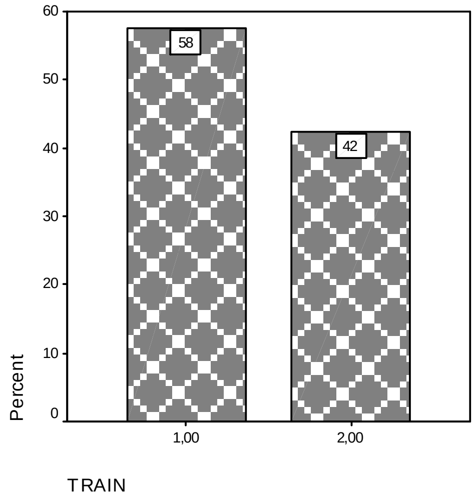


Figure F9 : Frequencies of level of training

Table F9 : Frequencies of level of training

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	42	57,5	57,5	57,5
	2,00	31	42,5	42,5	100,0
	Total	73	100,0	100,0	

Variable name: ***cskill***

Screen for specific skill for the task

1. Yes
2. No

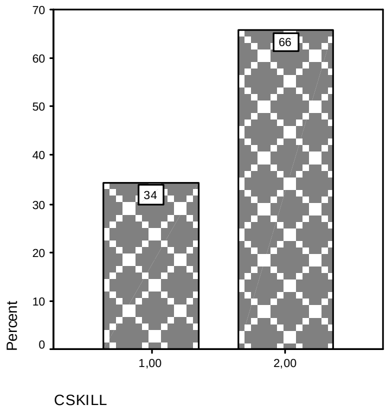


Figure F10 : Frequencies of specific skill for the task

Table F10 : Frequencies of specific skill for te task

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	25	34,2	34,2	34,2
	2,00	48	65,8	65,8	100,0
	Total	73	100,0	100,0	

Variable name: ***team***

Screen for level of teamwork activities

1. Very Heaviliy
2. Heaviliy
3. Moderately
4. Slightly

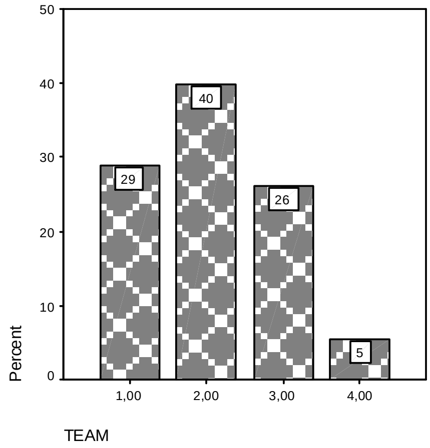


Figure F11 : Frequencies for level of teamwork activities

Table F11 : Frequencies for level of teamwork activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	21	28,8	28,8	28,8
	2,00	29	39,7	39,7	68,5
	3,00	19	26,0	26,0	94,5
	4,00	4	5,5	5,5	100,0
	Total	73	100,0	100,0	

Variable name: ***proteam***

Screen for promotion by joining teamwork activities

1. Yes
2. No

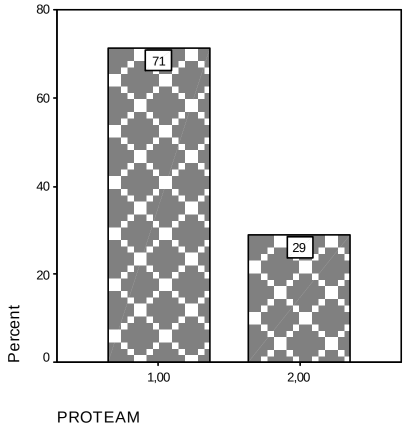


Figure F12 : Frequencies for promotion by joining teamwork activities

Table F12 : Frequencies for level of teamwork activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	52	71,2	71,2	71,2
	2,00	21	28,8	28,8	100,0
	Total	73	100,0	100,0	

Variable name: ***qualc***

Screen for joining employee involvement groups

1. Never
2. Always
3. Usually
4. Sometimes
5. Rarely

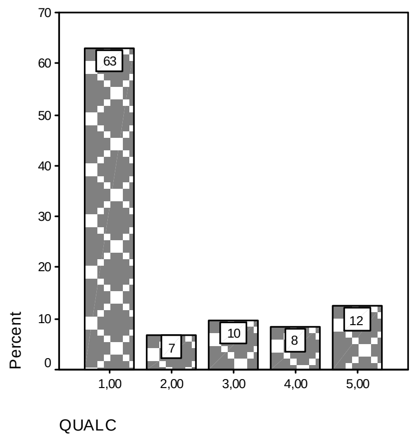


Figure F13 : Frequencies joining employee involvement groups

Table F13 : Frequencies for joining employee involvement groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	46	63,0	63,0	63,0
	2,00	5	6,8	6,8	69,9
	3,00	7	9,6	9,6	79,5
	4,00	6	8,2	8,2	87,7
	5,00	9	12,3	12,3	100,0
	Total	73	100,0	100,0	

Variable name: ***stdreg***

Screen for obeying standard regulations

1. Always obeyed
2. Usually obeyed
3. Sometimes obeyed
4. Rarely obeyed
5. Never obeyed

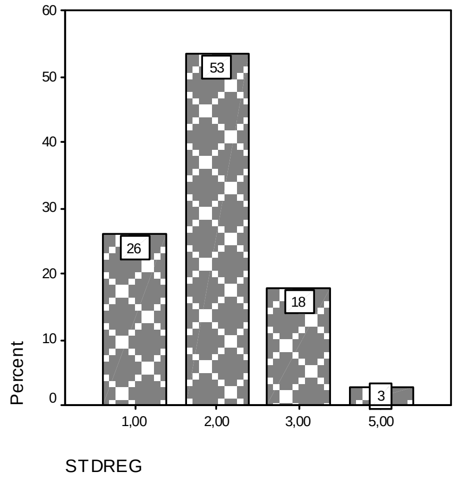


Figure F14 : Frequencies obeying standard regulatons

Table F14 : Frequencies obeying standard regulatons

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	19	26,0	26,0	26,0
	2,00	39	53,4	53,4	79,5
	3,00	13	17,8	17,8	97,3
	5,00	2	2,7	2,7	100,0
	Total	73	100,0	100,0	

Variable name: ***pace***

Screen for deciding pace of work

1. Exclusively managers
2. Mostly managers
3. Equally
4. Mostly workers
5. Exclusively workers

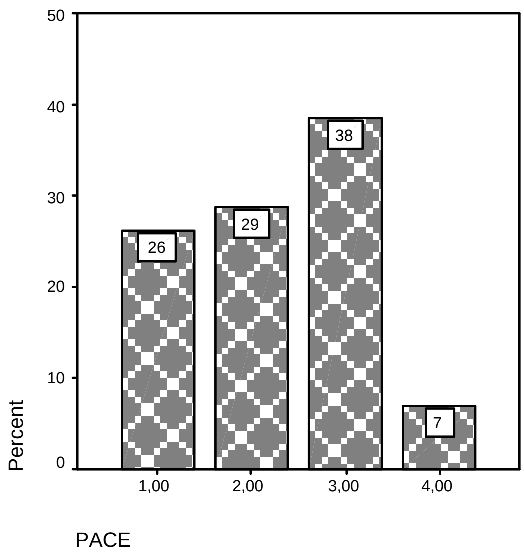


Figure F15 : Frequencies for deciding pace of work

Table F15 : Frequencies for deciding pace of work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	,00	1	1,4	1,4	1,4
	1,00	19	26,0	26,0	27,4
	2,00	20	27,4	27,4	54,8
	3,00	28	38,4	38,4	93,2
	4,00	5	6,8	6,8	100,0
	Total	73	100,0	100,0	

Variable name: ***method***

Screen for deciding pace of work

1. Exclusively managers
2. Mostly managers
3. Equally
4. Mostly workers
5. Exclusively workers

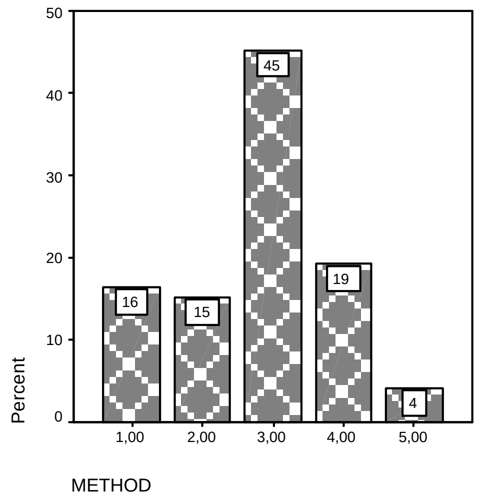


Figure F16 : Frequencies for deciding method of work

Table F16 : Frequencies for deciding pace of work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	12	16,4	16,4	16,4
	2,00	11	15,1	15,1	31,5
	3,00	33	45,2	45,2	76,7
	4,00	14	19,2	19,2	95,9
	5,00	3	4,1	4,1	100,0
	Total	73	100,0	100,0	

Variable name: ***init***

Screen for having initiation

1. Exclusively I have
2. Mostly I have
3. Seldomly I have
4. The task that I have initiation has no importance for me.
5. Never I have

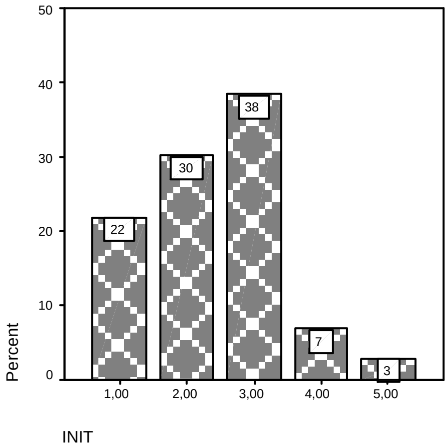


Figure F17 : Frequencies of having initiation

Table F17 : Frequencies of having initiation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	16	21,9	21,9	21,9
	2,00	22	30,1	30,1	52,1
	3,00	28	38,4	38,4	90,4
	4,00	5	6,8	6,8	97,3
	5,00	2	2,7	2,7	100,0
	Total	73	100,0	100,0	

Variable name: ***compusg***

Screen for using computer to accompish the task

1. Yes
2. No

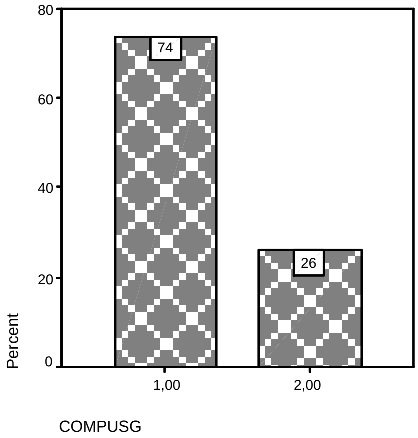


Figure F18 : Frequencies of using computer to accompish the task

Table F18 : Frequencies of using computer to accompish the task

		Frequenc y	Percent	Valid Percent	Cumulative Percent
Valid	1,00	54	74,0	74,0	74,0
	2,00	19	26,0	26,0	100,0
	Total	73	100,0	100,0	

Variable name: ***comprng***

Screen for the level of computerization

1. Very heavily
2. Heaviliy
3. Moderately
4. Slightly
5. Almost never

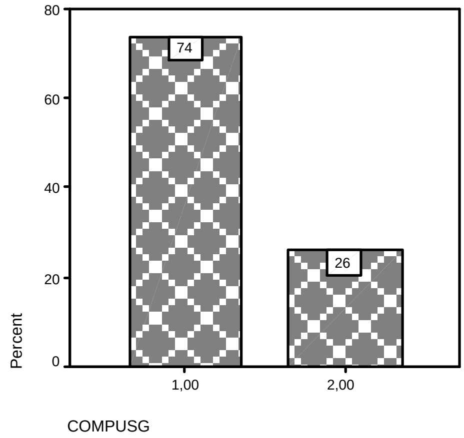


Figure F19 : Frequencies for the level of computerization

Table F19 : Frequencies for the level of computerization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	32	43,8	43,8	43,8
	2,00	7	9,6	9,6	53,4
	3,00	12	16,4	16,4	69,9
	4,00	1	1,4	1,4	71,2
	5,00	5	6,8	6,8	78,1
	6,00	16	21,9	21,9	100,0
	Total	73	100,0	100,0	

Variable name: ***comprp***

Screen for the purpose of using computer

1. Data storage/collecting
2. Controlling product and/or stock
3. Communication
4. Design
5. Information accumulation
6. General purposes
7. Other purposes

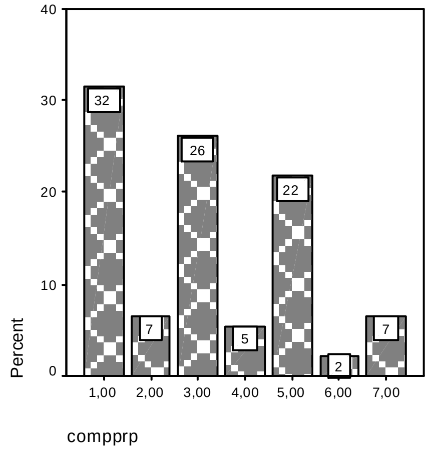


Figure F20 : Frequencies for the purpose of using computer

Table F20 : Frequencies for the purpose of using computer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	29	31,2	31,5	31,5
	2,00	6	6,5	6,5	38,0
	3,00	24	25,8	26,1	64,1
	4,00	5	5,4	5,4	69,6
	5,00	20	21,5	21,7	91,3
	6,00	2	2,2	2,2	93,5
	7,00	6	6,5	6,5	100,0
	Total	92	98,9	100,0	
Missing	System	1	1,1		
Total		93	100,0		

The number of observation is 93 because some of the employees who answered my questionaire selected more than one section for this question.

Variable name: ***comtsk***

Screen for the level of differentiation

in the way of performing tasks

1. Completely changed
2. Heavily changed
3. Moderately changed
4. Slightly changed
5. Never changed

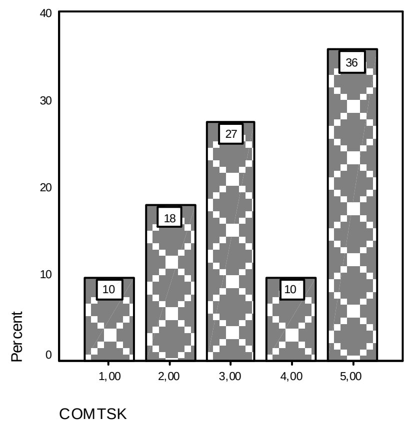


Figure F21 : Frequencies forthe differentiation in the way of performing tasks

Table F21 : Frequencies for the level of differentiation in the way of performing tasks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	7	9,6	9,6	9,6
	2,00	13	17,8	17,8	27,4
	3,00	20	27,4	27,4	54,8
	4,00	7	9,6	9,6	64,4
	5,00	26	35,6	35,6	100,0
	Total	73	100,0	100,0	

Variable name: ***comprpt***

Screen for the level of differentiation in the repetitive tasks

1. Completely changed
2. Heavily changed
3. Moderately changed
4. Slightly changed
5. Never changed

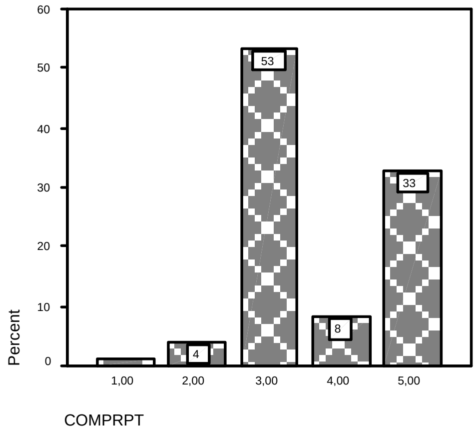


Figure F22 : Frequencies for the level of differentiation in the repetitive tasks

Table F22 : Frequencies for the level of differentiation in the repetitive tasks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	1	1,4	1,4	1,4
	2,00	3	4,1	4,1	5,5
	3,00	39	53,4	53,4	58,9
	4,00	6	8,2	8,2	67,1
	5,00	24	32,9	32,9	100,0
	Total	73	100,0	100,0	

Variable name: ***compnd***

Screen for the level of differentiation

in the need for controlling

1. Greatly increased
2. Increased
3. Decreased
4. Greately decreased
5. No change

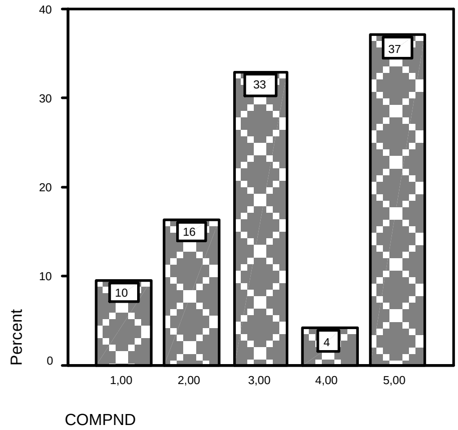


Figure F23 : Frequencies for the level of differentiation in the need for controlling

Table F23 : Frequencies for the level of differentiation in the need for controlling

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	7	9,6	9,6	9,6
	2,00	12	16,4	16,4	26,0
	3,00	24	32,9	32,9	58,9
	4,00	3	4,1	4,1	63,0
	5,00	27	37,0	37,0	100,0
	Total	73	100,0	100,0	

Variable name: ***compabl***

Screen for the level of differentiation
in the ability for controlling

1. Greatly increased
2. Increased
3. Decreased
4. Greately decreased
5. No change

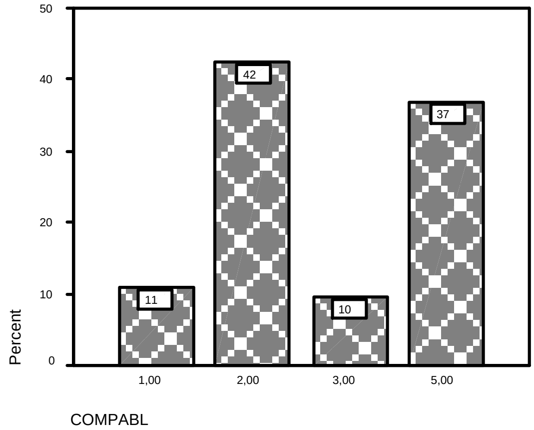


Figure F24 : Frequencies for the level of differentiation in the ability for controlling

Table F24 : Frequencies for the level of differentiation in the ability for controlling

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	8	11,0	11,0	11,0
	2,00	31	42,5	42,5	53,4
	3,00	7	9,6	9,6	63,0
	5,00	27	37,0	37,0	100,0
	Total	73	100,0	100,0	

Variable name: ***compmon***

Screen for the level of monotony

1. Greatly increased
2. Increased
3. Decreased
4. Greately decreased
5. No change

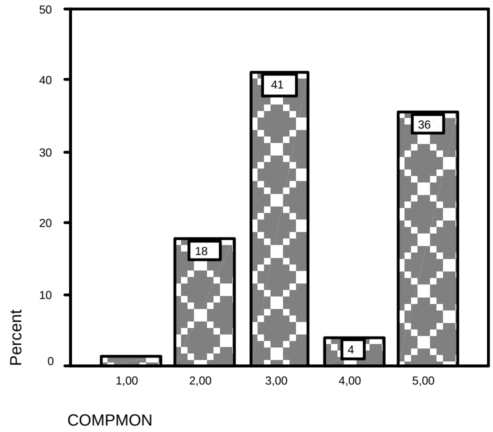


Figure F25 : Frequencies for the level of monotony

Table F25 : Frequencies for the level of monotony

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	1	1,4	1,4	1,4
	2,00	13	17,8	17,8	19,2
	3,00	30	41,1	41,1	60,3
	4,00	3	4,1	4,1	64,4
	5,00	26	35,6	35,6	100,0
	Total	73	100,0	100,0	

Variable name: ***tasklft***

Screen for the level of automation

1. Greatly increased
2. Increased
3. Decreased
4. Greately decreased
5. No change

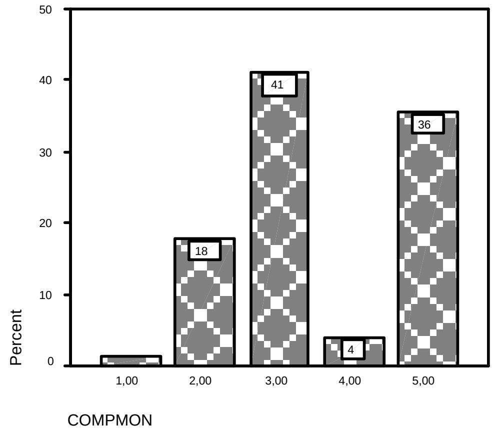


Figure F26 : Frequencies for the level of automation

Table F26 : Frequencies for the level of automation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	,00	1	1,4	1,4	1,4
	1,00	15	20,5	20,5	21,9
	2,00	48	65,8	65,8	87,7
	3,00	9	12,3	12,3	100,0
	Total	73	100,0	100,0	

Appendix F

Survey Questions

6. What is your educational level?
    1. Graduate Degree
    2. Undergraduate Degree
    3. Technichal School
    4. High School
    5. Less than High School

7. Would you say your educational background is
    1. Extremely important
    2. Very important
    3. Somewhat important
    4. Not too important
    5. Not at all important

8. How long have you been working in this sector?
    1. 1-5 years
    2. 6-10 years
    3. 11-15 years
    4. 16-20 years
    5. 21-25 years

9. How long have you been working in this company?
    1. 1-5 years
    2. 6-10 years
    3. 11-15 years
    4. 16-20 years
    5. 21-25 years

10. What is your occupation?
    1. Manager
    2. Professional
    3. Clerk
    4. Labor
    5. other

11. How long have you been working in this position?
    1. 1-5 years
    2. 6-10 years
    3. 11-15 years
    4. 16-20 years
    5. 21-25 years

12. Have you ever been promoted since you began to work here?
    1. Yes

2. No

13. Have you ever received any work-related training?
    1. Yes
    2. No

14. Did you receive any kinds of training in last year?
    1. Yes
    2. No

15. Do you perform this task because of the fact that you have specific skill?
    1. Yes
    2. No

16. Do you participate in teamwork activities?
    1. Very Heaviliy
    2. Heaviliy
    3. Moderately
    4. Slightly

17. Is participating in teamwork activities important factor for promotion?
    1. Yes
    2. No

18. Do you participate in employee imvolvement groups?
    1. Never
    2. Always
    3. Usually
    4. Sometimes
    5. Rarely

19. What would you say about obeying the standard regulations in your firm?
    1. Always obeyed
    2. Usually obeyed
    3. Sometimes obeyed
    4. Rarely obeyed
    5. Never obeyed

20. Who sets the pace of work?
    1. Exclusively managers
    2. Mostly managers
    3. Equally
    4. Mostly workers
    5. Exclusively workers

21. Who decides how the task should be accomplished?
    1. Exclusively managers

2. Mostly managers
3. Equally
4. Mostly workers
5. Exclusively workers

22. Which one is true for having initiation?
    1. Exclusively I have
    2. Mostly I have
    3. Seldomly I have
    4. The task that I have initiation has no importance for me.
    5. Never I have

23. Do you use computer in your work?
    1. Yes
    2. No

24. What would you say that the range of computerization in your task?
    1. Very heavily
    2. Heaviliy
    3. Moderately
    4. Slightly
    5. Almost never

25. What is/are the main purpose(s) to use computer for your duties?
    1. Data storage/collecting
    2. Controlling product and/or stock
    3. Communication
    4. Design
    5. Information accumulation
    6. General purposes
    7. Other purposes :____

26. Is there any differentiation in the way of performing your task by results of computerization?
    1. Completely changed
    2. Heavily changed
    3. Moderately changed
    4. Slightly changed
    5. Never changed

27. What would you say about repetitive works in your task after computerization?
    1. Greatly increased
    2. Increased
    3. Decreased
    4. Greately decreased

5. No change

28. What would you say about the necessities of controlling work after computerization?
    1. Greatly increased
    2. Increased
    3. Decreased
    4. Greately decreased
    5. No change

29. What would you say about the abilities of controlling work after computerization?
    1. Greatly increased
    2. Increased
    3. Decreased
    4. Greately decreased
    5. No change

30. How computerization has affected autonomy of working life?
    1. Greatly increased
    2. Increased
    3. Decreased
    4. Greately decreased
    5. No change

31. Can you leave from your work?
    1. Never
    2. Sometimes
    3. Whenever I want
    4. No comment

32. What would you say about supervision and controlling mechanism of firm since you have started to work here?
    1. Increased
    2. Decreased
    3. No change
    4. No comment

Table 1: Early information technology: innovation characteristics of (the most important technologies of the IT Regime[1]

TECHNOLOGY	USERSIDE			SUPPLY SIDE	
	*Effect on **established** competencies, i.e. clerical work before IT Regime*	*New **professions***	***Required skills***	***Characteristics** of dominant design*	*Incremental improvements / trajectory*
Typewriter	Replacement of copyists	Typist; establishment of typing pools.	Touch typing (round 60 words a minute), shorthand writing at least 60-75 words a minute (partly replaced by Dictaphones), good language and grammar skills, letter writing ability. High school degree preferred. Training period: approx.250-400 hours	Front stroke types. QWERTY keyboard. Shift key.	Reduction of typing effort and increase of possible typing speed (electrical typewriters), noise (noiseless typewriters) and size (portable typewriters - but mostly for non-business uses)
Adding and Calculating machines	Replacement of mathematical skills	In large enterprises Comptometer or adding machine operators; used in funclionalised book-keeping, sales or billing departments also on sporadic base. Establishment of computation pools	Machine use Touch typing Training period: ???	Large number of application domains --no clear dominant design. Two main principles: adding machines based only on the operation of addition. Calculators that could perform four basic operations. Full keyboards and ten key keyboards.	Size. user interface (ease of touch), electric movements, automatic entry controls. available mathematical operations
Book-keeping machines	Replacement of book-keepers (mathematical skills, bookkeeping skills replaced through different work preparation)	None; used in functionalized book-keeping departments (i.e. by operators who have to have simple double-entry bookkeeping skills but do not need to know balance sheet analysis or budgeting methods) which took also the form of bookkeeping pools.	Machine use. Training period: accounting clerks with double-entry skills two weeks.	Several niche application domains for large scale and back office processing; no clear dominant design. Interface depending on the base machine, i.e. typewriter, calculator or cash-register.	
Hollerith - Powers systems (card punch, sorter. tabulator, and collator)	Replacement of mathematical and statistical skills; sorting and indexing tasks.	Card Puncher Sorter Tabulator Programmer; Establishment of card punch units, and machine rooms.	Puncher: in some cases typing skills mostly not; primary school degree No further skills needed. "I 'mining period: 1-4 month Sorter: No special skills, but strong physical constitution required; primary School degree. Training period round 6 month. Tabulator: secondary school degree and technical skills. Training period: 1.5 to 2 years Programmer: organizational skills, business skills; preferably university degree in mathematics or a technical discipline Training period: 4 years.	Punched cards as data and as program memory, punch, sort and tabulate process, electric contact principle, interfaces are typewriter like or typewriter keyboards, 10-key keyboards.	Speed of all parts of the system (eg. tabulator speed 1900: 415 cards an hour; 1926: up to 4500 cards an hour), size and information content of cards (12 rows 24 columns irt 1890. 10 rows 37 columns in 1906, 80 rows 10 columns 1928, 90 column format by Remington Rand in 1930) and related processing capacity (e.g. multiplying punch 1931), improvements of punch process, and further mechanization of processes (e.g collator device).

[1] Source : Hoelzl, 2001