A COMPARATIVE ANALYSIS OF SOFTWARE INDUSTRY DEVELOPMENT STRATEGIES: INDIA, IRELAND AND TURKEY

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A COMPARATIVE ANALYSIS OF SOFTWARE INDUSTRY DEVELOPMENT STRATEGIES: INDIA, IRELAND AND TURKEY

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Approval of the Graduate School of Social Sciences

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ABSTRACT

A COMPARATIVE ANALYSIS OF SOFTWARE INDUSTRY DEVELOPMENT STRATEGIES: INDIA, IRELAND AND TURKEY

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This thesis emphasizes the importance of software industry within global perspective, in addition, aims to study the economic, social and structural dimensions of Indian, Irish and Turkish software industries. Because of coming from developing countries scale and attaining to significant software export achievements in global software industry, India and Ireland will be in center of this study. In this context, the determination of India and Ireland's industrial and national software strategies and the results and achievement evaluations in application case are accomplished. In consequence of related assessments, Turkish software industry is analyzed and future oriented suggestions are presented via taking into account country dynamics.

In theoretical perspective, Indian, Irish and Turkish software industries are analyzed on the basis of Richard Heeks' "Software Strategies in Developing Countries" model with appropriate approaches.

Beyond, in this study, which is commenced on the basis of three countries, division of labor of global software industry will be analyzed in "core and periphery" framework and the suggestions will be presented to developing countries on their national software industries.

The findings of the study indicate that, countries which have advanced national software industries keep high value added phases in their home countries, however outsource low value added phases of software development projects to developing

countries because of workforce cost, qualified human resources, tax incentives, geographical market position etc. advantages.

Keywords: Software Industry, Information and Communication Technologies, Developing Countries, India, Ireland, Turkey.

ÖZ

YAZILIM ENDÜSTRİLERİ GELİŞİM STRATEJİLERİNİN KARŞILAŞTIRMALI ANALİZİ: HİNDİSTAN, İRLANDA VE TÜRKİYE

Emiroğlu, A. Ulaş
Yüksek Lisans, Bilim ve Teknoloji Politikası Çalışmaları Bölümü
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Bu çalışma yazılım endüstrisinin küresel anlamda önemini vurgulamanın yanısıra, İrlanda, Hindistan ve Türkiye yazılım endüstrilerinin ekonomik, sosyal ve yapısal boyutlarını incelemektedir. Gelişmekte olan ülkeler ölçeğinden gelip, global yazılım endüstrisinde önemli ihracat başarıları elde ettiklerinden, Hindistan ve İrlanda bu çalışmanın merkezinde olacaklardır. Bu bağlamda, Hindistan ve İrlanda'nın endüstriyel ve ulusal yazılım stratejilerinin belirlenmesi ile bu stratejilerin uygulama alanındaki sonuçları ve başarı değerlendirmeleri yapılmaktadır. İlgili değerlendirmeler sonucunda, Türkiye yazılım endüstrisinin analizi yapılmış ve ülke dinamikleri gözönünde tutularak, geleceğe yönelik öneriler sunulmuştur.

Teorik perspektifte ise Hindistan, İrlanda ve Türkiye yazılım endüstrileri, Richard Heeks'in "Gelişmekte Olan Ülkelerde Yazılım Stratejileri" modeli temelinde uygun yaklaşımlarla incelenmektedir.

Ayrıca, üç ülke temelinde başlatılan çalışmada, küresel yazılım endüstrisinin ülkeler bazındaki iş bölümü, "merkez-çevre" yaklaşımı çerçevesinde incelenmekte ve gelişmekte olan ülkelere ulusal yazılım endüstrileri odaklı öneriler sunulmaktadır.

Sonuçlar, yazılım endüstrisi gelişmiş ülkelerin yüksek katma değerli işleri kendi ülkelerinde yapmakta olduklarını, fakat yazılım geliştirme projelerindeki düşük katma değerli işlerde ise işgücü maliyeti, nitelikli insan kaynakları, vergi avantajı, coğrafik pazar pozisyonu vb. avantajlarından dolayı gelişmekte olan ülkeleri kullandıklarını ortaya koymuştur.

Anahtar Kelimeler: Yazılım Endüstrisi, Bilgi ve İletişim Teknolojileri, Gelişmekte Olan Ülkeler, Hindistan, İrlanda, Türkiye

To My Mother, Father and Sister

Nursen, Selahattin and Sinem

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CHAPTER I

INTRODUCTION

Since the existence of human being, the world and social-economic systems have been in a continuous economic transformation which commenced with agricultural society, continued with industrialized society and now in the form of information society. Besides, societies have strived to adapt their social and economic structures into these transformation periods; several of them became successful, other majority not. For instance, emphasized circumstance is valid for information age for today, as well. Several developing countries which go forward within information society, as US, Japan etc., the most of the others stays in industrial age, also, in agricultural age; as Middle East and African countries.

In this perspective, information society and knowledge-based economy are major milestones of current transformation, because information is one of main factors of today's economic and social development in this era. Besides, this worldwide transformation based on scientific developments in order to produce information which could be transformed into products or services by innovation oriented approaches. Thus, science and technology also continue to become the locomotive factor of national economic development. Today, importance of technology is rapidly rising and being indispensable for societies and human life, because these technological developments also enable processing, storing and sharing the information, therefore, economic and social life easily transform through information society and knowledge-based economy in all over the world via new aged technologies.

Information society and economy also began to transform the global production and service sectors and the nations realized the requirement of information and communication technologies infrastructure in order to adapt to this new system under economic and competition conditions. In this perspective, global production system has also been transformed to a new form, such as; information skills, qualified human resources and technological applications have become more important than standard physical skill and capabilities. Moreover, besides the results of global economic and social transformation, information and communication

technologies (ICT) subgroup has important potential in itself and considerable effects on other technology fields and industries. Especially in a few decades, ICT has played a significant role in national, regional and global development via contributing to global social and economic integration. For instance, computer systems have increased productivity and efficiency in public and private operations, internet, network devices and mobile phones have enabled the worldwide communication and made easier the communication for humanity. During 1960s and 1970s, telecommunication technologies investment was quite significant for national economies; in 1980s information technologies were added to telecommunication as another crucial factor of economic growth. By 1990s, the globalization, technological developments, importance of information in economic activities have set information and communication technologies as a player in national and regional developments, as a name of ICT.

> The emergence of the computer industry was itself deeply tied to the state in advanced capitalist countries, particularly to military funding for technology research. In the United States, this took the form of "military developmentalism" in which private firms were heavily subsidized by public research funds and military markets were critical to the growth of firms such as IBM and regions such as Silicon Valley. The U.S. state was central to the founding of the basic building blocks of ICT today – the academic discipline of computer science, the programming labor force, and the leading firms and regions of the private sector. (O'Riain, 2004c: 6)

In addition, mutual historical relation between science and technology is valid as a subgroup for ICT, as well; science also becomes the driving force of ICT via significant innovation processes. Namely, global ICT industry requires high rates of investments for research and development field and transforms the scientific information into product or services via innovative strategies. In such a way that, first researchers or comers could attain to high success ratios in ICT market. This case indicates the importance of science and innovative determinations for ICT industry, too.

ICT mainly comprises information technologies and communication systems. Information technologies subgroup also includes computer systems (hardware and software) industry which had acceleration growth trend especially after mid-1990s. Since those years, software industry and hardware market have got parallel development trends within IT industry. Although there is significant competition between hardware producers, global software industry has an impressive growth potential and provides strategic opportunities for developing and developed countries in rapidly globalizing world. Thus, several nations, which have previously

realized the importance of software industry in national economy and trade perspectives, commenced to invest in this field; India, Israel, Ireland (3Is) and China, Brazil, South Korea, have formed and developed considerable software industries in recent decades; especially the 3Is have focused on export oriented projects, the last three have mostly focused on domestic market oriented projects.

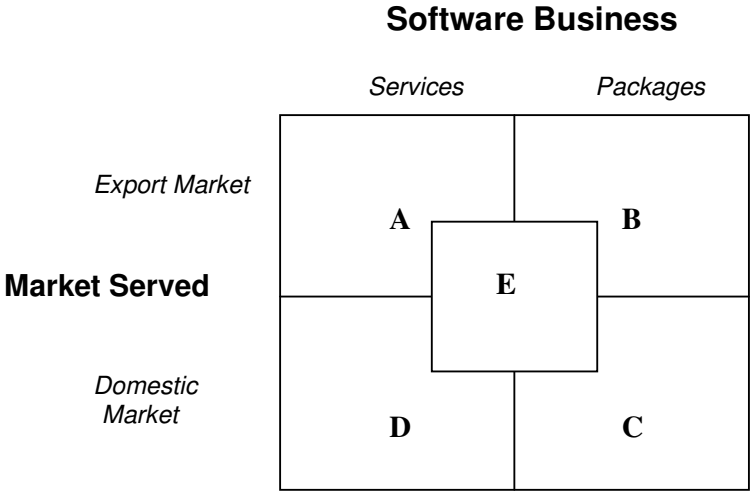
In this perspective, the main aim of this study is to emphasize the importance of global software industry as a sub-group of information and communication technologies; besides specify main industrial and national software strategies of India and Ireland, which are major software exporter countries, and setting a model for Turkish software industry on Richard Heeks' "Software Strategies in Developing Countries" model. In this respect, thesis of the study aims to indicate the exploitation relation between core and periphery countries within software industry. In such a way that, the countries which have advanced national software industries keep high value added phases of software development projects in their home countries; for instance US, Israel, however outsource low value added phases to developing countries; for instance India, Ireland, Indonesia, China in order to take workforce cost, human resources, tax incentives, geographical market position etc. advantages.

The comparative analysis of Indian, Irish and Turkish software industries, although the geographical and cultural differences caused to difficulties, has added a broad glance for the study. India and Ireland have been chosen because these two countries are latecomer countries for IT industry however attained to significant amount of software export revenues via significant future oriented strategies and investments, and now brand countries for global software industry. Furthermore, Ireland has been chosen because of being in European continent and the bridge position between U.S. software market and Middle East and African markets. Another reason of studying India is, despite being a poor country according to economic statistics, however, achieving significant amounts of software development projects with multinational software corporations.

On the other hand, Irish and Indian software industries will be analyzed within similar topics, however, Turkish software industry will be on a different way because of insufficient studies, reports and restricted information and statistics concerning Turkish software industry. In addition, Turkish software industry has not attained an advanced software industry, as in India and Ireland yet. Therefore, this analysis will occur within a different manner.

In thesis, in chapter 2, information society and information economy and also ICT and software industry concepts will be analyzed briefly on economic and structural approaches. In chapter 3, Indian software industry will be analyzed within historical development periods, development components, national industry export strategies and approaches of export succession topics. In chapter 4, Irish software industry will be studied on topics of historical development periods of industry, development components and analysis of sub-sectors of Irish software industry. In chapter 5, Turkish information economy will be analyzed in the scope of Turkish ICT and software industries. Finally, thesis will be concluded with chapter 6.

Theoretical approach of thesis addresses Richard Heeks' "Software Strategies in Developing Countries" model indicates that developing countries, which aim to have an advanced national software industry, have to identify and apply the appropriate strategy according to their national dynamics. In this perspective, developing countries may follow five main approaches which were previously determined by Heeks in order to attain considerable achievements within global software industry. (Heeks, 1999)



Source: Heeks, 1999

Figure 1.1 The Strategic Positioning for Developing Country Software Enterprises

Approach A: (Service-Intensive & Export Oriented Strategy)

This type of strategy is mostly preferred by developing countries which do not have sufficient infrastructure, financial resources and capabilities for R&D

activities within product-oriented projects. Thus, software services export represents quite greater proportion than software packages export for these developing countries, because these countries focus on service-intense part of software projects and export labor-intensive service phases.

There are two subtypes for position A, such as; providing services on-site (on customer-site) in home-countries or outsourcing these phases to cost advantageous countries. On-site services illustrate that the software engineers or programmers complete the projects in customer site with home country sources and potentialities. This sub-strategy was common until the end of 1980s, however, is quite expensive and illogical for today, because this is clear that labor costs are quite lower in developing countries with respect to developed western countries. In this perspective, especially multinational software corporations prefer outsourcing several phases of software development projects to periphery countries' firms (for instance: India, Ireland, China etc.) to be completed with their own sources (labors, facilities, infrastructure etc.). These MNCs outsource mostly low-skill, low value added software development phases to developing countries and the most important example of this strategy is India; software service projects have more than 80% share in Indian software income table (http://www.nasscom.in)

The other considerable countries, which have assumed the service-intensive and export oriented strategy, are China, Philippines and Russia export labor intensive software services to other developed countries with definite contracts.

For the critical point of this strategy; the software service exporter countries spend significant amount of their revenue for ICT devices importation from multinational corporations for infrastructure, training expenses, traveling to these countries etc. Therefore, software service export strategy is not a profitable way for developing countries industries in long-term.

Approach B: (Packaged Programs & Export Oriented Strategy)

Approach B which is the most profitable strategy and this strategy requires intensive R&D activities that need considerable amount of financial capital and also special know-how. For instance, major multinational software firms; Microsoft spent nearly 15% of revenue for R&D activities, and also Oracle spent 12% in 2005. (OECD Information Technology Outlook 2006)

Israeli software firms could be classified in this approach; Israeli popular security and network software oriented firms which complete the high-value added phases in

their own facilities, in home countries and generally outsource low-value added phases to developing countries which have low cost workforce opportunity.

On the other hand, multinational subsidiaries in Ireland could be classified in this group for package export side, because Irish government policies and tax reforms have impressed U.S. software corporations which have set up their own subsidiaries in this country in order to market software packages to European, African and Middle East markets. However, this point is critical, Ireland MNC subsidiaries are different from Israeli software firms; although Irish firms achieve mainly low value added phases; localization, marketing, disk duplication, packaging etc. operations, Israeli national firms achieve R&D oriented software development phases.

Approach C: (Packaged Programs & Domestic Market Oriented Strategy)

Approach C is preferred and applied by developing countries which generally focus on domestic market. In addition, despite domestic market orientation, these strategies' firms have to get significant financial budget for R&D operations, because the packaged programs require R&D investments.

There are several barriers for this approach; such as, high R&D costs, marketing and advertising spending, piracy problems etc. In addition, well-known, multinational software package brands are generally much more preferred instead of the domestic brands and this is another disadvantage for this approach.

Approach D: (Service-Intensive and Domestic Market Oriented)

Although this type of strategy may be a suitable starting point for software export oriented countries; Approach D does not provide considerable revenue and special know-how in order to develop the local software industry and can not obtain significant, profitable projects for national industry; because, approach D scope is quite limited in respect of other types of strategies. Mostly, inexperienced firms use this strategy in order to get experience, marketing capabilities, and set the relationships with other firms in software service market.

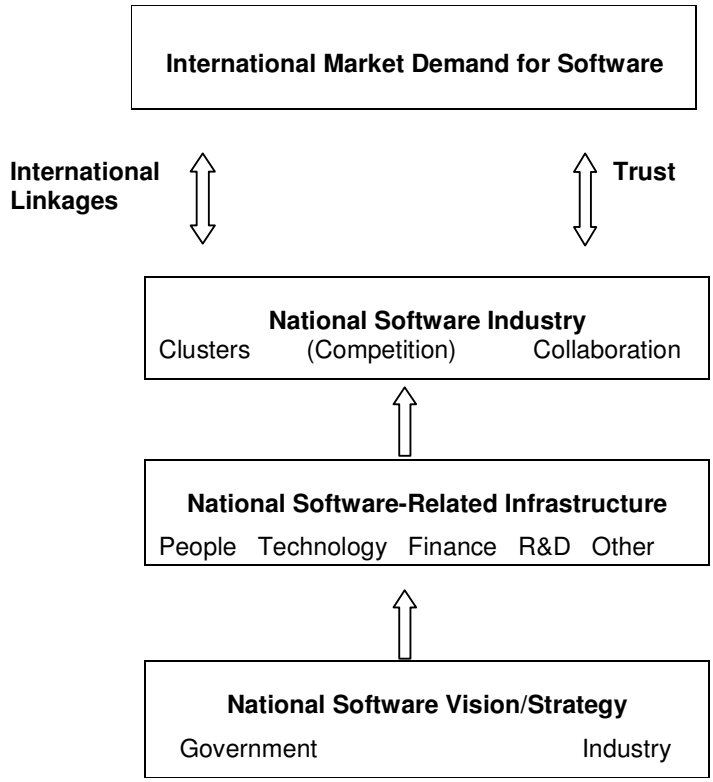
Moreover, one of the most important barriers for this approach is insufficient local IT markets. Thus, the firms may not gain considerable profit and experience.

Therefore, this type of strategy is only a survival strategy, not a profitable and future oriented strategy.

Approach E: (Packaged and Service-Intensive; Abroad and Domestic Market Oriented)

The countries, which perform in Approach E, generally focus on niche markets; such as; finance, health, tourism, telecommunication, defense etc., web browser add-ons or linguistic niches for local or regional languages as Spanish, Russian or Chinese and aim to market for both domestic and abroad markets. This strategy is quite significant for developing countries' national firms, because if these firms achieve successful projects, in time much more profitable projects may follow then after. Thus, the human resources get experience and the capital accumulation may be provided by these niche projects and necessary R&D expenditure could be financed with this approach.

Ireland indigenous software firms could be classified in this group, because, niche sectors; finance & banking, telecommunication, mobile applications etc. are in main focal points of majority of Irish national software firms. Another example for this approach belongs to Chilean firms which have developed a project concerning Spanish translation of previously developed customized software. This project was exported to other Spanish-speaking markets via significant marketing strategies.



Source: Heeks, Nicholson, 2002

Figure 1.2 The Software Export Success Model

In addition, Heeks illustrates the software export success model in above figure which indicates the vital points as national software vision or strategy by government and industry, national software-related infrastructure includes human resources, technology, finance and R&D, national software industry obtains clusters, collaboration and also competition, finally international market demand with marketing capabilities, international linkages and also trust.

CHAPTER II

INFORMATION SOCIETY AND INFORMATION ECONOMY

Especially since 1980s, in developed western countries, value added and information based production industries, such as, information and communication technologies, microelectronic, biotechnology etc. began to seize the fame and place of heavy industries. These value added information age industries mostly need to have qualified human resources and information in order to get successful production processes. Therefore, raw materials, natural sources and labor could be illustrated as secondary inputs in this production model, because the main and the most significant input become information.

> The main difference between a knowledge-based economy and a traditional economy is in the way in which knowledge is generated and introduced into the production process. In traditional economies the knowledge component (innovation) typically takes the form of ad hoc, exogenous ideas (such as the inventions of Thomas Edison, for example); in a knowledge economy the knowledge is created and used as an integral part of the process of designing and implementing new business activities and products. This systemic use of knowledge as a production factor gives rise to products the value of which is less and less embedded in their physical components, and more and more in the knowledge component. (World Bank, 2004b: 13)

Today, world is transforming to a new model in which information plays major determinative role within each sub-systems of this new society. The nations, aware of this transformation, endeavor to vary their economic and social structures according to defined requirements; as U.S., Japan. Hence, these countries have increased their productivity, competitive capability, long-term welfare etc. via transformation to information epoch.

> The term ”information society” was applied for the first time by Koyama in 1968 and subsequently by his compatriot Masuda in 1971 in his master plan of building the Japanese information society. The “information society” evolved from such slogans in the 1960s as computer-serviced society (Sackman, 1967) and in the 1970s as the age of cybernetics, information era (McLuhan, 1968), knowledge society (Drucker, 1968), technotronic society (Brzezinski, 1971), computer revolution, wired society (Martin, 1978), telematic society (Martin, 1981), post-industrial society (Bell, 1973), and Gutenberg two (Godfred & Parkhill, 1979). The “information society” was coined in order to intellectualize the change in social behavior that transformed capitalism

> with “capital and material” into a new political and social order based on “information.” (Lan, 2005: 4)

> Information society; a society characterized by a high level of information intensity in the everyday life of most citizens, in most organizations and workplaces; by the use of common or compatible technology for a wide range of personal, social, educational and business activities, and by the ability to transmit, receive and exchange digital data rapidly between places irrespective of distance. (IBM Community Development Foundation, 1997: 3)

In order to construct a comprehensive information economy and society, there are key requirements; human resources development, information and communication technologies, national innovation system, institutions, business environment and the interactions between these key factors via effective and efficient networks.

> One of the key features of informational society is the networking logic of its basic structure, which explains the use of the concept of ’network society’. (Castells, 2000: 21) As an historical trend, dominant functions and processes in the Information Age are increasingly organized around networks. Networks constitute the new social morphology of our societies, and the diffusion of networking logic substantially modifies the operation and outcomes in processes of production, experience, power, and culture. (Castells, 2000: 500)

In this structure, governments have to identify, set and organize the interrelations between these below groups.

> Information economy and information society has four fundamental components;
> - Economic and Institutional Environment: The appropriate business environment for information economy.
> - Innovation Policies: The sources, institutions, enterprises in order to create, develop and locate local and externally funded innovation environment.
> - Developments of Social Capital: Life-time education and information based employments.
> - Information Technologies: Comprehensive IT infrastructure for information economy. (Turkey 2. ICT Council, 2004: 7)

Moreover, science and technology policies have to be embedded into national production systems in order to attain to national economic development environment; thus, the information, knowledge and researchers could be combined into production systems. In this model, universities (source of new information and researchers) and the firms and organizations (production systems) come to exist within a strong innovation network in order to attain a real economic development. For instance, Soviet Union and Japanese economic systems could be illustrated as unsuccessful and successful examples. Soviet Union was ahead in science and

technology than Japan; however, they could not set the direct relations between their science and technology fields and production systems within innovation concept. On the other hand, Japan was aware of the importance of innovation and the network between science and technology and production processes, hence, became one of the leader technology producers and exporter nations in the world. Therefore, indispensable components of information economy are an effective innovation system and a business environment which comprises innovation awareness and capabilities, because, innovation is the key component of economic growth and national competitive advantage in information age.

As mentioned above, information economy has a vital relation with ICT, also a subgroup of IT, too. IT infrastructure is a prerequisite for successful transformation to information economy. Hardware components and also software systems have to be considered as a whole in order to ensure information diffusion to whole the society. In this perspective, social programs and services also work on electronic base and this structure depends on the reciprocal relation between hardware and software systems.

> Software capacity is a key to the knowledge economy. Not only is it a critical part of modern industrial infrastructure and an important industry in its own right, but it is also the vehicle for implementing the other key elements of a knowledge economy: responsive and transparent government; a supportive business environment, with low transaction costs; enhanced learning environments; and effective social programs. In particular, software is not just another industry, but a generic technology and core capability that can be deployed across almost all sectors of an economy. (Tessler, Barr, Hanna, 2002: 3)

2.1 The Economic and Structural Evaluation of Information and Communication Technologies, and Software Industry

> The convergence between the revolution in information technology and the predominant role of information-processing activities in production, consumption and state regulation, leads to the rise of the new, informational mode of development. This process triggers a series of new structural contradictions which highlight the relative autonomy of technological change in the process of social transformation. In fact, the diffusion of new technologies under the new mode of development calls into questions the very processes and organizational forms those were at the basis of the demand for information technologies. This is because these organizational forms were born within the industrial mode of development, under the influence of the capitalist mode of production, and generally reflect the old state of technology. (Castells, 1989. 19-20)

> The making of the global information economy rests on very different underpinnings. The ICT sector was forged out of a series of historical class compromises between

> capital and technical communities, embedded within a variety of state developmentalism. After World War II, the computer industry was created through a U.S. –led military developmentalism in which the state served as both the primary investor in R&D and the major market for high-tech goods. Embedded within national Keynesian economies, those forms of state developmentalism created global firms and a new ICT industry. Those global firms were challenged in 1970s and 1980s by firms by the DBSs of East Asia, protecting and financing their business groups while pushing them toward improved export performance… The global information economy existed not in a disembedded global market but rather was deeply embedded in a variety of historically and politically constructed social structures of innovation and accumulation. (O'Riain, 2004c: 81)

From historical perspective; the importance of ICT awareness began to widespread especially in 1980s, and after 1990s, information and communication technologies (ICT) have commenced to play significant role in productivity, economic development and comparative advantages of countries in all over the world, and today this approach increased its contribution for national welfare, especially via internet technology, e-applications, mobile devices etc.

> Worldwide total ICT spending reached to an estimated $2.964 billion in 2005. Worldwide more than half of 2005 ICT spending was on communication services and hardware, 23% was on computer services, 17% on computer hardware and 10% on software. The United States, by far the largest national market, spent some $1.094 billion in 2005: $537 billion on communication services and hardware, $288 billion on computer services, $145 billion on computer hardware and $126 billion on software. (OECD, 2006: 44)

Table 2.1 ICT Industry Worldwide Growth 1993-2003 (Billion Euro)

Years	Billion Euro	Growth Rate
1993	1.153	4,1%
1994	1.236	7,2%
1995	1.358	9,9%
1996	1.498	10,3%
1997	1.636	9,2%
1998	1.776	8,6%
1999	1.946	9,6%
2000	2.194	12,7%
2001	2.292	4,4%
2002	2.442	6,6%
2003	2.680	9,8%

Source: Payzın, 2002

Table 2.1 illustrates worldwide growth of ICT market. In 1993, ICT market was only €1.153 billion, in 2003 attained to €2.680 billion with 132% growth rate in 10 years. And the highest growth rate was occurred in 2000 with 12,7%. This table also indicates that ICT have attained significant growth rates within 10 years and for the following years these growth rates will also occur probably for ICT.

Table 2.2 World ICT Market Annual Growth Rate 2004-2005 (%)

Information and Communication Technologies		
Countries	**2004**	**2005**
EU	3,3	3,6
US	2,9	3,9
Japan	2,1	1,1
Rest of the World	6,2	8,4
World	3,7	4

Source: EITO, 2006

According to average growth rates of ICT market, in 2004 and 2005 significant markets, US, Japan, EU were in below of 3.7% and 4% (world growth rates). This position illustrates that rest of the world, especially emerging markets, have attained significant growth rates in those years.

Table 2.3 Global ICT Trade, 2004, ($ billion) [1]

Countries	Exports	Imports
US	149,2	234,8
Japan	124,2	72,6
Germany	91,3	89,8
Korea	86	42,8
UK	43,6	65,9
Ireland	23,6	15,5
Turkey	3	7,2
Greece	0,6	3,5

Source: OECD, 2004a

Table 2.3 indicates country based contribution to global ICT trade. US, Japan, Germany are the leader countries in global ICT market, with $364,8 billion ICT export and $ 397,4 billion ICT import in 2004. On the other hand, Turkey had $7,2 billion ICT import, however only $3 billion export in 2004. As seen, US Japan and Germany are the leader countries for ICT export and import operations. Although Ireland is one of the leader software service exporter firms, can not compete with developed countries (US, Japan) in ICT export field, because of insufficient software product development operations.

[1] Table numbers have been converted to $ billion.

Table 2.4 Effect of ICT Use on Enterprise Performance in Developing Countries

Indicator	Enterprises that do not use ICT	Enterprises that use ICT	Difference
Sales growth (percent)	0,4	3,8	3,4
Employment growth (percent)	4,5	5,6	1,2
Profitability (percent)	4,2	9,3	5,1
Investment rate (percent)	n.a.	n.a.	2,5
Re-investment rate (percent)	n.a.	n.a.	6
Labor productivity (value added per worker, dollars)	5.288	8.712	3.423
Total factor productivity (percent)	78,2	79,2	1

Note: n.a. Not applicable

Source: World Bank, 2004a

Table 2.4 indicates the importance of ICT usage on enterprise performance in developing countries, such as, provides 5,1% advantage in profitability, 3,4% in sales growth, 2,5% in investment and 3,4% in labor productivity. This table also proves the importance of ICT investment for developing countries and their national indigenous industries from both of effectiveness and efficiency perspectives.

On the other hand, ICT industry has also affects on global employment environment. This term technologic transformation has begun to change the traditional workforce type into information oriented employment fields. In this perspective, ICT oriented labor supply is not in sufficient level in order to meet the demand side in all over the world.

> In 2001 more than 17 million were employed in the ICT sector, or around 6.3% of total business sector employment, in the 23 OECD countries for which data are available. The United States accounted for around one-third of the total, the European Union for around 37% and Japan for 15%; the G7 countries alone accounted for more than three-quarters…The ICT sector has been a major source of employment growth, with an average annual growth rate of over 4% and a net addition to employment of over 3.5 million people in the 1995-2001 periods. (OECD, 2004b: 36)

2.2 Software; Sub-group of ICT

There are three main groups within ICT industry as hardware, software and service markets, and a clear difference between these three concepts; although hardware industry requires important amount of capital for start-up and maintaining the production and marketing phases, ICT services and software industry does not require such amount of capital especially for start-up and main operations. In

addition, software industry has attained to attractive growth rates; therefore, especially latecomers aim to increase their shares in this growing market. On the other hand, ICT oriented services are rapidly growing, thus, IT services could be seen as a strategic sector in newly emerging countries, as software industry.

Because of this study's main focal point; hardware and IT services will not be briefly studied.

Table 2.5 World Software Industry Value (Products, Services- Billion $)

Year	Value	Growth (%)
2000	738,2	11,4
2001	822,3	8,5
2002	892,2	10,5
2003	985,9	10,7
2004	1.091,4	10,3
2000-2004	4.530	10,3

Source: http://www.datamonitor.com, 2006; web site data.

Table 2.5 indicates the worldwide market value and growth rates of software industry. Between 2000 and 2004, world software industry had average 10.3% growth rate and attained to $1.091,4 billion in 2004. Worldwide software market attained to these significant growth rates, especially, because of increasing rate of networked personnel computers ownership. In this volume multinational software firms have the biggest shares; Microsoft (3%), IBM (5,6%), HP Services (1%), Computer Sciences (1%), EDS (2%) (http://www.datamonitor.com)

Table 2.6 Geographic Dispersion of World Software Market

Regions	Percentage
North America	42,4%
Europe	29,2%
Asia-Pacific	21,2%
Other	7,2%

Source: http://www.datamonitor.com, 2005; web site data.

World software market mainly intensifies in North America as 42,4%, Europe 29,2% and Asia-Pacific 21,2% and only 7,2% expresses the other markets. This table illustrates the superiority of US in world software trade market and also the dominant position of US multinational corporations which direct the majority of software operations for all over the world.

Table 2.7 Top 10 Software Firms ($ millions in current prices and number employed)

	Country	Revenue 2000	Revenue 2005	Employee 2000	Employee 2005	R&D 2000	R&D 2005
Microsoft	USA	22.956	39.788	47.600	61.000	3.772	6.184
Oracle	USA	10.231	11.799	42.927	49.872	1.010	1.481
SAP	Germany	7.562	9.563	24.177	34.095	1.170	1.323
Softbank	Japan	3.927	7.737	7.219	6.865	…	…
CA	USA	6.094	3.530	18.200	15.300	1.110	690
Electronic Arts	USA	1.420	3.129	3.500	6.100	256	633
Symantec/ Veritas	USA	746	2.583	3.800	6.500	108	332
Intuit	USA	1.037	2.038	6.000	7.000	166	305
Amdocs	USA	1.118	1.918	8.400	10.600	75	132
Adobe S.	USA	1.226	1.885	2.947	3.142	240	351
Total		56.317	83.970	164.770	200.474	7.907	11.431

Source: OECD, 2006

The previous table emphasized the superiority of North America with 42,4% share in global software industry and table 2.7 proves the superiority of US multinational software firms; 8 of top 10 software firms' origins are from US and only two others are from other countries; SAP (Germany) and Softbank (Japan). For an interesting statistics, these firms spent $7,9 billion in 2000 and $11,4 billion in 2005 for only R&D operations. This is the critical point and emphasizes the importance of R&D and innovation operations for software industry.

Table 2.8 Contribution of Software Industry to GDP

Countries	Sales ($ Billion)	Software Sales / GDP (%)
Brazil *	7,7	1,5
China	13,3	1,1
India	12,5	2,5
Ireland (MNE)	12,3	10,1
Ireland (Domestic)	1,6	1,3
Israel *	4,1	3,7
US	200	2
Japan **	85	2
Germany *	39,8	2,2

Source: Arora, Gambardella, 2004
*** 2001, ** 2000**

Although US and European countries are the leader successful regions in software industry, there are also latecomers; India, Ireland, Israel have become successful software exporter countries, in addition, Brazil and China are domestic market oriented countries in global software industry. According to 2002 data, Brazil had $7.7 billion, China $13,3 billion, Israel $4,1 billion and Ireland $13,9 billion revenue

($12.3 billion comes from multination firms). In addition, 3Is (Israel, Ireland and India) have the biggest ratios of software sales in GDP, as Israel 3,7%, Ireland 11,4% (MNE and domestic), India 2,5%. In addition, according to sales volume, US ($200 billion), Japan ($85 billion), Germany ($39.8 billion) are the leader countries.

For a contradictory point, India is one of the leader software service exporter countries, however, software sales attains only 2,5% in GDP, because India is mainly focused on low value added phases of software development projects of multinational corporations.

2.3 Importance of Software

> Software is defined as the instructions that a computer follows to perform a specified task. Software development is the process of understanding and enumerating the requirements, translating those specifications into instructions for the computer, testing to make sure the specifications and their translation are correct, and documenting and maintaining this "program" as the people using it request modifications. The software R&D process differs from other technology R&D in that there is no tooling or manufacturing phase of product development; rather, when R&D is finished, the program is ready to copy, ship and use. (Barr and Tessler, 1996: 1)

> The information technology (IT) sector, driven by the software industry, is now one of the fastest-growing and most vibrant segments of the global economy. It is a proven engine for delivering all-important economic growth and national prosperity. In addition, high connectivity with other sectors, the size of market potential, high rate of technology density are the main basic specifications of a strategic industry, and software industry is a strategic industry, because of responding to these criteria. (Müller, 2005: 1)

Software applications had similar historical development periods with hardware invention and production. In those years, the importance of software industry had not been realized, and industry had not attained an impressive growth rate. In time, this approach commenced to change via combination of software systems with hardware products in order to increase the effectiveness and perfections of hardware devices. Thus, software industry created its own market within hardware market and also independently. Although hardware prices and profitability rates began to decrease, software industry complexity and prices increased in time by impressive growth rates.

There are two main types of software systems; application software and system software.

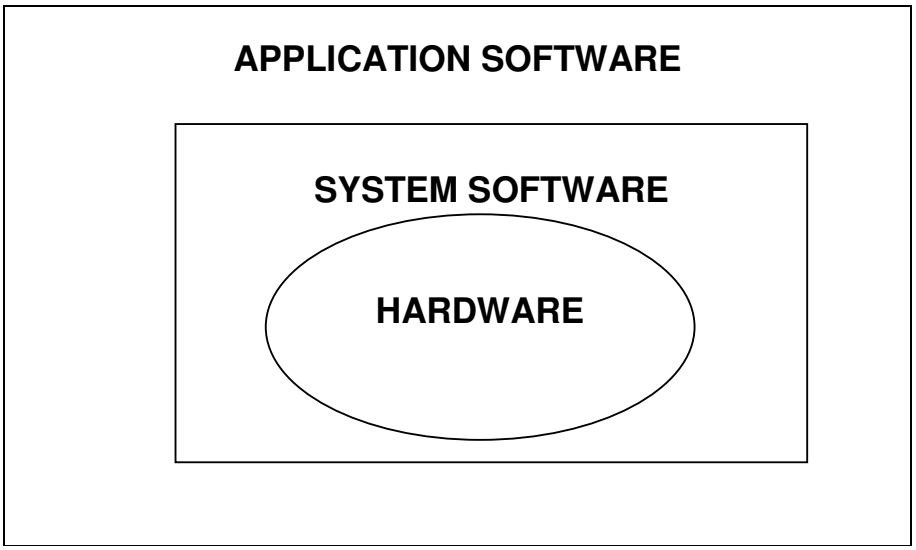


Figure 2.1 Types of Software Systems

- **System Software (Software Infrastructure)**

  System software is a generic term referring to any computer software which manages and controls the hardware so that application software can perform a task. It is an essential part of the computer system. Systems software- a set of programs that organize, utilize and control hardware in a computer system. (http://en.wikipedia.org/wiki/System_software)

This group of software systems is used as an intermediary between hardware components and application software systems and obtains self-regulatory functions for computer systems, because this system control and support the main computer systems. System software could be grouped as; Operating Systems, Networking Systems, Security Systems and Database Systems. Value of this group of software systems occurs with accumulation of product sales prices and copyright revenue.

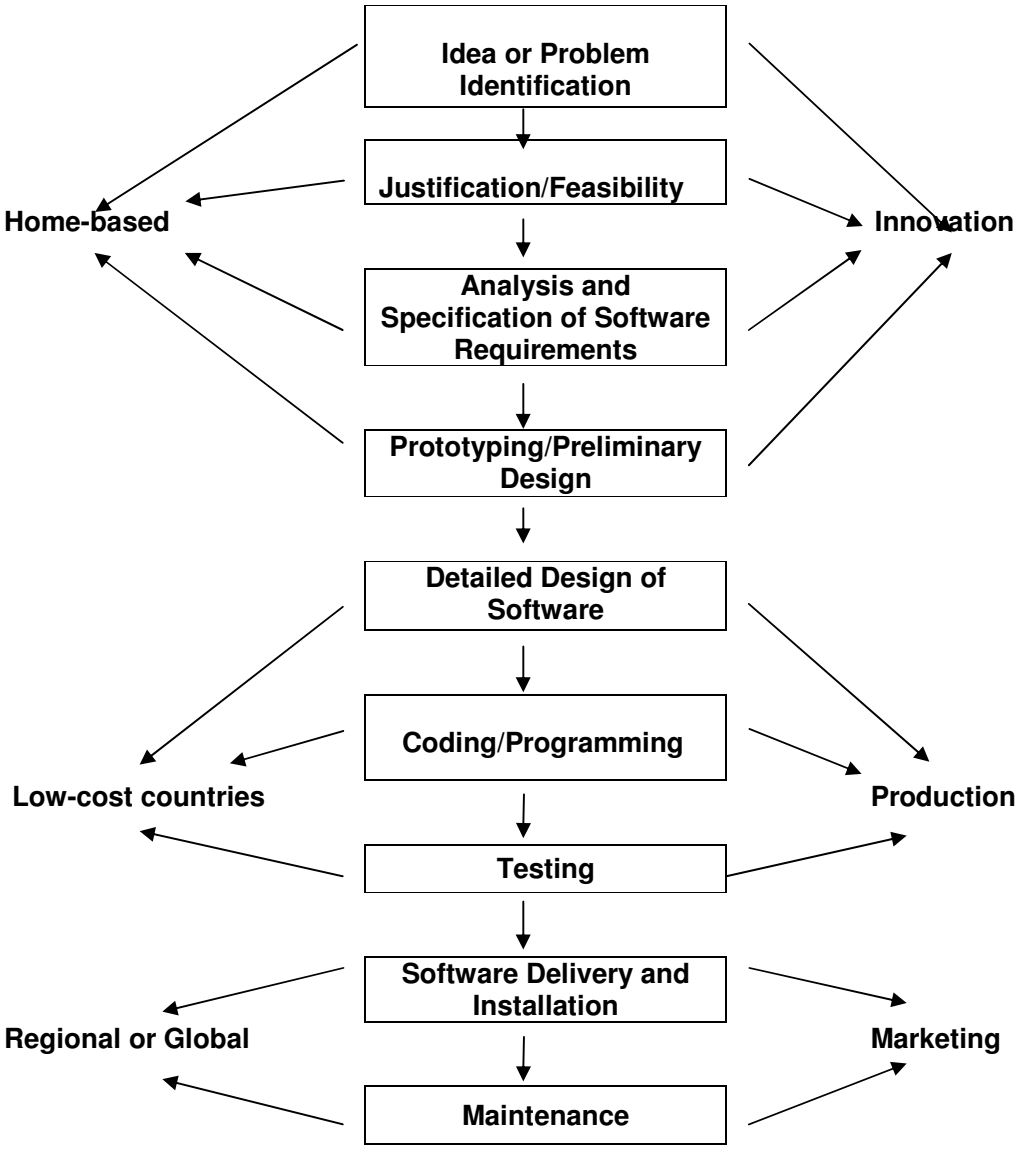
Multinational software firms (Microsoft, Oracle etc.) are dominant in software infrastructure group and strict competition exists between these firms, besides, entrance to this field requires strong financial position and capital accumulation.

- **Application Software**

These systems are designed in order to satisfy market and customer preferences. Computer systems attain to specific functionality with a determined customer need via these application systems. Application software programs direct computer systems in order to perform specific information processing activities. There are many kinds of application software systems, however, CRM (Customer Relations Management), ERP (Enterprise Resource Planning), LOB (Line of Business) could be exemplified. Developing countries mostly prefer to invest in this second platform, application software systems, because this field has a wide range of business scope and does not require strong financial capital in order to achieve development, production, marketing etc. phases.

Moreover, the latecomers, which aim to involve in ICT, could operate within software industry as an emerging sector, because;

- Start-up costs are quite lesser than other IT sub-technologies (an office, several computers and sufficient communication infrastructure for start-up),
- Dynamic high growth rates in global market,
- Energy consumption is quite less than other manufacturing industries (For instance, hardware industry)
- Software industry includes value added and profitable project opportunities,
- Broader usage and market field in other sectors in order to increase the effectiveness and quality of organization businesses.
- Software, especially embedded software systems are quite significant for other industries too, for instance, consumer electronics, automobile industry, defense industry, health industry, white goods production, etc.



Source: Heeks, 1996

Figure 2.2 Software Development Life Cycles

Heeks also illustrates software development life cycle in Figure 2.2. There are three main groups of activities;

- Higher value added innovative phases (problem identification, justification, analysis the requirements, preliminary design) are generally completed in home countries, as in US.
- Whereas, second phase (detailed design, coding/programming and testing) deals with production operations, be completed relatively low cost countries in order to decrease the production costs, such as in India, Philippines, and China etc.

- The final stage includes regional or global sales and after sales operations which are also low-value added activities and be completed in low-cost and target market proximity countries, for instance in Ireland.

In a broad scale, this is division of labor in global software development operations. Such as, higher value added phases are completed in multinational software firms' home countries within their facilities and mostly low value added phases are outsourced to countries which provide low cost opportunities.

2.4 Conclusion

Information society and information economy are target approaches for nations in order to attain to social and economical developments within capitalist economic system, in 2000s. In this view, information based industries are playing significant roles and information is an embedded source which appreciates the value of these industries; information and communication technologies, microelectronic, biotechnology, genetics, nanotechnology, space etc. In addition, information dense life style is inevitable for citizens' everyday life; such as, in houses, schools, offices, streets, transportation vehicles, entertaining facilities etc.

This information economy contains major players; qualified human resources, ICT infrastructure, business organizations, government institutions, information awareness and effective network between these players. The nations, which aim to transform into information society and economy, have to invest and set direct relations between all these factors. Moreover, in these factors, ICT infrastructure has significant place in order to transmit, receive and exchange the information between thousands of kilometers, from south hemisphere to north hemisphere etc. Therefore, ICT infrastructure and ICT market are significant for countries, especially for developing countries. Although increasing rate of ICT usage for citizens are quite significant, production and marketing operations of ICT products and services are future-oriented economic businesses.

The developing countries, which are the main focal point of this study, could focus on software or service sides of ICT much more, because these are less capital intensive sub-groups of ICT and do not require significant financial investments, as hardware industry. In addition, software industry has attained significant growth rates for recent years, and high connectivity with other sectors, the size of market potential etc. make industry as a strategic, future-oriented industry.

In this perspective, following chapters will focus on global software industry in which there are two significant developing countries; India and Ireland. These countries' software industries have attained significant software export revenues especially after mid 1990s. In third and fourth chapters, Indian and Irish software industries will be briefly studied with development periods, international relations, government policies, successions and deficiencies by information society and information economy fundamentals.

CHAPTER III

INDIAN SOFTWARE INDUSTRY

> India missed the Industrial Revolution of the 19th century because we were then under colonial rule. But today, we are at the forefront of the Knowledge Revolution of our era. India has established itself as a major force in the knowledge-based industries. We are well known for our human resource of scientific and technical personnel in these areas. I believe that nearly 40% of the best 500 companies source their software requirements from India. I see a growing role for India in the frontiers of technological development in the coming years. (Vajpayee, A., B., 2002 (The Prime Minister Of India))

In this chapter, historical development periods of Indian software industry will be analyzed in a defined time scale, then, development components, the main features and the challenges of national software industry, export strategies and approaches related to Indian software industry achievement will be studied.

First of all, Indian software industry may be illustrated as; export-led industry more than domestic market orientation and provides customized software services rather than software products and packages; thus, may be called as exportable software service oriented industry in global software world.

India is one of the leader software service exporter countries in all over the world. This success story occurs with a meaningful and random combination of high technology oriented education policies, accurate government strategies, global ICT revaluation and also good timing. For instance, in the ends of 1980s, India had 170.000 English speaking engineers and these educated people were excess supply for India. At the same time, the information technologies began to take importance and the shortages of skilled engineers and programmers become a significant problem for global ICT industry. Thus, Indian engineers were used as considerable resources in order to close workforce gap within global ICT environment.

Although India is the leader software services exporter country via considerable number of software development projects, and getting important share in national economy, could not gain the greatest share in global software market;

because, Indian software industry could not ensure high value-added phases (such as, high level design, requirement analysis, various R&D activities etc.)

> India has only nearly $4 billion software revenues in 1999, while the world's software market was nearly $500 billion in that year. (http://www.nasscom.in)

Exportable software service strategy in global software industry comes from a trend which could be defined as outsourcing the low-value added software services to developing countries; because of the global shortage problems of skilled and talented labor and wage cost advantages across national boundaries.

> The proportion of software exports to merchandise exports grew from insignificant amounts in 1990 to 18 percent in 2002-03. The sector's contribution to India's overall invisible receipts is more remarkable and accounted for about 59 percent of receipts in 2002-03. Despite this impressive export performance, the software sector's share in overall GDP and employment is small – contributing less than 3 percent of India's GDP and employing 500,000 people in 2002-03. The domestic market for IT, although growing, is minor and the industry has no links with other domestic sectors. This is supported by the fact that exports account for a high share in total software revenue. Nonetheless, the Indian software industry accounted for over 28 percent of India's GDP growth between 2000 and 2002. So, although the size of software services in India in terms of GDP and employment is small, it is one of the fastest growing sectors of the economy. (Arora, Gambardella 2005: 7)

On the other hand, arising importance of outsourcing services trend (especially low-value added phases), makes Indian software industry faced with diminishing labor cost advantages and strict competitive environment with other countries' qualified, low-cost labor pools. These countries, such as, China, Russia, Philippines obtain low wage and talented human capital for software service-export oriented projects, too, as rivals to India. In order to eliminate these problems and protect the competitive national advantage in software industry, Indian government sets up new common and private institutions to increase labor supply, and developing new methodologies and strategies for reducing project costs. These solutions may keep on the leadership of India barely in customized software and software services which are the main focus points of Indian software industry.

3.1 The Development Periods of Indian Software Industry from 1972 to 2000s

Table 3.1 Policy Changes Affecting the Indian Software Industry: 1972-99

Year and policy	What the policy did
Software export Scheme, 1972	Permitted the imports of hardware for purposes of hardware development on the condition that the price of hardware was recouped through foreign exchange earnings within 5 years.
Liberalization of policies related to software industry, 1976	Hardware import duties reduced from 100% to 40% Faster clearance of software export applications Software could take advantage of export incentives including location in Export Processing Zones Nonresident Indians were allowed to import software for purposes of export. Export obligation was 100% of all output produced.
Software Export Policy, 1981	Import duties on hardware raised to encourage use of indigenous computers Firms allowed to import hardware to write software for both domestic and export purposes Software exporters could also import "loaned" computers.
New Computer Policy, 1984	Import procedures simplified Import duties on hardware reduced from 100% to 60% for software developers Access to foreign exchange was made easier for software firms Income tax exemption on net export earnings lowered from 100% and 50% Software exports were sought to promoted through satellite based communication links with overseas computers, and the national computer network Indonet was made available for exports from public sector and small firms.
Software Policy, 1986	Software growth seen for the first time as independent of hardware growth in the domestic economy Imports of hardware liberalized and duties on them abolished for exporters of software Export obligations for hardware importers, however, increased: export obligations ranged from 250% to 150% of foreign exchange used, to be repaid to the government in four (rather than five) years. A penalty fine was also imposed on nonfulfilment of the export obligation. Imported software attracted a 60% duty on its value Special export obligations governed the use of dedicated satellite links

Table 3.1 Continued

Software Technology Parks of India, 1988	Established under the Department of Electronics of the Government of India, the STPs were autonomous bodies to encourage and support small software exporters, by giving 100% export-oriented firms a tax-free status for five years within the first eight years of operation. In addition, they were provided with office space and computer equipment, access to high-speed satellite links and an uninterrupted supply of electricity. STPs also provided services such as import sertification, software valuation, project approvals, market analysis, marketing support and training and 'single window clearance' for projects. STPs are connected by an integrated network, so subscribers can lease a point to point digital channel, and have access to the Internet with their own TCP/IP number, which would give them e-mail, remote log in, and file-transfer services as well as access to the World Wide Web Export obligations applied to firms in the STPs using telecom infrastructure.
New Economic Policy, 1991	Devaluation and partial convertibility of the rupee Abolition of foreign exchange for travel tax Reduction in telecommunication charges for satellite links Export obligations on STPs removed Reduction of hardware import duties
Import duties on imported software, 1992-95	Reduced to 20% on applications software and 65% on systems software in 1994 Reduced to 10% on both in 1995.
Income-tax exemptions, 1993-99	Software exports were exempt from income tax and this tax-free status was confirmed every year till 1995 after which it became open-ended. There is talk of ending this status in 2001.

Source: Arora, Gambardella, 2005

Especially beginning the 1980s, Indian government realized that IT industry would be one of their major export-led industries and a valuable revenue source for Indian national economy. Hence, Indian government focused on domestic hardware manufacturing in previous years. High tariffs and restrictions for hardware imports were applied in order to protect the domestic hardware manufacturers. Besides, software industry was seen as a significant part of domestic hardware manufacturing. In the course of time, Indian government noticed that protective policies for hardware manufacturing hinder the development of national software industry, because of lack of current hardware infrastructure in India. So, these unnecessary strict policies were cancelled in order to get sufficient hardware devices which were required for software development projects. Furthermore; Software Technology Parks of India has launched new policies and investments regarding telecommunication infrastructure and applied them in order to facilitate the

communication within the national borders and with all over the world. So, thanks to these policies, internet access costs began to decrease in the mid 1990s, in India. This progress has added a quite important competitive advantage to Indian software industry.

In conclusion, there are two main topics, which have caused to Indian software industry appearance, such as, effective, foresighted government policies and strategies (regulations, deregulations etc.) and global demand for information technologies in all over the world, especially western part of the world.

Table 3.2 Indian Software Export Figures

Year	Software Exports ($ M)	Export Growth (%)
1981	6,8	70%
1982	13,5	99%
1983	18,2	35%
1984	25,3	39%
1985	27,7	9%
1986	38,9	40%
1987	54,1	38%
1988/89 (Apr-Mar)	69,7	-29%
1989/90	105,4	51%
1990/91	131,2	24%
1991/92	173,9	33%
1992/93	219,8	26%
1993/94	314,0	43%
1994/95	480,9	53%
1995/96	668,0	39%
1996/97	997,0	49%
1997/98	1.650	65%
1998/99	2.180	32%
1999/2000	3.600	65%
2000/01	5.300	47%
2001/02	6.200	17%
2002/03	7.550	22%
2003/04	8.800	17%
2004/05	12.400	41%

Source: http://www.mit.gov.in, 2006; web site data.

As illustrated in Table 3.2, India focused on software export projects in 1980s and the export revenue grew year by year. For instance, India has only $6,8 million revenue from software export projects in 1981. After only 23 years, this amount has been increased to $12,4 billion in 2004-2005 with growth rate of average 37% per

annum. Specifically, a slowdown occurred in export growth in the period of 2001-2004. This case could be explained by dot com crash and recession in United States economy which is the main focal market of Indian software industry.

3.1.1 The First Steps of Indian Software Industry; before 1984

> The Major Thrust of government policy was achieving self-reliance in hardware capability and the major event for fledgling software firms was the dramatic exit of IBM in protest against the draconian FERA rules. (Arora and Gambardella, 2005: 21)

First of all, Indian government had chosen hardware manufacturing industry as one of the focal points for Indian IT industry. Therefore, the high tariffs were started to be applied against the foreign hardware producer firms and hardware importation. Although, this strategy aimed to protect the domestic hardware industry; however, caused to problems, for instance, one of the most important multinational IT firms, IBM has abandoned the country by protesting these policies.

In India, the importance of the software industry was realized in 1972 and hardware import was allowed partially; only if those products would be used to develop export-oriented software systems. However, this method has been exploited in time and this strategy failed without attaining to its main goal; to facilitate domestic software development.

For these years, although India did not have sufficient domestic IT market and ineffective communication infrastructure, software industry has continued to develop and become one of the major growing export industries in Indian economy; via talented, educated, English-speaking programmer pool with considerable labor-cost advantage. Moreover, for the first years, software service exportation projects were in the form of on-site software service delivery which was the most popular business model for Indian software industry.

> The on-site model for software service delivery – where the software-exporting firm provided the personnel to execute the project while the client firm provided the specifications and the needed capital equipment – emerged and became the popular business model for software firms. (Arora and Gambardella, 2005: 23)

For these years, Indian software service industry had focused on especially data conversion projects, which had been executed on-site in multinational corporations' facilities. In reality, this method was more profitable and easier because of the strict protectionist policies of Indian government.

In those years, Indian software industry had located only in a few locations because only these places had sufficient communication infrastructure and stable electricity. One of these locations was Bangalore; included some important electronic research laboratories, in addition, Bombay was the city where one of the first export oriented projects had been carried out. Also, Delhi was in this group of cities as the software oriented firms had located in.

For this period; although Indian software industry did not advance and develop adequately within global software industry; Indian software firms had specialized in data conversion and migration and maintaining the legacy systems on old mainframe platforms, via foreign based projects by Indian talented software programmers and engineers.

3.1.2 Entrance to Software Development; 1984-1991

In first years of this period, there was considerable development in information technologies world especially for Europe and U.S. countries, such as, the mainframe computer technologies started to lose their importance against the networked, personal computer technologies. Such as, these new machines were less capital intensive and more efficient to store the data in their own disk units. In addition, this new computer technology caused to increase the demand for new software systems and programs which would be operated within these new systems. Moreover, this technological transformation required specific customized software systems which would be used to migrate existing data from mainframes to new networked systems. As well, this migration process required special and considerable experience in which Indian firms had already specialized before this technological transition and also had completed related projects for U.S. firms, before 1984. Thus, Indian software programmers became appropriate source for these migration projects; because of their data migration experience and low labor cost advantageous. Therefore, the foreign firms began to influence the Indian programmers to engage into their projects.

> For instance, while an Indian programmer earned average $5.500 per year in India; however Microsoft proposed average $45.000, plus accommodation expenses, plus green card in order to work in their projects in U.S. (http://www.nasscom.in)

Therefore, many programmers migrated to U.S. Besides, these migrations brought several advantages and disadvantages, such as, these migrated programmers caused to important decreases in Indian programmers pool, on the other hand, Indian programmers found opportunity about getting in touch with U.S. software firms, and of course venture capital firms, too. Thus, Indian programmers had a chance to improve their capabilities about software development projects.

In the year 1986, the difficulties of Indian software sector began to be eliminated one by one. Firstly, the government has authorized hardware imports for Indian firms, thus necessary hardware infrastructure could be provided more easily. In addition, a second opportunity was about the hardware prices which commenced to diminish in those years worldwide, thus, set up costs for software firms was also quite lower than the previous years' ones. Meanwhile, Indian hardware firms started to focus on software technologies in order to get more profit by using this advantageous term; for instance, WIPRO Technologies, Hindustan Computers Ltd. could be considered in this group.

> A number of Indian software firms have also developed software packages aimed at the domestic market. However, with very few exceptions, these packages have not been very successful. A number of firms had targeted to domestic market for products and services in the late 1980s. Some produced packaged software products for the domestic market, including a word processing packages for Indian languages, while others focused on developing custom software for domestic clients. For the most part, these efforts were not very remunerative compared to the export market. (Arora et al, 1999: 7)

On the other hand; there were also problems and insufficiencies which cause to obstruct the developments of Indian software industry in this term, such as, insufficient communication and non-widespread electricity infrastructures, and incapability of attracting foreign venture capital firms etc. Hence, Indian government applied a strategy to attract the investors within regional policies, called as Science Technology Parks in where at least the government allowed firms to invest in communication and electricity infrastructure in those parks on their own. Separately, there was quite interesting point which caused to provide benefits to Indian software firms, although this had been seen as a problem, before. Such as, time difference between US and India has caused a new advantage to both countries' firms; such as, idle satellites of U.S. were used by Indian programmers without any additional hardware or line costs. Thus, the insufficiencies and problems of communication infrastructure were eliminated by time difference between U.S. and India in software development projects.

Furthermore, the advent of these new networked personnel computers and decreasing hardware prices increased the sales of personal computers and microcomputers in domestic market in India. Although this increase was reflected as an increase in software package sales market, the domestic market was insufficient in order to focus on software packages development projects.
As a result, on-site service model (especially in U.S.) was the most popular model for software development projects in this period, in India.

3.1.3 Offshore to India and Financial Liberalization 1992-99

> One rather unexpected phenomenon of the 1990s has been the spectacular growth of the software industry in some non-G7 economies. The first element of surprise is that these are not countries where one would expect to see the growth of what is commonly thought of as a high-tech. The second element is that what the 1990s have shown is not just growth of the industry, but a remarkable growth. In India, for example, software production was virtually non-existent in the early 1980s. (Arora, Gamberdella, 2004)

For this period, there were two considerable changes in Indian economy; one of them is the depreciation of the rupee and the second was the broad liberalization of government policies and strategies which caused to transform the Indian national economy. For instance; by the depreciation of rupee, the software salaries become quite competitive according to other nation's software programmers' salaries. In addition, by the assistance of liberalization policies, foreign capital and foreign investors could invest to India more easily than previous years. Therefore, MNCs realized that outsourcing some operations to Indian subsidiaries could provide quite important competitive cost advantage for these firms. Thus, multinational subsidiaries of US software firms (Microsoft, Oracle etc.) were founded by MNCs in India. In mid 1990s, the considerable scarcity has occurred in Indian programmers' pool, because of excess demand of MNCs subsidiaries. Thus, the wages grew over average 30 percent in software industry per year. Therefore, the firms' profitability began to decrease due to labor cost increases. In order to eliminate this problem, Indian government set up new institutes and gave authorization to some private institutions in order to educate new software engineers and programmers in order to increase the supply of human resources. Another important problem was employee attrition in this term. Software programmers might take better offers from other firms and might leave their firms and project suddenly, before their completion dates. Thus, the firms might lose own specific know-how concerning the projects which

might not be completed in the anticipated duration that had been agreed on previously.

Offshore Model to India

> Despite the steady increase in the supply of software technology and tools, much of these activities still require suitably trained people, the demand for whom exceeded supply in the developed world as the information technology revolution took hold in the 1990s. However, a substantial portion of these activities could be outsourced from the user organization. This type of demand formed the basis of the initial growth of the Indian software industry. (Arora and Gambardella 2005: 8)

While Indian software industry focused on on-site services, multinational firms realized that a new business model which would provide more cost advantages in global market, called *offshore to India model*. In this model, low-value added phases of software development projects would be completed in India by local firms and multinational subsidiaries; the main aim of this strategy was the greater cost saving.

> The relationship between MNCs and Indian software industry is marked by two major events, first, the exit of IBM in 1977, which was induced by restrictive policies on international trade and foreign direct investments, second, the establishment of a Texas Instruments (TI) R&D laboratory in Bangalore in 1985. The entry of TI by mid-1980s marked another important change in the evolution of the domestic software industry since it pioneered the offshore model in India. (Giarratana, Pagano, Torrisi 2003b: 5)

Table 3.3 India: Growth in Domestic, Export and Total Revenues

Year	Export in $M	Domestic Revenue $M	Total $M
1993-1994	330	227,9	557,9
1994-1995	485	340,8	825,8
1995-1996	734	515,4	1.249,4
1996-1997	1.085	680,8	1.765,8
1997-1998	1.800	900	2.700
1998-1999	2.650	1.250	3.900

Source: http://www.nasscom.in, 2000; web site data.

As seen in Table 3.3; Indian software industry had significant growth rate between 1993 and 1999 from export perspective, such as; in 1993-1994 period, Indian software industry's volume was $330 million however for the period of 1998-1999 this amount was nearly $4 billion. On the other hand, domestic revenue for Indian software industry is $227,9 million in 1993-1994 periods and this amount has increased to $1,25 billion in the period of 1998-1999. This statistic considers that

Indian export revenue has the biggest share in Indian total software revenues since 1993.

On the other hand, thanks to financial liberalization, some of the firms went public and listed in U.S., on NASDAQ, for instance, Infosys. This was an important development for Indian software industry, because, these listed firms had considerable importance and credibility in software sector. Thus, the Indian software entrepreneurs started to get venture capital much more easily in order to establish new firms with these considerable relations.

3.1.4 Indian Software Industry in the 2000s

In this period, Indian government realized that high-value added phases of software development projects should be completed in India; otherwise only low-skilled stages will not add expected contribution to Indian software industry, and also to Indian economy. In this perspective, several Indian niche companies have focused on product-based model in 2000s, such as, digital signal processing software, system on chip, embedded software etc., for instance; Impulse Tejas Networks (optical switches for telecom carriers), Sasken (embedded telecom solutions), Xybridge (soft switch) etc.

> In order to "move up the value chain" the leading Indian software service firms, such as Tata Consultancy Services, Wipro and Infosys, have started to provide services beyond simple programming services, intensive in industry specific business knowledge (domain expertise) and technical capability. This approach enables the software supplier to provide "solutions" to business problems, rather than simply programming services to implement solutions that the customer or firms such as Anderson Consulting and Oracle provide. (Arora, Gambardella, Torrisi, 2001: 11)

In addition, software industry has been affected by slowdown in demand side of information technologies and economic recession of largest market, U.S. Therefore, the Indian firms have decided to focus on other markets, too, such as, European, Japanese and African markets.

3.2 Software Markets: Domestic Market and Export-Oriented Market

Indian software firms operate within two markets; domestic market and export-oriented market which have important key differences from each other.

Indian firms, which are domestic software market oriented, mainly focuses on sales of software packages and products that are mostly imported from U.S. multinational firms or other western countries. These sales do not provide considerable contributions to Indian economy, and also this economic activity increases the deficit because of the negative impact of imported products on national economy. In addition, several Indian firms develop and produce software packages to domestic market, too, (quite small ratio according to imported packages).

> The Indian domestic software market grew at a rate of 13 percent during 2002-03 as compared to growth rate of 18 percent achieved in 2001-02. This decline in growth rate is a mirror of the decline in the overall domestic IT industry and is attributed to factors such as the global economic slowdown and resulting IT budget cuts and freezes on new IT purchases. (Rothman, 2003: 1)

Second group of firms operate within the boundaries of Indian software export market mainly focuses on software services; labor-intensive software development services, customized software development, consultancy etc. In addition; these services are concerned with low-level design, coding and some types of supporting and testing activities which are low-value added phases of software development projects.

Table 3.4 Composition of Indian Software Development and Services (Domestic and Export)

Software Activity	Domestic Software (%)	Export Software (%)
Turnkey Projects	28,6	31,5
Professional Services	4,1	48,4
Products and Packages	52	8,8
Training	6,1	1,5
Support and Maintenance	3,2	3
IT Enabled Services	6	6,8

Source: http://www.nasscom.in, web site data.

As seen in Table 3.4, Indian turnkey projects and professional services have share of 79,9% in export oriented software businesses, however, products and packages have only 8,8%. On the other hand, products and packages has 52% share in domestic software businesses. This statistics indicates that, Indian export oriented software firms mainly focus on service side, however, domestic market oriented industry mainly focuses on software products and packages activities.

Table 3.5 Software Exports - Major Destinations Software Export (2000-01)

Country	US $ (Million)	Percentage %
USA	3.467,2	61,15
UK	670	11,84
Japan	204	3,6
Germany	180	3,4
Canada	85	1,5
Belgium	80	1,41
Netherlands	72	1,27
Switzerland	68	1,2

Source: http://www.nasscom.in, 2002; web site data.

Table 3.5 indicates the major territories to where Indian firms export software services, mostly. According to statistics, the Indian software industry's export revenues come from U.S. as 61,15%, United Kingdom as 11,84%, Japan as 3,6%, and Germany as 3,4%. This statistic proves that U.S. firms are the foremost customers of Indian software services export projects; other countries have quite small percentages. However, this position is quite risky for Indian software industry. Whenever any crises or problems occur in US economy or software industry, directly affects Indian software industry. Therefore, Indian government should tend to other world markets, too.

Table 3.6 Location of Primary Competitors of Indian Software Firms

Location of Competitors	Number of Firms	Percentage of Firms
India	75	82%
Israel	12	13%
Ireland	12	13%
USA	58	63%
Singapore	19	21%
Philippines	6	7%
Eastern Europe / Russia	10	11%

Source: Carnegie Mellon University (CMU) Software dataset, 1999

Moreover, Indian firms have competitors from other countries in the scope of software export projects. Table 3.6 indicates the primary competitors of Indian software firms; U.S. firms are the main competitors with 58 firms and 63% percentage, Singapore 21%, Eastern Europe and Russia 11% follows the U.S. firms. In addition, Philippines and China will be other main competitors of Indian firms in near future, because of low labor cost advantageous.

3.3. Indian Software Industry Development Components

3.3.1 Human Resources

In glance of historical perspective, several national successes have appeared by converting national weaknesses to competitive strengths for societies and states. Indian software industry almost proves this view. A few decades ago, India had quite crowded population, like as today (nearly 1.080 million in 2006) and in this population there has been considerable amount of talented and educated workforce which includes many graduated engineers, mathematicians or any kinds of scientists. High graduation ratio caused the problem of high rate of unemployment which was significant weakness for Indian economy and Indian state. Then, India has converted this weakness to a competitive national advantage by assistance of the investments in information based industries, for instance in software industry, via state policies and strategies. The competitive advantage of having excess supply of plentiful trained, low-waged software professionals have made the software projects less costly if software systems are completed in India with Indian national sources.

> The initial growth of the Indian software industry was undoubtedly due to the fortunate circumstance of an excess supply of engineers and scientific labor. As the cost-quality advantage of Indian programmers was realized there was fierce competition for the scarce resource-Indian software programmers- both by foreign competitors who persuaded the their governments to relax immigration laws and increase visa quotes for Indian programmers and later MNC subsidiaries that came to set up firms in India. The stock of engineers rapidly depleted and by the mid-1990s there were signs of a growing tightness in the labor market. A state of 'educational emergency' was declared by the government in 1998-99 in response to the growing scarcity of engineers as demand for them mushroomed. The three new Indian Institutes of Information Technology were set up and private training institutions boomed. (Arora, Arunachalam, Asundi, Fernandes 1999. 1267-1287)

Furthermore, Indian government has generated a national strategy which aims to increase the supply side of software professionals and staffs. Therefore, the government has commenced to found information technology institutions, to give authorization for private institutions and new departments related with information technologies in the universities and colleges.

> A potentially serious constraint on the ability to rapidly increase the output of trained software and computer engineers is the shortage of engineering doctorates being awarded in India. Recent data show that the PhDs awarded in engineering disciplines have fallen from their high of 675 in 1987 to 375 in 1995. This case indicates the insufficiency of academic staff potential of Indian IT industry. (Arora et al 2001: 3)

Furthermore, the demand side of software programmers and engineers has outranged the supply side and this circumstance cause to problem of wage increases and the most important competitive advantage of Indian software industry was under risk. In addition, high employee turnover rates have been another kind of problem for Indian software industry, especially, for the complex project-oriented firms which have had long-term projects mostly and the employee turnovers have caused to deceive the accumulated specific knowledge for the projects.

3.3.2 Finance

From a general perspective, product oriented, exporter software firms require more financial investments and sources than only domestic market oriented service firms in software industry. As known, these firms strive for value-added projects and add considerable amounts of benefit for national economy with these high-value added operations. Thus, if a national software industry is willing to raise software development capability, has to increase great deal of financial funds for R&D activities. Otherwise, the industry could not organize competitive national software firms of which products couldn't compete in the global software industry market.

> Obtaining finance is, however, a major concern for firms developing software products. In contrast to services, a substantial investment is required to develop the product, and even more to market the product. Firms that are trying to develop software products have faced problems in getting finance, in part because the inexperience and conservatism of Indian venture capital funds. The problem, it appears, is as much on the demand side as on the supply of venture capital. (Arora et al 2001: 22)

For Indian software industry; the lack of financial funds and venture capital are quite important problems, because, getting venture capital funds is quite difficult for Indian national firms. Therefore necessary R&D investments are not sufficient for an exact development in national software industry, because venture capital logic is not common in Indian software industry, as in many other developing countries.

3.3.3 Communication and Physical Infrastructure

Indian economy has increasing growth trend, however, there exists common poverty throughout the country.

> Although GNP is $658.8 billion, per capital income is only $558 because of the 1.080 million populations. (Economist Intelligence Unit, 2006)

In addition, this poverty may be illustrated by inadequate physical infrastructures, such as, electricity infrastructure problems, transportation insufficiencies, communication problems, lack of necessary technological infrastructure etc. and these problems hinder the developments of national software industry in India. For instance; export oriented software firms complain about communication infrastructure that is vital for software development projects. On the other hand, national firms can not spread throughout the country because of the transportation, electricity and also communication infrastructure problems which affect the diffusion of internet service throughout the country.

In conclusion, the Indian government has to smooth these hitches in order to get broader scale development in national software industry.

3.4 Software Service Export within Different Forms

Mainly, there are three different methods for software service export oriented projects. These models diversify according to management, development and organization methods of projects. The first method is entitled as “on-site projects method” in which the client firms take whole control concerning all the stages of software development projects, such as; requirement analysis, high level design, development phases, defining the deadlines, managing and organizing all the stages etc. The second method could be described as a shared model of onsite and offshore software development methods. For instance, the Indian firms’ programmers are invited to customer site for several phases and they come back to India in order to develop software offshore with Indian local sources. In this strategy, firms mostly need professionals, specific software development methodologies, capability of software development and software development expertise. Eventually, the third method indicates the advantages of hiring developing countries’ talented professionals and programmers for quite lower wages and counts them in the software development projects which occur in their own countries.

> Given the tight labor market conditions in the US, especially for IT workers, the availability of software development services from India has been of substantial value to many large and medium-sized US firms that have been able to free up their in-house IT staff for more valuable and creative projects…US firms do not outsource requirement analysis, specification, and high-level design, nor do they outsource

> large scale system integration types of activities to India. However, the leading Indian software firms do have the ability to provide these high-end services. (Arora, Arunachalam 1997: 5)

For instance in India, this method is especially carried on in Offshore Development Center. The projects, which are coordinated within the scope of this type of strategy, have generally long-term agreements with fixed prices and certain time and deadlines. During the software development processes, the Indian firms or MNCs' Indian subsidiaries send uncompleted projects to main office of the firm periodically and the project owner firm controls and audits the software development circumstance according to the agreement and declare the suggestions about the affairs. On the other hand, the security is another important point for this kind of method, because, the client firms (mostly from U.S. or European Countries) are willing to get special places, which are isolated from all the departments of their firms, in order to get the secrecy and privacy about software development projects. Besides, this type of software development strategy (3rd method) is the most advantageous strategy for western firms according to project cost factors.

Table 3.7 Software Professionals: Comparative Salaries, 1997

Designation	United States ($ per annum)	India ($ per annum)
Programmer	32.500 - 39.000	2.200 – 2.900
System Analyst	46.000 - 57.500	8.200 - 10.700
Programmer Analyst	39.000 - 50.000	5.400 – 7.000
Network Administrator	36.000 - 55.000	15.700 - 19.200
Database Administrator	54.000 - 67.500	15.700 - 19.200
Software Developer	49.000 - 67.500	15.700 – 19.200

Source: INFAC, 1998
Note: Firms which have at least 50 software professionals

As indicated in Table 3.7, the firms could hire a software programmer for minimum $32.500 in U.S., however, the same level qualified programmer earned maximum $2.900 in India in 1997. Additionally a programmer analyst might earn between $39.000 and $50.000 in U.S. in 1997 however in India this job was worth only between $5.400 and $7.000. Therefore, MNCs strategy of hiring Indian workforce in India is quite logical than inviting them to western countries with paying visas, accommodation, transportation expenses etc. Therefore, MNCs left the on-site service strategy and began to outsource low value added phases to India.

In epitome, although outsourcing software development projects to India obtains significant cost advantageous for multinational firms, these low value added phases do not provide significant contribution to Indian economy.

3.5 Geographical Dispersion of Indian Software Firms

There are two various kinds of firms in Indian software sector, such as; the first group firms were already exist in IT industry, however, have changed their business scope from hardware production or other kinds of IT services (system integrator etc.) into software development scope. The second group includes newcomer software firms which only focus on software oriented projects. Mostly, these firms are established by experienced managers of foreign software companies. In addition, these firms mostly intensify in Madras, Bombay, Pune and Bangalore.

> The basic infrastructure required for software production, viz. stable electricity and good communication were available only in some regions. The Bombay-Pune region was particularly favored for its stable electricity and the first export-processing zone began there. Bangalore, which had several space and electronics research labs, was another favored location. Delhi was also a favored location possibly due to its proximity to the central government. (Arora, Gambardella, 2005: 23)

Table 3.8 Revenue Distribution of NASSCOM Member Firms (n=405) by geographic region

Region	Revenue ($M)	Number
Mumbai	539,8	86
Bangalore	323,6	84
New Delhi	152,9	72
Noida & Gurgaon	132,9	23
Chennai	130,9	34
Hyderabad	62	21
Pune	57,7	21
Calcutta	44,8	26
Gujarat	3,1	13
Kerala	1,4	7
Other	8,3	18

Source: http://www.nasscom.in, web site data.

Table 3.8 indicates the geographical dispersion of software firms in India. As seen, the cities of Mumbai, Bangalore and New Delhi are the most important cities and nearly 70% software export revenue comes from these cities. In addition, although Indian software industry spreads to west and south of the country, the foreign software firms are located in Bangalore mostly. This statistic considers that Indian software industry do not have widespread software business awareness in all cities and regions of India, yet.

Table 3.9 Number of Capacity of Engineering Colleges in India, Approved up to 1998-99, by region

Region	Number Colleges	Sanctioned Capacity (number of students)	% of Sanctioned capacity at Self-Financed Colleges
Central	50	9.470	0,52
East	25	4.812	0,26
North (inc. North-West)	140	25.449	0,42
West	140	34.165	0,74
South (inc. South-West)	308	82.597	0,79
Total	663	156.493	0,69

Source: Ramarao, 1998

Besides, in table 3.9, geographical dispersion of engineering colleges is illustrated. In the south-west side of India, includes the cities of Mumbai and Bangalore which are the most important cities for Indian software industry, there are 308 colleges and this amount of colleges equals to the half of all Indian engineering colleges. Therefore, MNCs and other Indian firms generally locate in this geographic area where the main location for engineering education.

3.6 The Problems of Software Service Exporter Firms in India

> The Indian software industry faces a number of challenges as the labor cost advantages diminish and competition from other countries with supplies of educated and underutilized workers increases. (Arora et al 2001: 3)

One of the most important problems is increasing rate of programmers' wage costs and the difficulties about hiring and retaining talented software professionals. In addition, from countries perspective; there are rival countries which have competitive wage costs for software development projects, China, Russia, Philippines, and East European Countries that are in competition with India in software development services export.

In order to eliminate these problems and risks; Indian firms should pass through the next step via focusing on high-value added phases of software development projects, such as, requirement analysis and high-level design which require considerable know-how and sufficient technical capability in order to analyze and understand the customer demands and shape the software systems according to these needs. Thus, Indian software developer firms could have a transition from low-level and coding steps towards requirement analysis and design phases. In

addition, this transformation becomes more meaningful by combination with marketing capabilities; because, when a firm develops a software system or package, the main success occur by marketing this product. Therefore, marketing is the vital point for software development projects. Unfortunately, Indian firms are not as successful as U.S. firms in marketing stage. Therefore, Indian firms have to develop marketing capabilities and define the successful marketing strategies for their own software projects.

Venture capital is another vital problem for software development projects, because, the firms, which are willing to move up the value chain is software industry, have to attract venture capital funds and financial supports inevitably. Especially, product development and marketing phases require significant amount of investment, in this respect, Indian firms have difficulties of getting finance sources; the unawareness of venture capital logic, inexperience of venture capital firms and conservatism of venture capital firms in India could be considered.

> A manager for a venture fund run by a public sector investment bank noted that although they had invested in as many as 32 firms in the past, only 5 were product focused, the rest being software service firms focusing on exports. (Arora et al 2001:13)

In addition, weak intellectual property rights could be considered as another problem of Indian software industry and could be eliminated by Indian government policies and attitudes.

Table 3.10 Major Problems for Indian Software Firms

Problem	Export	Domestic	Total
Manpower shortage/skills	57	32	89
Employee attrition	44	27	71
Physical Infrastructure	12	12	24
Commercial Infrastructure	24	17	41
Quality Certification	11	6	17
Visas	33	NA	33
Finance / Capital	20	14	34
Marketing Access	42	17	59
Lack of Domestic Computerization	6	21	27
Lack of Government Support	10	11	21
Tarrifs and Other Barriers	11	8	19

Source: Carnegie Mellon University (CMU) Software dataset, 1999

Table 3.10 indicates the answers of 104 (domestic and export market oriented) Indian software firms for a questionnaire regarding major problems of industry. For instance, manpower shortage/skills, employee attrition, marketing

access and commercial infrastructure could be considered as the most important problems. In addition, finance, the difficulties for getting visas, lack of domestic computerization and lack of government support are also considered as other major problems. In this respect, India should tend to eliminate the financial problems, workforce insufficiencies, marketing and commercial infrastructure problems urgently for both of domestic and export oriented firms.

3.7 The Approaches for Indian Software Industry Achievement

> In India, the combination of the enormous population, the excellent engineering education system and the fact that there are few alternative careers for engineers created a giant pool of software talent (approximately 200.000 in 1995). Clever entrepreneurs and effective government policies turned that resource into an important export industry for India. However, although there are talented programmers all over the world, there are no other countries in which we find an enormous and underutilized engineering talent pool combined with English competency, systems and communications infrastructure, and the entrepreneurial energy that made India's software industry such a success. (Barr, Tessler 1996: 11)

Although India has a poor economy and insufficient IT and communication infrastructure, Indian software service industry has grown enormously and become an achievement case for other developing countries. In this part, this contradiction and the reasons will be analyzed regarding Indian software industry's success story within various, independent approaches.

One of these approaches comes from Richard Heeks who advocates that India had an absolute advantage concerning comparative software wage costs against other developed countries and this advantage was the main explanation of Indian software growth and software service export income. As far as, this absolute advantage takes an important role in order to analyze the Indian software industry; however, this approach is insufficient alone in order to explain the whole structure of this growth.

From another perspective, some studies (for instance by Ghemawat) advocate that Indian software success is totally the result of liberalization policies of 1990s. Actually, these policies have important effects on the developments of national software industry; several liberalization policies have provided benefit to Indian software sector, such as; the entrance of foreign competitors and firms was facilitated and tariffs on IT devices were diminished. Unfortunately, this approach is not sufficient in order to explain this export growth, completely. Actually, 1990s

Indian software export boom was based on the result of the state policies of 1980s and those years' state policies and strategies have appeared merely in 1990s.

From the side of comparative advantage, several analysts advocate that although other Indian sectors have wage cost advantages according to other developing countries' sectors, however there are no any considerable export successes for these sectors as in software industry. What are the main reasons for this fact? Generally, the answer emphasizes importance of the productivity of software industry which is not certainly enough in order to explain whole of success in software export.

Finally, all these approaches and interpretations are insufficient one by one in order to explain the Indian software industry growth totally; however, all of them become much explanatory for the growth of Indian software industry in an integrity form. In addition, there are also other factors which have shares in the growth of Indian software industry, such as; communication language of English, talented programmer pool, relations with US, increasing rate of global IT market, invention of personal computers etc.

3.8 Heeks' Software Strategies in Developing Countries Model Classification-India

Before 1990s, global software industry set the relations with India in the model of hiring excess supply of Indian qualified human resources for the projects in US. This model was called as "on-site (on customer-site) services model", in multinational firms' home countries. However, this model caused to extra costs (accommodation, visas, transportation etc.) for development projects.

Specifically in 1990s, multinational corporations realized that outsourcing operations to India provided workforce cost advantages for software development projects. In respect, MNCs began to establish their Indian subsidiaries with the assistance of government liberalization programs and strategies.

In time, Indian software industry attained to significant amount of software service export revenues by both of Indian national firms and multinational subsidiaries. However, majority of these outsourced phases of software development projects were low value added operations of development projects.
According to IDC 2001 data, global market of software services over $400 billion in 2001. India was the leader software service exporter country and software services

export reached to only $7.5 billion and gets only 1.88% share in global market of software services. This statistic proves that Indian software industry undertakes the low value added service side of global software industry with qualified workforce.

In this perspective, according to Heeks' "Software Strategies in Developing Countries" model, Indian software industry could be classified in Approach A, because, software firms mainly focus on service-intensive part of software development projects and export labor-intensive service phases to developed countries' multinational software firms both of "on-site services model" and "offshore model".

In conclusion, Indian software industry is one of the most significant software service exporter countries in global software industry especially via significant labor cost advantageous and excess supply of qualified human resources. In this view, mostly low value added phases of software development projects are completed and this is a quite significant problem for the future of Indian national software industry.

3.9 Conclusion

> As a result, the Indian software export industry, which started out as a cost-savings alternative, has become a major source of talented programmers and software development services. Indian businessmen have reduced the discount they need to offer to get repeated business from customers, and have grown their business by word-of-mouth based on successful projects. At the same time, US software and high-tech firms have opened subsidiaries in Bangalore to tap into this talent pool directly and attempt to realize increased cost savings. (Barr, Tessler 1996:10)

Indian software industry is an export-oriented service industry; however mostly execute the low value added and tedious tasks in software development processes. This case is quite significant deficiency for Indian software firms, because these routine tasks, which are repeated and low valued activities, have caused to limit the learning potential of Indian software firms. Therefore, recently, several firms have begun to complete the greater software projects and these firms have commenced to execute the high value added phases in their own facilities, not in U.S.

Meanwhile, Indian government applies strategies in order to promote IT and software sector in India; such as; telecom reforms have been routed by liberalization period and policies; internet services have been opened up, voice over internet, satellite international gateway have been allowed, also the custom tariffs have been

decreased. In addition, some financial reforms have been applied by Indian government, such as, fiscal incentives, the allowance for FDIs (foreign direct investments), the custom duties have been decreased to zero for import of software and hardware if they would be used for export projects and 100% income tax exemption up to 2010. Although all these strategies and policies;

> India has the largest number of people working in the industry as well as apparently the highest rate of growth of revenue, but also the lowest revenues per employee. Whereas the Irish and Israeli firms appear to earn as much as $100.000 per employee or more, firms in the Indian software industry earn only about $15.000. This difference is intriguing, and a matter of some concern for managers and policy makers in India. (Arora et al 2001:7)

Moreover, Indian firms complete software projects for many different industries; manufacturing, banking and insurance, telecommunication, transportation, etc., and the most important customers are the large U.S. telecommunication firms. On the other hand, these Indian firms serve for different computer systems, such as, mainframe systems, open systems, Windows and NT platforms etc.

For the future, Indian software firms aim to be software system solution providers which could transform customer demands and needs into business solutions. In addition, Indian firms could describe new customized methods and techniques which have never used before by software service exporter countries. Separately, these firms should strive to produce new software products and new technologies in order to take a competitive advantage against the other countries' firms. Thus, the software service export will gain higher value added tasks and this position will assist Indian firms to come closer to U.S. firms in global software industry arena. In this perspective, Indian government is applying an extensive strategic plan to make India as one of the most important countries for software industry and to achieve the amount of $ 50 billion in software exports by 2008.

CHAPTER IV

IRISH SOFTWARE INDUSTRY

> In the future we will have to put a greater emphasis on creating our own Michael Dell or Bill Gates rather than importing them. (Irish Times, 2004, (Ireland Minister for Enterprise, Trade and Employment))

The 3Is - India, Ireland and Israel - have similar success stories regarding investment in software industries especially within last two decades. In addition, these countries are significant model countries for the concept “rise of software industry in emerging economies”.

> These countries have benefited from historical linkages with the US and the UK which have been reinforced by the communities of expatriates working for leading information and communication technologies (ICT) producers or big users such as financial institutions. These linkages have promoted the inflows of capital, ideas, business models, and technologies. (Giarratana, Pagano, Torrisi 2003b: 2)

In this perspective, as Indian software industry chapter, the motivation of this chapter aims to define historical development periods, main advantages and challenges, the structure and characteristics of Irish software industry. The chapter begins with the great transformation of Celtic Tiger economy via including development periods of software industry, for the second part determine the development components of software industry, thirdly, study the sub-sectors of Irish software industry in the scope of national and overseas industries.

4.1 The Great Transformation of Irish Celtic Tiger Economy (Development Periods of Irish Software Industry)

Ireland was in political and economic difficulties for years; long-term conflicts with Great Britain in order to emerge a free state, and also civil wars within borders. At the end of these dispute terms, Irish State has been founded. Because of the aim of being a self-sufficient country within economic perspective, protectionist policies

and strategies were applied and state-owned enterprises were also established. For the first years, considerable economic growth did not emerge and the unemployment had increased enormously, thus emigration became one of the most important national problems. From industrial perspective, Ireland economy based on traditional agriculture and fishing activities in those years, and also there was only primitive state owned manufacture industry.

> Full integration into the international economy has been the central plank of Irish economic policy since the early 1960s and protectionist measures were almost completely dismantled by the 1970s. When most national economies were still attempting to negotiate with and control foreign capital, the Irish state turned itself to a relatively unconditional pursuit such investors – creating the first free trade zone in the world in 1958 (at Shannon), providing generous tax incentives and grants, a transnational-friendly environment, a young and cooperative labor force and, in the 1980s, a world class telecommunications system. An array of financial incentives has been offered for foreign investors and exporters in Ireland over the past 40 years. (O'Riain, 2004a: 648)

4.1.1 Joining to EU and Technology Awareness Years

In 1970s and 1980s, Ireland economy was in a great depression of double digit unemployment, unpreventable emigration from Ireland to other European countries, a great deal of national debt and of course national poverty. When Ireland joined to European Economic Community in 1973, was the poorest member within this union according to economical statistics. As indicated in Table 4.1, in 1973 GDP per capita was $13.416 for Denmark, $13.152 for Germany, $11.905 for Belgium, however, only $7.023 for Ireland.

Table 4.1 GDP per capita in 1973

Countries	GDP per capita
Denmark	$13.416
Belgium	$11.905
France	$12.940
Netherlands	$12.763
Germany	$13.152
Italy	$10.409
Ireland	$7.023

Source: http://www.nationmaster.com; web site data.

In this perspective, Ireland state began to determine and apply strategically important policies in order to get welfare in social and economic titles for long term

period and overcome the increasing budget deficit and high unemployment rate problems. In the course of time, the strategic state policies, tax incentives, investments for education, infrastructural policies became the priorities of Irish state. In order to carry out these state plans and policies, government strived to get financial sources.

> The financial transfers of European Union played important role especially in 1980s and the early 1990s in order to apply these strategies. The absolute magnitude of net transfers averaged approximately IR £700 million in 1980s and IR £1.6 billion in the 1990s. Compared to other EU countries, Ireland was perhaps the most-favored recipient on a per capita basis. (Braunerhjelm, Faini, Norman 2001: 70)

In addition, since end of 1970s, state funds were mostly used to develop the quality and perfection of Irish education structure, such as, these funds were spent for boarding Regional Technical Colleges (RTC) and founding new universities and technology oriented departments. In this perspective, IDA (Industrial Development Agency) was founded and taken the responsibility of attracting RTCs in order to focus on especially new generation technologies, for instance, information technologies.

> During the 1970s the IDA perfected its approach by targeting selected industries, and high performing companies within those industries. Electronics and pharmaceuticals were the first industries to be identified by the IDA as offering the best opportunities for Ireland's drive to industrialize through FDI. These sectors remain to this day the two most important sectors of FDI in Ireland. Subsequently other sectors were seen as having good potential for Ireland - health care, and more recently software and financial and other computer based services. (O'Connor, 2001. 8-9)

Also, IDA has founded and launched international services programs in order to provide financial incentives for firms. Thus, especially American software firms began to use Ireland to localize their products for European markets. Firstly Microsoft, Lotus (IBM) and Digital Equipment (HP) came and invested to Ireland and Oracle, Novell and SAP has followed these firms in order to invest. The majority of these firms came to Ireland in order to complete their low value added phases of project, however, there were a few firms investment in Ireland in order to achieve R&D operations, develop new software systems, not only for logistic or localization operations. For instance, SUN Microsystems and Motorola invested in Ireland in this perspective.

4.1.2 After 1990s and Today

The multinational software investments in Ireland, generally focused on low profit rated, low skilled service projects for the first years.

During 1990s, Irish national industry had realized this problem and got a switch from service projects to product projects and from local market to export oriented market via government venture capital funds. In this perspective, National Software Directorate was set up in 1991 and managed the state-sponsored venture capital fund, which was the key of acceleration of growth for 1990s.

Table 4.2 Software Industry Employment Compared to Leading Manufacturing Sectors

Sector	Employment 1997	Employment Growth 1993-1997
Metals and Engineering	93.000	24.300
Food	40.300	5.300
Chemical (incl. Pharmaceuticals)	21.100	4.600
Software	**19.000**	**10.057**
Paper and Printing	15.200	300
Processing of Plastics and Rubber	11.100	1.400
Clothing, Leather and Footwear	10.100	-600
Textiles (incl. Knitting)	8.700	-1.300
Timber and Wooden Furniture	8.400	1.400

Source: Crone, 2002

From statistical perspective, development of Irish software industry is illustrated clearly for 1990s, in Table 4.2. While the employment rate was nearly 9.000 in 1993, this amount increased to 19.000 in 1997 via the growth rate of nearly 110% between 1993 and 1997 for software industry. This significant growth was the outcome of investments in education sector especially after 1960s and high-tech industry oriented government strategies. In this respect, as seen there is a clear shift in Irish employment from clothing, leather, footwear, textiles sectors to high-tech industries, such as, chemical, engineering, pharmaceuticals, software etc.

> Software accounted for $2.8 billion in exports in 1993 and employed 9,000 people. By 1995 this had risen to $4.4 billion and 11,784. Ireland is currently one of the leader software exporter countries although this figure is deceptive as a great deal of revenues come from the translation, duplication and assembly of packaged software for transnational corporations such as Microsoft, Claris and Symantec. (O'Riain, 1997: 11)

> For 2005 data, Irish software industry consisted of more than 900 companies, 140 of them foreign, employing 24,000 people and exporting over €23bn worth of products and services. Irish companies account for almost €1.2bn of that. (Gallen, 2005: 2)

Table 4.3 Institutional Changes in the Irish Political Economy, 1960-2000

Period	Developmental State	Distributive State
1960-1973	I. Move to Attracting FDI	I. Welfare State Expansions
	II. Integration into International Economy	
1973-1987	III. Consolidation of FDI Policy	II. Welfare State Consolidation
	IV. Consideration of Supplementary Strategies in Face of Industrial Contraction	III. Rapid Expenditure Growth
1987-2000	V. Increased Focus on Indigenous Industry and "Deepening"	IV. Structural Adjustment with Social Partnership
	VI. Definition of Key Sectors and Activities	

Source: O' Riain, O'Connell, 2000

Table 4.3 illustrates the institutional change of Irish political economy from 1960 to 2000s. Especially, attracting FDI and integration into international economy policies provided significant infrastructure for Irish economy, however, these policies were insufficient in order to get a national development. In this perspective, state policies began to emphasize the importance of indigenous industry especially after 1990s via defining the key sectors and business activities. Today's success on ICT industry, also software industry, is the conclusion of these planned investments and strategic policies.

4.2 The Development Components of Irish Software Industry

> The Republic of Ireland is an ideal case in which to assess the prospects for NICs (Newly Industrializing Countries) of achieving goals. Since the late 1980s it has attracted a greatly disproportionate share of U.S. information technology foreign direct investment in Europe. It has also developed a healthy indigenous electronics sub-supply sector and a growing indigenous software industry. The information technology sector has been the driving force behind the fastest GNP and employment growth levels within the European Union in recent years – although some of this growth is illusory due to the repatriation of profits by transnational corporations. (Shirlow, 1995: 687)

Principally, Ireland determined and applied a comprehensive state policy in order to provide high-tech industrial development by the assistance of increasing rate of export oriented foreign investments. During this period, provision of the developments for national software industry was not the main target of national

strategy, however indigenous software industry came out as a consequence of well defined state strategies and significant global factors. These factors could be considered as; global demand for ICT, investment in IT education, well defined state policy, impact of MNCs, European integration and the effects of globalization.

> Some crucial local factors, such as heavy investment in education (especially engineering and computer science), an English-speaking workforce and an investment in telecommunications, prepared Irish firms to take advantage of opportunities in the newly created independent software industry. Internship programs in computer science degrees and the development of software engineering quality programs in universities helped to foster industry-university links. (O'Riain, 1997: 29)

4.2.1 National State Policy Regarding High-Tech Industries

After Second World War, Irish governments realized the importance and necessity of foreign investment in order to get a developing national indigenous industry, for future decades. Therefore, the vital physical and managerial arrangements, which were necessary for attracting the overseas investments, were determined and prepared by Irish governments.

> The Industrial Development Authority (IDA), established in the 1950s, played an active role in soliciting foreign investment and provided substantial-and frequently controversial-subsidies for many firms in the form of no repayable capital grants, ready-made facilities, training, and research and development (R&D) grants. (Burnham, 2003: 538)

> The strategy consists of linking Irish firms with global business networks, either directly or indirectly through MNCs. Since the end of the 1950s the Irish government has prompted development through policies of 'industrialization by invitation' of foreign investment. These related policies regarding investment in education and infrastructure (IT, electricity, transportation etc.) and financial incentives, as taxes. (Tallon, Kraemer, 1999)

Irish national telecommunication infrastructure was quite insufficient and was one of the worst in Western Europe in 1980s; in addition, was quite overstaffed, inefficient and obtained ex-technologies equipment and devices.

> In this situation, IDA became an important lobbying force for change, emphasizing to ministers, mandarins in the Department of Finance, and parliamentarians in the Dail the linkages between creating new jobs and upgrading a primitive telecommunications system. (Burnham, 2003: 543)

The telecommunication case was strategically important factor in order to attract foreign investors; therefore Irish government and IDA had taken the responsibility and began to lobbying activities. IDA prepared briefings and meetings with government ministers in order to tackle the telecommunication system problems. In this plan, telecommunication market was opened to private sector and other reforms came into existence within this period. For the result, in the beginning of the 1990s, Telecom Eireann was the leader position in other telecommunication entities in Europe, especially for international services and charges; because in those years Telecom Eireann had completed the digital switching for all over the country.

Moreover, state institutions have played major roles, in 1994 Ireland Republic founded an institution; called Forfas, aim to encourage and support the scientific and technological developments which are occurred by domestic investors and entrepreneurs. In addition,

> The main responsibilities of Forfas which are arranged following; Organizing Competition, Defining the Science Technology and Innovation Policies, Organizing Foreign Trade, Determining Regional Infrastructure Priorities, Organizing Regional Infrastructure Database, Analyzing Communication and Retail Sectors, Supporting Entrepreneurship etc. Besides, The Irish Council for Science Technology and Innovation - (ICSTI) has already focused on national science and technology policies and strategies, too. (http://www.forfas.ie)

> One important step forward was taken, however, in tax policy. The European Commission objected to the tax exemption on export-derived profits as excessively discriminatory. (The Existing statutory rate on domestically traded output was 50 percent.) In 1978, the Irish government negotiated a very favorable “compromise” that enabled it to make a twenty-year commitment to a 10 percent rate on all manufacturing, while still honoring the zero-rate, twenty-five-year commitments made to earlier investors. (MacSharry, White, 2000: 249-250)

The tax incentives began to be applied in order to attract foreign investors via decreasing their operational costs in Ireland. In this way, the state has decreased the corporate taxes from 40% to 10% for export-oriented foreign companies and guaranteed this rate until 2010. Thus, this policy created a hospitable environment for multinational corporations. In order to compare the corporate taxes with other countries; while corporate tax rate was 40 percent in Germany, 39.5 percent in US, 30 percent in UK in 1981, 10% tax rate of Ireland was quite impressive. (Arora, Gambardella 2005: 60)

> It is also likely that stable government has played some part in the success story. Irish politics is dominated by centrist parties so that when new governments take over, any changes in policy towards industry are barely discernible. For example, in

> early 1997, the government announced a doubling of the number of college degree places for software. A few weeks later, it lost an election and a new government took over. The new government immediately endorsed the expansion, and voted even more funding to support it. (Gallen, 2005: 3)

In conclusion, Ireland has obtained an enormous success by determining the correct state policies and strategies via applying them at the right time with correct tools effectively and continuously.

4.2.2 National Education Policy and Human Capital

> The restructuring of Ireland's educational policy formed to cornerstone of the country's success resulting in an education system that was specifically designed to meet the needs of industry, providing an ample supply of highly skilled graduates from educational institutions that demonstrated a flexibility rivaled by few. The accumulation and building up of the national stock of human capital in Ireland began well before the international skill shortage became a serious bottleneck and was undoubtedly assisted by a skewed demographic profile. (Arora, Gambardella, 2005: 60)

The second significant factor is national education system and educated Irish human capital; the result of collaborative studies of IDA and Irish governments since 1970s. Ireland national education system mainly aimed to supply highly skilled and new generation technologies oriented (engineering and computer sciences) human capital. In addition, young and skilled, English speaking workforce was considerable source for other European countries' aged population. Thus, especially in 1990s, MNCs began to invest in this country as realizing the excess supply of educated and highly skilled young workforce potential.

In addition, these policies caused to immigration to Ireland. Such as; one of the most important problems of Ireland was the brain drain; the young population had begun to emigrate from Ireland to the rest of the world, because of the high unemployment rates in country for previous years and these people had got job opportunities in other countries, especially in U.S. However, in mid 1990s, when the economic stabilization and employment opportunities were provided in Ireland, those people began to immigrate to Ireland via Irish government impressive strategies and policies.

In this term, the assistance of EU funds was the most important financial support factor for national educational policies. As follows, Ireland governments have received nearly €10 billion between 1989 and 1998 from European Structural Funds and spent the larger proportion of these funds on human capital, not for

physical infrastructure. Therefore, for today, Ireland has highly skilled workforce and the future provides many opportunities with the assistance of this trained population.

4.2.3 External Factors of Ireland Software Industry Success

There were also external factors, which contributed to the growth of Irish software industry, such as, increasing importance of the globalization, European integration, increasing demand for software products and services because of ICT technologies growth. At those years, Ireland had comparative advantages compared to other EU countries, such as, Ireland was one of the two English speaking countries in union and Ireland had historical relations with US because of the outward emigration of Irish young population in order to get job opportunities in previous years. Therefore, US IT firms also were willing to invest in Ireland.

Irish state formed essential infrastructural requirements and sufficient incentives in order to attract the foreign corporations regarding investment software operations in Ireland. The main contribution of these overseas investments was transferring IT projects culture to the potential indigenous national firms in Ireland. The second important contribution of these overseas companies was outsourcing some of operations to indigenous Irish firms, and this collaboration created new job opportunities and a potential job experience for new indigenous software firms. In these projects, Irish firms also got the reference projects for abroad export markets and realized the importance of the quality standards within software projects. Besides all these, unfortunately, the business mostly contained low skilled and low valued added operations.

> Many foreign-owned firms in Ireland, such as Microsoft, Claris Manufacturing and Symantec, still concentrate their local operations on low value added, low skill manufacturing activities such as porting of legacy products on new platforms, disk duplication, localization (text translation, changing formats etc.) and assembling/packaging. (Giarratana et al, 2003b: 9)

For instance, in 1985 Lotus, and in 1986 Microsoft set up their operations in Ireland in order to outsource disk duplication, manuals printing and packaging operations in Dublin.

4.3 Sub-Sector Analysis of Irish Software Industry

> In total, there are more than 800 international and indigenous software companies located in Ireland, employing over 25.000 people and generating a combined turnover of IR £6bn. Of these all figures, the indigenous sector employs more than 11.000 people and generates revenues of IR £1bn. In total, the software sector in Ireland is responsible for nearly %8 of Ireland's GDP and nearly 10% of its exports. (Hot Origin, 2001: 5)

Table 4.4 Geography of Leading Indigenous Software Firms in 2001

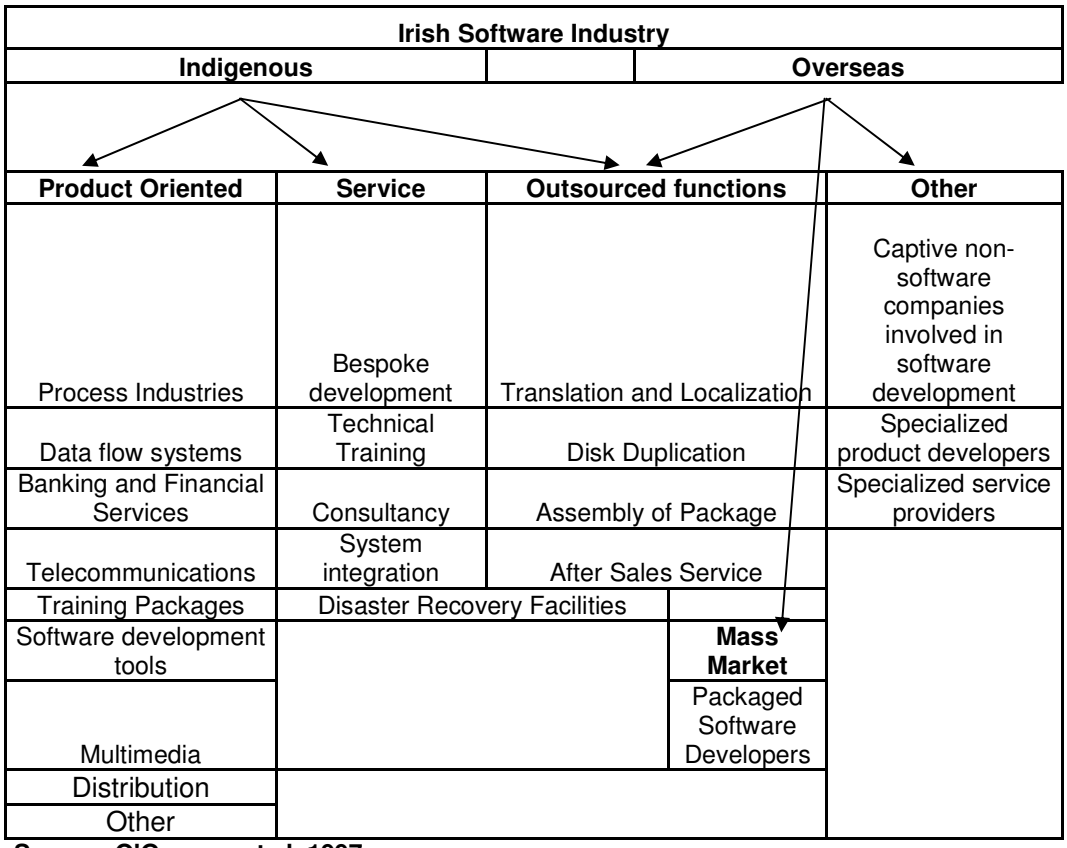
Location	Companies		Employment		Average Size
	N	%	N	%	
Dublin	96	76%	8.424	87,0%	87,8
Cork	7	6%	469	4,8%	67
Limerick/Shannon	7	6%	275	2,8%	39,3
Galway	8	6%	226	2,3%	28,3
Other	4	3%	134	1,4%	35
Unknown	4	3%	140	1,4%	33,5
Total	126	100%	9.688	99,7%	76,9

Source: http://www.idaireland.com, 2001 data.

Mainly, Irish software industry has located in Dublin region mostly, and Cork, Galway and Limerick could be considered as other less important regions. As illustrated in Table 4.4, Dublin is clearly the capital of Irish software industry by having nearly 76% of companies and 87% employment rate. As seen, software industry awareness is not homogeneous across the country; therefore government (IDA and Enterprise Ireland) strives to spread the software industry throughout Ireland. Thus, infrastructure; transportation and communication investments have been increased in less developed regions in order to spread software firms within these locations, too.

> There are two branches of the industry: an overseas sector, dominated by US multinational companies engaged primarily in software logistics, localization, and development, and an indigenous sector populated by small and medium-sized Irish-owned firms, engaged in software development activities, many of whom are "gaining growing recognition in international market". (O'Riain, 1997: 185)

In sum, Irish software industry includes two main types of platforms; the first group includes multinational software companies' Irish subsidiaries which are mostly U.S. origin and generally carry out low-value added operations, such as software localization, logistics, distribution etc. operations, however, the second group includes indigenous software corporations which are small or medium sized, however, mostly software development oriented firms for niche sectors.



Source: O'Gorman et al, 1997

Figure 4.1 Structure and Sub-sectors of the Irish Software Industry

Figure 4.1 indicates the main business scopes of two sub-sectors; indigenous and overseas software industries. Indigenous industry mainly focuses on product oriented, service and outsourced businesses, however, overseas industry mainly tends to outsourced functions and mass market. Although indigenous software firms mostly focus on software development projects for niche sectors (finance, telecommunication etc.), majority of overseas software firms achieve low value added phases of software development projects.

4.3.1 Overseas Software Industry (Foreign-Owned Software Firms)

> Foreign software firms in Ireland can be divided into two main categories: firms focusing on the manufacturing, distribution, and localization of mass-market software packages; and firms providing systems integration and software services or with dedicated software-development centers. Each sector has a distinctly different profile and makes a different contribution to industrial development. Each has also

> undergone a succession of rounds of globalization and localization. (O'Riain, 2004c: 81)

Previously, multinational U.S. packaged software firms aimed to serve for their domestic market in 1980s, in U.S. In time, MNCs realized the potential of international markets demand for computer software systems via emerging of personal computer and other IT technologies in all over the world. Thus, these firms added a few small operations within their production cycles and began to customize their products with little additional costs for international markets; Asia Pacific, Africa, Europe etc. As indicated, several localization processes (translating and adapting according to local needs and cultures) were sufficient for international marketing of the previously developed packaged software systems. Therefore, an international division of labor emerged for production operations of packaged software systems. In this perspective, MNCs have outsourced some of functions with sub-contracts in order to take advantage of cost opportunities.

> Outsourcing has been pursued for a number of reasons including the opportunity to take advantage of external economies of scale and the potential for shifting risk/costs onto suppliers – i.e. cost reduction. (O'Riain, 1997: 20)

> Outsourcing also allows packaged software MNCs to concentrate on their core competence, namely software development. (Crone, 2002: 42)

The outsourcing strategy has expanded the group of software supporting sub-contractors focused on translation, localization, testing, printing, disk duplicating, telemarketing, customer support etc. Besides, outsourcing strategy also provided positive effects on Irish economy, firstly; increased the employment rate in Ireland. Secondly, outsourcing to Ireland has formed an infrastructure for attracting the software FDI with higher-value added phases of software development activities in Ireland. Thirdly, there have been communication linkages between overseas MNCs and Ireland local software subcontractor firms; thus, the know-how transfer began to occur spontaneously.

The history of overseas software companies began with the investments of Microsoft, Lotus Development, Oracle, Symantec and Corel since mid 1980s via attractive policies and incentives of IDA and Irish government. Major Irish operations of US owned packaged software firms were mainly low value added operations such as, manufacturing, disk duplication, manuals printing, packaging etc. In addition, these MNCs added software localization operations (translation, help desk testing, quality assurance, format changing etc.) as one of their main activity areas in early

1990s. These activities especially include; translation the previously developed software products into other languages and cultural formats in order to be used in EU, Africa and Middle East Countries. Especially since mid 1990s, Irish operations of overseas MNCs began to expand through management of distribution, customer support and back office administration.

Table 4.5 Ownership of Overseas Software Firms in Ireland in 2001

Nationality of Ownership	N	%
United States	71	48,3%
United Kingdom	18	12,2%
Germany	16	10,9%
Netherlands	9	6,1%
Canada	8	5,4%
Japan	6	4,1%
France	5	3,4%
Norway/Sweden/Finland	7	4,8%
Other(Switzerland/Belgium/Israel/Australia)	7	4,8%
Total	147	100,0%

Source: http://www.idaireland.com

According to statistical data; Table 4.5 indicates the origins of overseas software firms; U.S. is the dominant country in Ireland with 71 companies and 48,3% share, U.K. 18 companies and 12,2% share, Germany 16 companies and 10,9% share are other countries. These U.S. firms are mainly multinational software firms and invest in Ireland in order to outsource their low value added phases of software development projects and after sales operations.

Separately, since the mid 1990s, a few overseas software firms (IBM, EDS etc.) commence to establish software development centers which were mostly focused on customized software development for domestic and foreign customers. In addition, several global telecom corporations, Ericsson and Motorola, managed and performed the projects regarding the development of embedded software and software applications for their telecommunication products in Ireland, (these software development projects size could be neglected according to low valued operations). Despite the positive benefits of software outsourcing businesses, there are negative impacts of these services; firstly, outsourced services mostly include basic, routine and non-innovative phases and do not add future-oriented value for national economy. Secondly, this local industry has been shaped by powerful software MNCs and the future perspective of local software industry is designated by foreign owned MNCs, this is quite risky for national industry.

> Sun Microsystems and Motorola, the majority of R&D is probably undertaken in the home country. This is also due to the low corporate tax, introduced to attract MNCs, which does not stimulate the location of R&D activities in Ireland. By contrast, corporate tax may spur MNCs to inflate the value of local revenues and exports. (Giarratana et al 2003b: 9)

In conclusion, although Ireland has skilled workforce and sufficient infrastructural capacity for software development projects, most of overseas companies conduct R&D oriented development phases within their home country, because, these MNCs do not wish to lose control of these strategic operations. Therefore, high value added phases stay in their home country via political and economical policies and strategies.

> It would seem, then, that the majority of foreign companies – entering the country almost exclusively through negotiations with the state and largely unable to add development functions to their operations – contribute much in the way of employment but little to the development of a learning industry and region. (O'Riain, 2004c: 87)

4.3.2 Indigenous Software Industry

Historical analysis indicates that Irish indigenous software firms could be categorized within three groups. The first group of Irish indigenous software firms mostly focused on low-value added operations. During mid 1980s, while overseas software firms began to locate in Ireland, number of small scaled national software firms increased at the same time and these Irish indigenous software firms mostly focused on low-value added services as subcontractor of overseas software firms.

> Software product (or package) companies develop a software program which is then copied many times and sold to many different customers. In contrast software services can also involve writing software, but services are provided uniquely to each customer as required, rather than involving repeated selling of copies of a standardized product. (O'Gorman et al 1997: 8)

Second group indigenous firms have realized that high-value added, profitable projects could be provided by innovative, export oriented, product development projects. Therefore, indigenous industry has directed business scope into software applications for niche sectors (finance, telecom etc.) in 1990s, with telecommunication applications; especially mobile and wireless applications, financial services and applications, e-learning & computers based training, e-security and secure payment solutions within wide range of products.

The third group software firms which had been previously in other sub-industries such as hardware manufacturing, telecommunication etc., in time, established their software development departments. Several of these firms had close relationships with university environment. This relation was a conclusion of Irish government ongoing investment in higher education and mostly ICT related departments during a few decades. For instance; several successful software companies have been founded in the campus of Trinity College, Dublin; such as; Trintech, IONA Technologies, Havok etc. Among these firms, IONA technologies have focused on innovative technologies mostly and begun to achieve R&D oriented projects effectively in order to export to U.S. market.

Besides, these Irish indigenous software firms faced several financial challenges during the industry's early years, especially. These challenges could be summarized as lack of capital and unavailability of venture capital. In general, these financial fund problems could be eliminated via two manners; one is, classical method, obtaining capital accumulation with service projects and using this capital within product development projects, and attracting venture capitalists to get external funds is the second way and the more common approach. In order to eliminate these financial challenges; Irish government established venture capital funds in 1996. Until the venture capital was available, the Irish firms had limited growth and their businesses were mostly domestic market oriented. Thus, the government VC fund securely financed these firms after 1996; and the firms commence to apply the product development projects.

Table 4.6 Indigenous Software Industry - Employment, Revenue and Exports by Sub-Sector in 1998

Sub-Sector	Percentage of Companies	Employment	Revenue (IR£,M)	Exports (IR£,M)	Percentage of Revenue from Exports
General Business Applications	14%	1.080	95	34	27%
Banking & Finance Applications	8%	1.120	73	51	70%
Multimedia/ Computer Based Training	6%	935	123	119	97%
Telecommunications	5%	631	49	32	85%
Niche Product Development	20%	1.480	95	54	54%
Internet Related Product/ Services	11%	630	35	12	35%
Software Localization	3%	407	27	16	64%
Firmware	2%	140	8	7	82%
Software Tools/Systems Software	6%	728	99	75	75%
Services/ Bespoke Development	14%	1.065	54	11	24%
Customer Support	1%	58	4	0	0%
Other	10%	920	57	35	59%
Total	100%	9.255	719	446	

Source: http://www.nsd.ie, 2001; web site data.

As illustrated in Table 4.6, indigenous software companies mainly export in sub-sectors of Niche Product Development (20%), General Business Applications (14%), Services/Bespoke Development (14%), Internet related Product/Services (11%) however only 1% of companies work for Customer Support field. In addition, according to employment rates, niche product development and banking & finance applications sectors have the highest employment rates as 1.480 and 1.120 employees. In addition, from revenue side, Multimedia/Computer Based Training has the biggest share in revenue, IR £123 million.

In sum, Irish indigenous software industry have focused mainly on niche sectors, which are telecommunications, banking and financial services, chemical and pharmaceuticals industries and multimedia, in order to design software systems and solutions since the mid-1990s. In addition, for today, enterprise application

integration, wireless applications, niche specific applications (CRM and e-learning) are the other focal point of Irish indigenous software development industry.

> The success of Irish owned software companies is based on a small number of common characteristics;
> - The bulk of Irish companies build their business around a product offering rather than services. Irish owned companies are product oriented. They invest in the development of IPR and derive revenue streams from related services. This model is slowly beginning to change, reflecting world wide changes in the industry.
> - Export markets are a priority. Ireland is a small market, and products are more easily exported.
> - The market targeted is typically a niche (or vertical) market where the competition is not Microsoft or Oracle. This has been a crucial success factor, and Irish companies have shown a remarkable ability for picking suitable niches.
> - There is an emphasis on quality processes and products, and a significant percentage of Irish companies have quality certification. (Gallen, 2005: 4)

4.4 International Operations of Indigenous Software Firms

Thanks to the indigenous software industry export growth, firms began to establish overseas offices in key markets, all over the world. Although these offices mostly aim to increase the sales and marketing capability, several of them focus on local customer support services.

Table 4.7 Overseas Offices of Indigenous Software Companies

	1991	1993	1995	1997	Growth 1991-93	Growth 1993-95	Growth 1995-97
UK	36	36	43	41	0%	19,4%	-4,7%
Europe	13	21	18	10	61,5%	-14,3%	-44,4%
North America	5	9	14	31	80%	55,6%	121,4%
Other Locations	0	4	10	15	N/A	150,0%	50,0%
Total	54	70	85	97	29,6%	21,4%	14,1%

Source: http://www.nsd.ie, 1999; web site data.

Table 4.7 illustrates the abroad offices of Irish indigenous software firms. Especially in the beginning of 1990s these firms had focused on UK and Europe markets and invested in these regions. However, in time, these firms realized the importance of North America and especially Silicon Valley and began to invest in U.S. much more than UK or Europe, with the growth rates of 80% between 1991-1993, 55,6% between 1993-1995 and 121,4% between 1995-1997. Irish software firms aim to expand their business scope from European countries to North America

and other regions (Asia, Africa etc.) in order to sell their products in these markets and also get special know-how related to software industry.

Table 4.8 Export Markets of Indigenous Software Companies by Geographic Region

Geographic Regions	Export Markets
UK	21%
Western Europe	28%
North America	43%
Far East	1%
Pacific Rim	3%
Other	4%

Source: http://www.nsd.ie, 1999; web site data.

In addition, as indicated in Table 4.8, North America is the most important customer country of Irish indigenous software industry with 43% share. Western Europe 28% and U.K. 21% are other significant export markets for Irish indigenous software industry. This table emphasizes the same markets with table 4.7 and indicates that overseas offices focus on mainly marketing operations of Irish software products and services.

Another manner of internationalization of Irish indigenous software firms is merger and acquisition. In previous years, the most important successful indigenous firms have been acquired by foreign multinational companies.

According to Mike Crone, in "A Profile of the Irish Software Industry"; one of the most important cases is the acquisition of Saville Systems by ADC Communications for $675 million in 1999; besides, these foreign acquirer firms were mostly U.S., UK and other leader country origins. On the other hand, Irish firms have acquired some of foreign companies in order to internationalization. According to TIU TechWatch; there were 57 acquisition cases between 1999 and 2001 and the 37 of 57 were overseas companies.

4.5 Differences between Indigenous and Overseas Software Companies

Irish subsidiaries of US packaged software MNCs have been oriented mostly to low value activities, such as, disk duplicating, testing, packaging, localization software systems which are mostly developed (especially high value added phases) in U.S. On the other hand, national indigenous software firms aim to more involve in

high value added phases, such as, requirement analysis, high level design etc. and aim to produce and export niche software products

Table 4.9 Irish Software Industry - Number Employed

Year	Irish	Overseas	Total
1991	3.801	3.992	7.793
1993	4.495	4.448	8.943
Growth 1991-1993	18%	11%	15%
1995	5.773	6.011	11.784
Growth 1993-1995	28%	35%	32%
1997	9.200	9.000	18.200
Growth 1995-1997	59%	50%	54%
1998	9.250	12.380	21.630
Growth 1997-1998	1%	38%	19%
1999	11.100	13.791	24.891
Growth 1998-1999	20%	11%	15%
2000	14.000	16.000	30.000
Growth 1999-2000	26%	16%	21%
2001	15.000	16.500	31.500
Growth 2000-2001	7%	3%	5%
2002	12.600	15.300	27.900
Growth 2001-2002	-16%	-7%	-11%
2003	10.710	13.220	23.930
Growth 2002-2003	-15%	-14%	-14%
2004	11.250	12.700	23.950
Growth 2003-2004	5%	-4%	0%
2005	11.100	12.900	24.000
Growth 2004-2005	-1%	1%	0%

Source: http://www.nsd.ie, 2006; web site data.

Table 4.10 Irish Software Industry - Revenue (€m)

Year	Irish	Overseas	Total
1991	191	2.007	2.198
1993	300	2,23	2,53
Growth 1991-1993	57%	11%	15%
1995	490	3.316	3.806
Growth 1993-1995	63%	49%	50%
1997	650	5.032	5.682
Growth 1995-1997	33%	52%	49%
1998	913	5.704	6.617
Growth 1997-1998	40%	13%	16%
1999	1.278	6.347	7.625
Growth 1998-1999	40%	11%	15%
2000	1.400	8.750	10.150
Growth 1999-2000	10%	38%	33%
2001	1.508	11.571	13.079
Growth 2000-2001	7%	32%	29%
2002	1.537	12.331	13.869
Growth 2001-2002	2%	7%	6%
2003	1.058	14.620	15.678
Growth 2002-2003	-31%	19%	13%
2004	1.369	15.597	16.966
Growth 2003-2004	29%	7%	8%
2005	1.760	22.823	24.583
Growth 2004-2005	29%	46%	45%

Table 4.11 Irish Software Industry - Exports (€m)

Year	Irish	Overseas	Total
1991	78	1.966	2.044
1993	147	2.192	2.339
Growth 1991-1993	88%	11%	14%
1995	287	3.282	3.570
Growth 1993-1995	95%	50%	53%
1997	455	4.981	5.436
Growth 1995-1997	58%	52%	52%
1998	566	5.293	5.860
Growth 1997-1998	25%	6%	8%
1999	792	5.728	6.520
Growth 1998-1999	40%	8%	11%
2000	875	7.625	8.500
Growth 1999-2000	10%	33%	30%
2001	1.228	10.968	12.257
Growth 2000-2001	47%	43%	44%
2002	1.313	11.689	13.002
Growth 2001-2002	2%	7%	6%
2003	681	14.171	14.852
Growth 2002-2003	-48%	21%	14%
2004	946	15.109	16.055
Growth 2003-2004	39%	7%	8%
2005	1.176	22.298	23.475
Growth 2004-2005	24%	48%	46%

Source: http://www.nsd.ie, 2006; web site data. (Table 4.10 and Table 4.11)

Table 4.9, Table 4.10 and Table 4.11 analyze Irish software industry (Irish indigenous and overseas firms) within 1991-2005 periods on the basis of employment, revenue and export variables. According to Table 4.8; between 1991 and 2001 there was an increase for employment both overseas and indigenous firms, however, 2001 was top year for industry employment as 31.500 in total, after this year employment began to decrease and was only 24.000 in 2005.

According to revenue perspective (Table 4.9); there is clear superiority of overseas firms against indigenous firms. For instance, in 1991 overseas revenue was € 2.007 Million, and indigenous firms' revenue was only €191 Million. In 2000, overseas revenue was € 8.750 Million, and indigenous firms' revenue was €1,400 Million. Finally, in 2005 overseas revenue was € 22.823 Million, and indigenous firms' revenue was only €1.760 Million.

From exports perspective (Table 4.10); there is superiority of overseas firms against indigenous firms. For instance, in 1991 overseas export was € 1.966 Million, and indigenous firms' export was only €78 Million. In 2000, overseas export was €7.625 Million, and indigenous firms' export was €875 Million. Finally, in 2005 overseas export was € 22,298 Million, and indigenous firms' export was only €1.176 Million. As seen, overseas industry mainly works with export oriented strategies, because overseas export has 97,9% of their revenue in 1991 and 97,6% in 2005. On the other hand, export has only 40,8% of revenue in 1991 and 66,8% in 2005 for indigenous industry. Thus, overseas industry mainly follows clear export-oriented strategy.

In conclusion, Ireland software industry mainly operates low-value added phases with overseas firms that are mostly U.S. popular packaged software firms, such as Microsoft, Oracle, Symantec etc. and main aim for choosing Ireland is getting the benefits of 10% corporate tax rate in Ireland during the sales for EU market and other periphery countries. In addition, Irish software industry includes indigenous software firms that work for niche business solutions especially for finance and telecom industries. Therefore, Irish indigenous software industry is not in a direct competition with U.S. packaged software firms.

> Looking ahead, for Ireland to retain its competitive advantage, not just in software, it must reduce its over reliance on MNCs and focus on moving up the value added chain. This need is reflected in recent government initiatives such as the €600 million investment in Science Foundation Ireland, which is designed to increase the national R&D capacity, along with efforts by state agencies to embed overseas companies in Ireland in the face of growing competition, particularly from Eastern Europe. (Arora, Gambardella, 2005: 65)

4.6 Heeks' Software Strategies in Developing Countries Model Classification-Ireland

Especially in 1980s, multinational software corporations (Microsoft, Lotus Development, Oracle, Symantec etc.) began to invest in Ireland in order to take the advantages of excess supply of qualified English speaking workforce, tax incentives, proximity to European and African markets etc. However, these Irish subsidiaries of MNCs focused on low value added phases, as Indian software industry; such as translation, localization, testing, printing, disk duplicating, telemarketing, customer support etc. This group of firms is called as "overseas software industry".

In time, Irish state realized the importance of high value added phases of software development projects and began to encourage national software industry in Ireland in order to direct business scope into software applications especially for niche sectors, such as telecommunication applications; mobile and wireless applications, financial services and applications, e-learning & computers based training, e-security and secure payment solutions etc. This group of firms is called as "indigenous software industry".

Today, there are two main sub-groups within Irish software industry; such as overseas software industry and indigenous software industry.

In respect of Heeks' "Software Strategies in Developing Countries" model, Irish software industry could be classified in Approach A and Approach B in the scope of overseas and indigenous software industries separately, because, these sub-sectors have variant business scopes; such as, although indigenous industry works on mostly software development niche projects including R&D phases for recent years, on the other hand, multinational subsidiaries work for generally low valued phases (logistics, localization etc.) in projects of which R&D activities are completed in home countries, in U.S. especially.

In this perspective, Irish indigenous software industry could be classified in Approach B (Packaged Programs & Export Oriented Strategy) which describes export oriented product development strategies, because Irish indigenous software industry mainly focuses on R&D oriented software development projects in which high value added phases are achieved in Ireland and final products are also exported to abroad markets.

On the other hand, overseas software industry could be considered in Approach A (Service Intensive & Export Oriented Strategy) because, as determined in previous titles, Irish overseas software industry (multinational corporations'

subsidiaries) locates in Ireland in order to achieve the low value added service intensive phases of software development projects, such as, localization, logistics operations, back office services etc.

In a whole glance, Irish software industry, both for indigenous and overseas sub-sectors, deals with export oriented strategies.

4.7 Conclusion

In Ireland, there has been an uninterrupted economic growth since the mid 1980s with increasing budget surplus and having one of the lowest unemployment rates comparing to other EU countries via low corporate tax rates, future oriented education policies and strategies (ex: Regional Technical Colleges) and restructuring the telecommunication system.

In order to analyze Irish economic success, which mainly occurred after 1990s, the previous thirty years period should be briefly studied. The demographic structure plays one of the most important roles, for instance, high birth rates caused to young population and workforce potential. This growing population increased the unemployment rate for the first years, however in a time, by factors coming into play; this young population contributed to rapid and sustained economic growth. In addition, the aptness for foreign investment is another factor for Irish success, in this shape; the common language of English, becoming a member of European Union and appropriate law system which has been inspired from England law system were other attractive factors for foreign direct investors.

The success of Irish Celtic Tiger economy comes from accomplishments of several certain sectors; one of the most important is Irish software industry which has been raised by successful national policy of attracting foreign direct investment. In this episode, the impact of the Industrial Development Authority-IDA, which has encouraged the foreign corporations to invest in Ireland through financial (tax incentives) and investment incentives, IDA have also set these financial incentives mostly on high-tech sectors. Thus, the growth of Celtic economy was the result of this state strategy and the foreign investors from the sectors of software, pharmaceuticals, financial services, hardware, medical etc. began to invest during this period.

Actually, the developments of Ireland indigenous software industry was not one of the main aims of Ireland state before 1980s, this was a spontaneous

development. Because, the focal point of Ireland economic development was the application of successful foreign direct investment policy in high-tech industries. At this time, the importance of software industry was realized by the state and investment decision was taken for the industry.

> State support, as the visible edge of a broader state-society alliance, has had a significant effect on the development of an indigenous Irish software industry. Whereas neo-liberals proposed leaving firms to compete in the market and argue that the state should simply create the conditions for "the market," the Irish state has been successful through a much closer relationship with firms, negating the argument that state ties to firms must inevitably lead to clientelism and rent-seeking. (O'Riain, 2004c: 109)

Moreover, the multinational software firms invested in Ireland and contributed to the emergence of indigenous sector, especially for software industry. Renewing the telecommunication infrastructure, financial incentives (tax incentives etc.), excess supply of human capital, significant rate of international migration, membership to EU, strong connections to U.S. and American origin firms may be considered as the main reasons for multinational investments.

Summarize, Ireland has obtained an enormous success by determining the correct policies and strategies via applying the correct tools effectively. The below items are milestones of this success story;

- Investment to the education sector after 1967 which would facilitate the economic and social development of Ireland.
- In 1969, Ireland Development Agency (IDA) and other institutions were separated from government structure and organized as more elastic,
- Deregulation of Ireland Communication Sector.
- Influencing and affecting Foreign Direct Investments by consistent governmental polices.
- Reconsideration of legal and institutional environment regarding all the economic activities, especially for high-tech sectors, software etc.

In consequence, MNCs played the most important role for being known internationally and get a reputation of Irish ICT sector, especially for Irish software industry. However, for future, Ireland state should reduce its dependence on MNCs and should focus on high value added operations and projects much more. Hence, national R&D capacity will have to be increased within indigenous software industry via continuous state policies and incentives.

CHAPTER V

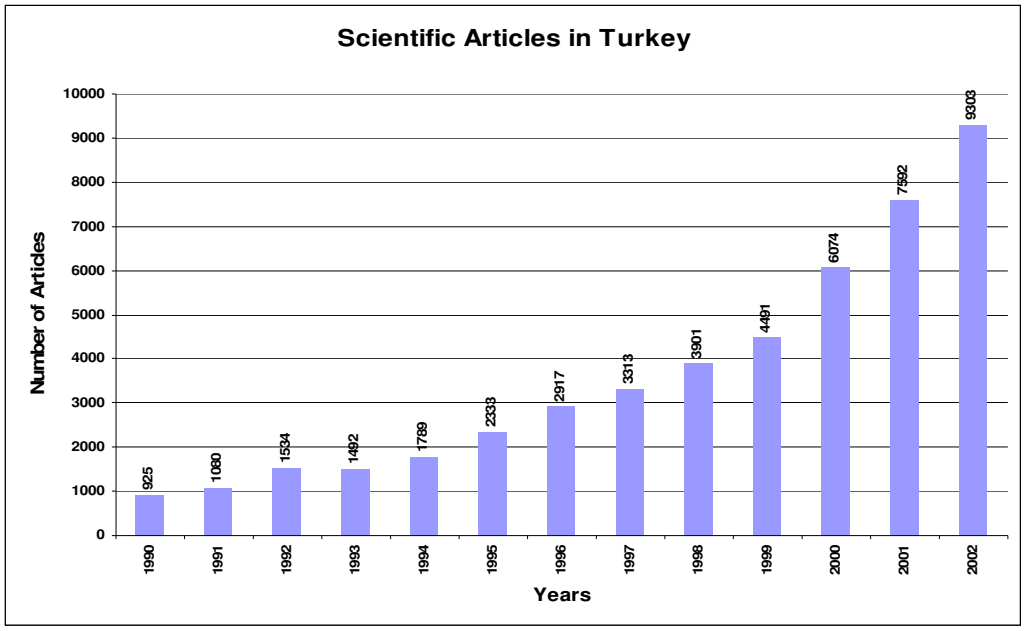
TURKISH INFORMATION ECONOMY

Turkish governments accelerated transformation to information economy and information society especially at the end of 1990s, and directed this transformation period by e-Transformation Turkey Executive Board mainly on e-government, e-trade, e-health and e-business field applications.

> The primary objective is to identify and prioritize activities that have the greatest impact on development of the knowledge economy, taking into account the institutional feasibility of those activities given the resources available. The agenda should contribute to the improvement of the competitiveness of the Turkish economy and enterprises by (a) connecting enterprises with sources of knowledge within Turkey and abroad (that is, creating innovation networks); (b) enhancing human capital to meet the requirements of the knowledge economy; (c) providing infrastructure for an information society; and (d) strengthening the regulatory and economic environment to enable knowledge-based initiatives to develop. (World Bank, 2004b: 11)

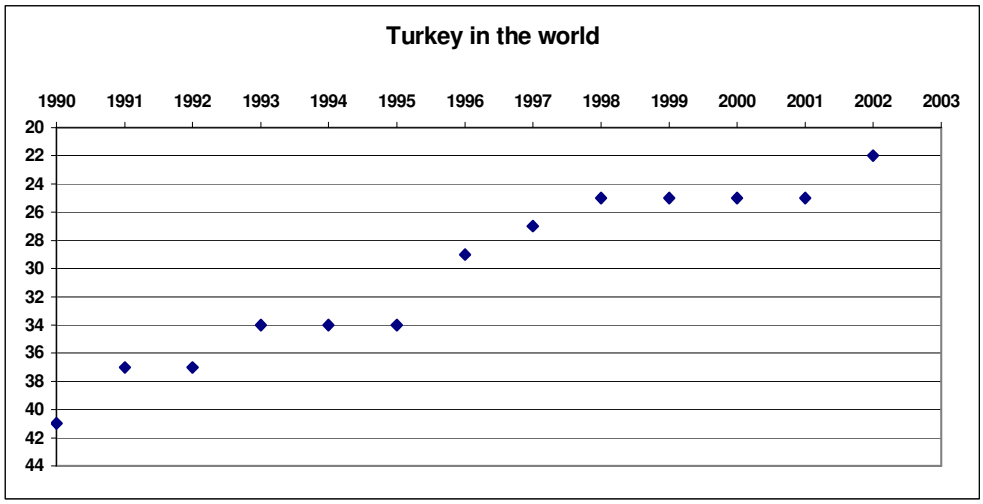
In order to analyze succession degree of transformation to information economy, scientific researches and innovation approaches could be used as important determinative criteria. In this respect, Turkish information economy policies could be studied with below statistics. As illustrated in table 5.1; Turkish universities have had significant potential about scientific researches with significant growth rates in number of articles especially for recent years. For instance, in 1990 there were only 925 articles from Turkey, however, in 2002, 9303 articles were presented from academicians according to Science Citation Index statistics.
This is a remarkable development for Turkish science.

Table 5.1 Scientific Articles in Turkey



Source: Science Citation Index, 2003

Table 5.2 Turkey in Scientific Contribution

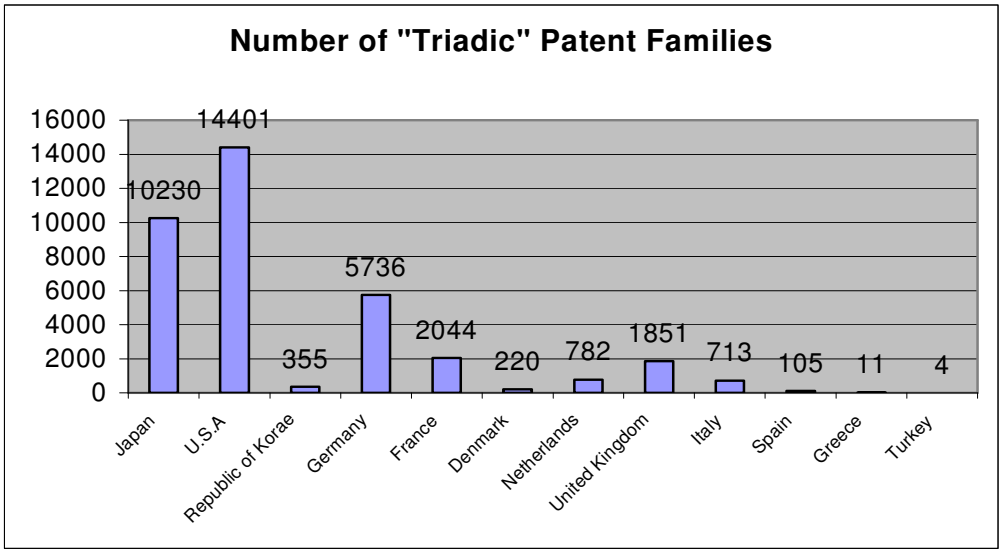


Source: SCI - Science Citation Index & SSCI - Social Science Citation Index, 2003

Table 5.2 illustrates Turkey's rank in total number of articles (SCI+SSCI) between 1990 and 2003. Obviously, Turkey was in 41st place in 1990, however, in 2002 Turkey attained to 22nd rank in scientific contribution criterion.

Unfortunately, these scientific achievements of academicians have not been transformed to patents via significant innovation policies, as illustrated below table.

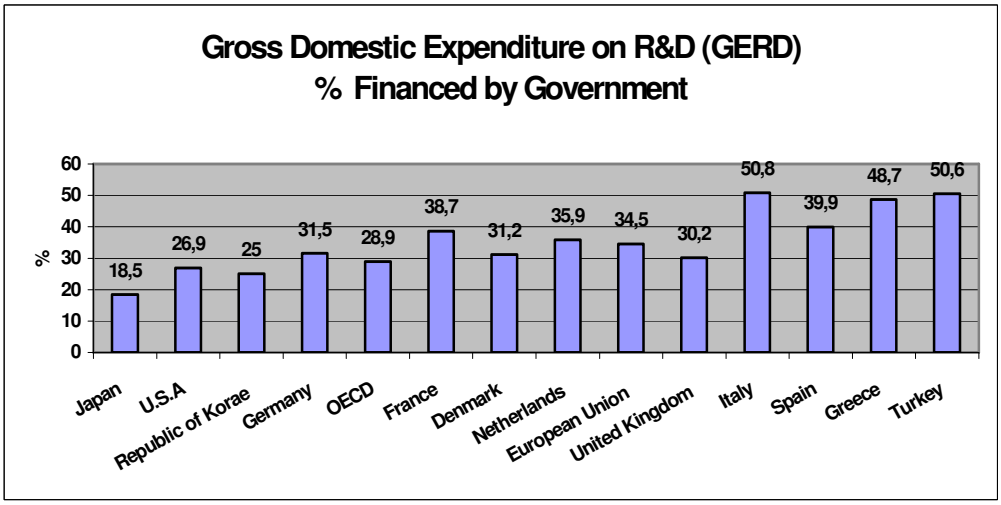
Table 5.3 Number of Triadic Patent Families



Source: OECD, 2003

Table 5.3 indicates that U.S. and Japan are the most successful countries in number of patent headline, whereas Turkey is really insufficient concerning the number of patents according to these countries. U.S. has 14.401, Japan has 10.230 patents according to 2003 data, and however Turkey had only 4 patents.

Table 5.4 Gross Domestic Expenditure on R&D % Financed by Government

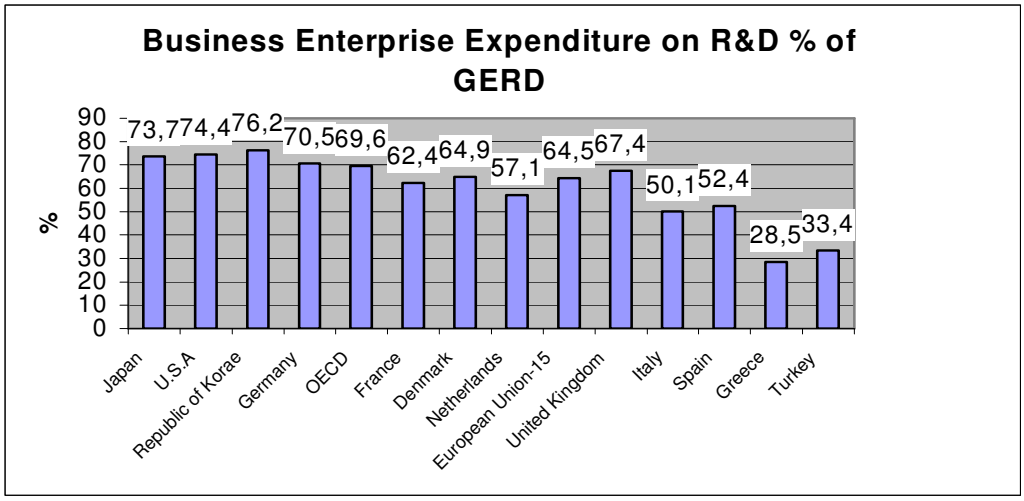


Source: OECD, 2003

Developed, leader countries on science, economy and technology have fewer ratios on government financed R&D operations. For instance, Japanese government has

18,5%, US government has 26,9% ratios, however, Turkish government has 50,6% share in this title.

Table 5.5 Business Enterprise Expenditure on R&D % of GERD



Source: OECD, 2003

Table 5.5 “Business Enterprise Expenditure on R&D % of GERD” indicates that, technologically developed countries business enterprise expenditures on R&D have greater ratios than government expenditures; such as, Japan has 73,7%, Republic of Korea 76,2% business enterprise expenditure on R&D % of GERD., whereas Turkey has only 33,4%. In this manner, Turkey should encourage the business enterprise expenditure on R&D activities for comprehensive and continuous scientific and technologic improvement, as developed, leader countries.

Separately, household ICT ownership is a significant criterion in order to describe the position of information society and also information economy.

Table 5.6 Household ICT Ownership (%)

	ICT Owns and Uses Households Rate	Internet Access Devices Owns Household Rates
Personal Computer	11,62	5,86
Notebook	1,13	0,74
PDA	0,14	0,08
Mobile/ Car Phones	72,62	3,21
Television (includes Satellite and Cable TV)	97,74	0,05
Game Console	2,9	0,02
Total Household, at least having one of the above	98,35	8,66

Source: http://www.tuik.gov.tr, 2005; web site data.

The ownership of ICT products are not widely diffused to whole regions of Turkey. In 2005, 11,62% household owned PC, 1,13% owned notebook, and in total 6,6% of them had internet access; this statistics are quite low and insufficient in order to attain to information society level. In addition, lack of systematic government policies and strategies, lack of financial funds, insufficient human resources related to information based industries are other considerable obstacles for Turkish information age transformation.

5.1. Turkish ICT Industry

Although comprehensive and systematic data is limited regarding Turkish ICT industry, these data are strived to be collected in this study in order to describe Turkish ICT industry's position within global ICT world.

Turkish governments have comprehended the importance of ICT unfortunately just mid 1990s by importing technology and products instead of investment on R&D oriented technology production. In this term, Turkish ICT market was in a construction period with imported ICT products. However, in 2000s, Turkish ICT market commenced to develop with significant growth rates; according to Interpro statistics, Turkish ICT market attained $18.7 billion volume in 2005, as indicated in below table.

Table 5.7 Turkish ICT Industry Development 2001-2006 (million US Dollar)

	2001	2002	2003	2004	2005	2006*	CAGR**
Hardware	1.054	1.400	1.540	1.768	2.227	2.700	20,70%
Software	293	336	393	452	618	780	21,63%
Services	823	775	847	1.122	1.412	1.690	15,48%
Software related Services	658	620	678	898	1.130	1.352	17,40%
Total Software (Products and Services)	951	956	1.071	1.350	1.748	2.132	17,52%
Consumption Materials	74	122	90	113	141	165	18,91%
IT Total	2.244	2.633	2.870	3.455	4.397	5.335	20,70%
IT Sector Growth		17,3%	9%	20,3%	27,2%	21,3%	
Communication	6.847	7.517	8.592	11.815	14.380	17.390	20,49%
ICT Total	**9.091**	**10.150**	**11.462**	**15.270**	**18.777**	**22.725**	**20,11%**

Source: http://www.interpromedya.com.tr, http://www.idc.com, 2006; web site data.
*** Forecasted, ** (Compound Annually Growth Rate)**

Table 5.7 indicates the growth of Turkish ICT market; while in 2001 Turkish ICT market included $1.054 million hardware and $951 million total software market (products and services), in 2005 Turkey attained to $2.227 million for hardware and $1.748 million for software with 20,7% and 17,52% (total software) compound annually growth rates. As seen, software has attained to greatest compound annually growth rate with 21,63% and indicates that software industry is a future-oriented industry for Turkish national economy and investment in this field could provide significant opportunities for the nation.

> In Turkey, total employment in ICT industry is not known definitely, however, as forecasted 65.000 for 1996, 81.000 in 2002 and 130.000 in 2006. According to Undersecreteriat of the Prime Ministry-Export Promotion Center Report, Turkish ICT industry should engage 70.000 new ICT personnel annually in order to sustain the development of ICT industry within forecasted growth rates. (Güder, Taşçı, 2006a: 15)

Table 5.8 ICT Graduates of Turkey

Departments	Number of Faculties	Max Number of Students
Computer Engineering	77	3.059
ICT System Engineering	4	60
Software Engineering	2	60
ICT/Information Engineering	10	314
ICT Systems	4	185
ICT Management Systems	7	252
Mathematics and Computer	13	211
Computer Sciences	3	60
Computer and Software Technologies	143	7.310
Computer and Software Technologies (High School)	136	7.475
Computer Teaching	49	2.110
Total	**448**	**21.096**

Source: http://www.tubisad.org.tr, http://www.yasad.org.tr, 2003; web site data.

TUBISAD and YASAD 2003 data indicates that; there are 448 faculties related to information and communication technologies in Turkey and there are 21.096 students in these departments; software engineering has only two faculties and 60 students are graduated from these faculties per year. The number of these departments and student capacities should be increased in order to supply qualified human resources for ICT Industry. In this perspective, government plays major role as establishing ICT oriented universities and departments and providing permission for private institutes. In addition, according to Turkish Informatics Foundation, in 2003 there were 160.000 IT specialist deficits and this amount will increase average 10% per year and will attain to 235.000 in 2007.

Table 5.9 ICT Industry in National Economy

	2002	2003	2004	2005	2006*
GNP Growth Rate (%)	7,9	5,9	9,9	7,6	6
ICT Industry Growth Rate (%)	11,6	12,9	33,2	23	21
The Ratio of ICT in GNP (%)	5,5	4,8	5	5,2	6

Source: State Planning Organization (DPT) web site, 2006.
*** Forecasted**

Turkish ICT industry attained to impressive growth rates in national economy, as indicated in Table 5.9. ICT industry had the share of 5,5% in GNP in 2002, 4,8% in 2003, 5% in 2004, 5,2% in 2005 and 6% in 2006 (forecasted). These indicators prove that Turkish ICT industry will continue to grow within next years and

increase the contribution to GNP. However, this increase mainly includes sales and marketing operations and also after sales services. In this respect, Turkish ICT industry should improve business scope and focus on technology development projects and high value added operations.

5.2 Turkish Software Industry

In Turkey, software industry began to emerge especially in mid 1990s by multinational software companies' local subsidiaries and several small-scale national software firms. Today, Turkish software market intensively arises via multinational software firms' products and their sales and service operations, such as Microsoft, Oracle, and Symantec etc. In addition, Turkish software industry has nearly 1.400 software firms and 16.800-19.600 workers. In addition, 417 firms are located in Technology Development Regions with 4.000 workers. (http://www.idc.com, 2006; web site data)

> There are significant positive improvements concerning software development and production operations in recent years in Turkey. In this perspective, there are almost 6.000 hardware and software oriented firms which generally include 2 or 3 employee. There are more than 100 unique software developer firms which attained to over $160 million sales revenue in 2002. (The Scientific & Technological Research Council of Turkey (TUBITAK), February 2004: 11)

As seen in Table 5.7 software package market attained to $618 million in 2005 (21.63% compound annually growth rate, 2001-2005) and software related services market attained to $1.130 million (17.40% CAGR, 2001-2005) in 2005. In addition, according to Interpromedya, Turkish software industry attained to nearly 40% growth rate in 2006; especially, Enterprise Resource Planning systems (ERPs), sector oriented software applications and consulting fields attract attention in this growing industry.

> In addition, Turkish software firms exported to abroad countries, too, in 2005; U.S. ($2.2 million), Germany ($2 million), Iraq ($1.7 million). (http://www.dtm.gov.tr)

Table 5.10 Software Firms in Turkey – 2004 Income Table

Rank	Firm	Income (US $)	Share (%)
1	Microsoft	80.026.000	25,99
2	Havelsan	39.387.581	12,79
3	IBM Turk	37.392.823	12,14
4	Oracle	17.167.000	5,58
5	SAP Turkey	10.000.000	3,25

Source: Interpromedya, 2005

According to income and market share, table 5.10, the four of top 5 software firms are Turkish subsidiaries of multinational firms (Microsoft, IBM, Oracle, and SAP) which have 46,96% share in Turkish software market. Only one Turkish software firm takes place in this table; Havelsan nearly $40 million revenue with 12,79% market shares. This table indicates the dominance of foreign multinational firms in Turkish software industry and these firms mainly operates sales and after sales operations in Turkey. Technology development and high value added operations are generally achieved in their home countries.

Table 5.11 ERP Oriented Top Software Firms

Firms	Income (Million $)	Share (%)
Meteksan Sistem	3,87	15,8
Oracle	3,2	13,1
Tepum Sigma	2,4	9,8
Link Bilgisayar	1,42	5,8
Eczacıbaşı Bilgi İletişim	1,27	5,2

Source: Interpromedya, 2005

ERP market is a significant choice for Turkish national software firms, because, as illustrated in table 5.11, four of top firms (Meteksan Sistem, Tepum Sigma, Link Bilgisayar and Eczacıbaşı Bilgi İletişim) get approximately 36,6% in Turkish ERP market. Therefore, Turkish software industry has significant experience in ERP sector and this field could be a strategic investment field for newcomers.

Table 5.12 Mobile Application Software Firms

Firms	Income (Million $)	Share (%)
Telenity	9,65	39,58
Oksijen Technology	5,97	24,5
Meteksan Sistem	2,28	9,39
Exim	1,53	6,28
Univera	1,1	4,54
Mobilsoft	0,78	3,23

Source: Interpromedya, 2005

Table 5.13 Finance Sector Software Firms - 2004

Firms	Income (Million $)	Share (%)
Meteksan Sistem	2,79	16,7
Oyak Teknoloji	2,52	15,1
SFS Danışmanlık	2,45	14,7
Intertech	1,67	10
Tepum Sigma	1,20	7,2

Source: Interpromedya, 2005

The niche sectors, such as mobile applications and finance sectors are quite significant; future oriented and value added sectors for national software firms. As seen in above tables 5.12 and 5.13; Telenity (39,58%) and Oksijen Technology (24,5%) are the leader firms in mobile applications field, and Meteksan Sistem (16,7%), Oyak Teknoloji (15,1%) and SFS Danışmanlık (14,7%) are the leader firms according to finance sector oriented software revenues. Therefore, there is important infrastructure and know-how in these sectors and Turkish software industry should focus on these fields by collaborating with MNCs in high value added development phases, not in low skilled, low value added operations. Thus, greater project and financial support opportunities could be caught within these projects.

Table 5.14 Software Employee Wages

Software Sector Jobs	$ / Month
Software Specialist *	900 – 3.800
Project Manager *	2.280 – 4.900
Database Manager	750 – 3.400
Analyst Programmer	1.500 – 3.000
System Analyst	1.150 – 2.300
System Manager	1.520 – 3.050
Software Test Specialist	1.350 – 3.800
Software Engineer	2.280 – 3.400

Source: Chip Magazine, 2006,*http://www.inproda.com, 2005, web site data.

According to employee wages related to Turkish software industry in table 5.14; Turkish software workforce is quite lower than developed countries, such as U.S. or other developed European countries etc., however, these prices can not compete with major software service exporter countries; India, Indonesia, China etc. Thus, Turkish software industry could compete with Ireland or other European countries and take position in European market via labor cost advantageous.

Besides, financial infrastructure is quite significant in order to develop the national software industry. For instance, Irish software industry has been supported and funded by EU funds and Indian software industry has been funded by Indian society that living abroad. In addition, these countries' governments have already prepared tax incentive programs, provided venture capital funds, direct financial aids, marketing aids etc. However, Turkish indigenous software industry has critical financial problems. There are several projects aim to eliminate this sufficiency, however a certain permanent achievement has not been attained, yet.

> National Software Industry Development Project was started by UNDP and TTGV in 1996, November with $1.000.000 financial budget. The main aim of this project is build "a software projects support mechanism" in order to support the national software industry. In this scope, Yazılım Destek A.Ş. has been founded by Türkiye Teknoloji Geliştirme Vakfı (TTGV), İstanbul Teknik Üniversitesi (İTÜ) Geliştirme Vakfı, Ortadoğu Teknik Üniversitesi (ODTÜ) Geliştirme Vakfı, Dokuz Eylül Üniversitesi (DEÜ) Vakfı, İzmir Teknopark Ticaret A.Ş. (İTAŞ) ve İzmir Yüksek Teknoloji Enstitüsü (İYTE) Vakfı. (http://www.yazilimdestek.com)

Table 5.15 Yazılım Destek A.Ş. Institutions' Share

Institutions	Shares
KOSGEB	30%
TTGV	20%
İ.T.Ü. Geliştirme Vakfı	16,5%
ODTÜ Geliştirme Vakfı	16,5%
DEÜ Vakfı	6%
İTAŞ	6%
İYTE Vakfı	6%

The main aims of the institution;

- Providing financial sources for national software projects via supporting software firms and marketing their software products,
- Providing consultancy and training services for domestic software firms,
- Assistance on development of software programs which are required in the scope of "Computer-Supported Education Program"

5.2.1 Software Development Centers - Technoparks

Respect to common view; network clusters provide suitable environment in order to accelerate innovative activities via encouraging collaboration and competition between firms. In these fields, the researchers and producers come together and this structure increases capability sharing, efficiency and also

productivity. Moreover, technoparks mainly aim to perform technology development projects via preparing appropriate substructures in order to market these projects commercially in all over the world.

Technology development centers and clusters are important facilities for ICT technologies, as well. Although these centers emerged especially within foundation of Silicon Valley between hardware manufacturers, after increasing the importance of software systems, these network structures were adapted to global software industry, too. For instance, 3Is (India, Israel, Ireland) also used this strategy and attained to important amount of software exports via software development centers. In this approach, India founded first software technopark in 1991, in Karnataka, in Bangalore. Today, the major software technoparks are Bangalore, New Delhi, Mumbai, Hyderabad and there were 5.608 firms and R&D organizations in 45 STPIs (Software Technology Parks of India), in March, 2005.

> Separately, Ireland software industry mainly locates in Dublin, Limerick, Galway and Cork with technology development centers. In these clusters; there are research centers, software firms, venture capital firms and software development centers with improved telecommunication and electricity infrastructure. (National Software Directorate of Ireland, [NSD], 2006)

In these technoparks, seed capital and venture capital opportunities are also provided to newcomers and one of the main problems of national software industry is solved in this respect.

Table 5.16 Software Firms Analysis in Active Technology Development Regions (September, 2006)

Foundation Year	Technology Development Region	Number of Firms	Number of Software Firms	Number of Software Firms/Total Number of Firms
2001	ODTU Teknokent	174	91	52,30%
2001	TUBITAK MAM	66	44	66,67%
2002	Izmir TGB	32	22	68,75%
2002	Ankara CyberPark	164	120	73,17%
2002	GOSB Teknopark	45	28	62,22%
2003	ITU Arı Teknokent	59	50	84,75%
2003	Hacettepe Universitesi TGB	25	9	36,00%
2003	Eskişehir TGB	16	8	50,00%
2003	Selçuk Universitesi TGB	50	25	50,00%
2004	Batı Akdeniz Teknokent	22	19	86,36%
TOTAL		**653**	**416**	**63,71%**

Source: Güder, Taşçı, 2006b

As analyzed in table 5.16; there are 653 firms in 10 technology development regions and 416 of them are software firms. In addition, Batı Akdeniz Teknokent (86,36%) and ITU Arı Teknokent (84,75%), Ankara Cyberpark (73,17%), Izmir TGB (68,75%) have intensively software firms. (Also Erciyes Technopark was established in 2006). In addition, only software industry oriented technology development regions should be established and infrastructure should be prepared in order to meet software industry requirements; for instance, electricity, communication infrastructures, venture and seed capital opportunities, effective management organizations etc.

In Turkey, Technology Development Regions importance was realized in 1990s, and several studies were prepared in this perspective; in 1998 draft of a law regarding software industry support was completed, however, not discussed and accepted in national council. In July 2001, Technology Development Regions Law came into force in order to provide the tax (institutional and income) incentives for firms until 2013 concerning software and R&D based activities. Income taxes exemption for software oriented workers and researchers; VAT exemption for developed software systems were provided in this law. In addition, academicians had rights in order to work or found new firms in these regions. However, in Turkey, these incentives are insufficient in order to attain significant successes, because

comprehensive venture capital opportunities have not been evaluated in this concept, yet.

[2] 5.2.2 Main Strengths and Weaknesses of Turkish Software Industry

Main Strengths

- Developing communication infrastructure, increasing rate of communication devices ownership; telephone, internet, mobile phones etc.
- Educable young workforce potential, (According to TUIK data, under 22 aged people had 40% in total population, in 2005)
- Geographic country position between Asia and Europe continents,
- The proximity to Turkish states and Arabian markets,
- Good brand image in EU markets via tourism, textile, white goods etc.
- Great potential of domestic local market, density of SMEs,
- Turkish military, as a significant customer,
- Public tendency for ICT related products and services

Main Weaknesses

- Economic and political indefiniteness (economic crisis terms, political instability etc.),
- Lack of ICT oriented graduates from universities,
- Lack of harmony between university education programs and business life expectations; (probably because of ineffective technopark policies),
- Insufficient financial funds (venture capital and other financial incentives),
- Lack of innovation, management and marketing capabilities,
- Lack of Science and Technology Ministry,
- Need for application of long-term oriented strategic approaches,
- Unawareness of the importance of software industry,
- Lack of English speaking human resources,
- 66% software piracy rate (IDC, BSA (Business Software Alliance Report)),
- Lack of standardization and quality awareness,

[2] This title (Main Strengths and Weaknesses of Turkish Software Industry) has been generated by writer according to previously mentioned topics within Turkish Information Economy chapter. The related information, tables, special statistics and their outputs were summarized under this topic.

5.2.3 Main Current Reports related to Turkish Software Industry

In this part, major reports which cover Turkish ICT Industry and also software industry; State Planning Organization's "Information Society Strategy 2006-2010 Report", TUBITAK's "Vision 2023 Technology Foresight Project, Information and Communication Technologies (ICT) Panel Final Report" and "Turkey 2. ICT Council Report-2004" will be analyzed on the basis of national software industry approaches, foresights and suggestions perspective. In the end of the title, these reports will be evaluated according to Richard Heeks' "Software Strategies in Developing Countries" model.

State Planning Organization – Information Society Strategy (2006-2010)

> *A Globally Competitive IT Sector; "IT sector active as an international player"*
> The focus will be on expanding into foreign markets by developing sector competencies via public-private partnerships and with project based services in the field of IT services, and on vertical solutions with highest competitive advantages in software. (p. 20)
>
> Turkey's regional markets present a significant potential for IT exports. Today, Turkey constitutes only 4% of the Middle East, Central and Eastern European software and services markets, which are expected to achieve an annual growth rate of 13.5% through 2010. Expansion into these markets will ensure growth of the sector and creation of value added for Turkey, and may significantly increase the export volume and the associated market growth. (pp. 16-17)
>
> Competitiveness can be increased by focusing on areas which can create a long-term and sustainable strategic competitive advantage. In this scope, the focus will be on project-centered services and outsourced services such as application management, hosting, management of business processes, etc. in the field of IT services, and on vertical solutions such as telecommunications, health, education, defense industry, etc. which offer a higher competitive advantage, in the field of software. (p. 36)
>
> The target is to transform the IT sector into a software and services hub among regional countries as of 2010 and increase its competitive power on a global scale. Similar to the developments achieved in 1990-2000 by India, Ireland and Israel which have adopted an export-focused strategy in the field of IT, Turkey's IT exports are targeted to go up to minimum USD 400 million from its current level of USD 80 million with an average annual growth rate of 38%. And the domestic IT market is targeted to achieve an annual average growth rate of 24% and reach USD 9,160 million in 2010. (p. 37)
>
> In public sector ICT procurement, with the use of open standards and application of software development quality standards, elements that hinder competition and that create dependency especially in the field of software and services will be eliminated. Application of open-source software in the public sector will be promoted, and it will

be ensured that the advantages offered by such software are used at the maximum level. (p. 32)

Shared Technology Services and Infrastructure: In the electronic provision of public services; shared services such as electronic payment and electronic identification and verification will be provided on a central infrastructure and shared infrastructures such as e-government portal, mobile services platform, secure public network, disaster recovery, management centre, call centers and geographic data platform will be established, and some common software will be developed and rolled out to agencies. Hence, inter-agency cooperation will be supported, and opportunities for savings will be created by preventing duplicate investments. (p. 35)

Developing Sector Competencies: Consultancy and training services will be provided in order to develop the competencies of the sector in the processes of development, marketing and sales of goods and services. In addition to building the necessary infrastructure for penetration into foreign markets, the software quality certification acquisition by companies will be directed via public purchases and encouraged via financial incentives in order to increase quality of goods and services. (p.38)

The Scientific & Technological Research Council of Turkey (TUBITAK) – Vision 2023 Technology Foresight Project, Information and Communication Technologies (ICT) Panel Final Report

IT products generally come into being from hardware which is formed with integrated circuit, and software systems which run on these hardware systems, thus, the importance of integrated circuit and software design and production sub-sectors continuously increase. (p.11)

New software systems will remove the language and comprehension problems in reciprocal communication. (p.14)

“Human-literate” computer designing and production;
In this field, the designing and production of hardware and software systems, which will make the computers “wise”, for our country and also exportation is aimed. By this method, contribution to national value added is also targeted (p. 37)

In the title of technological tendencies;
New computer and software technologies, which learn as artificial intelligence, will also improve.
Software will be an interdisciplinary department field. (p.13)

The requests from other panels;
Having a purpose of military and civilian; unmanned land, sea, air, and space platforms’ sensitive control and management hardware and software systems’ developments will increase importance, as well. (p. 59)

As indicated in table 5.21, precedence technologies are emphasized as in several niche software fields; such as learning software, network software, development and simulation tools, human-machine interface software, artificial intelligence.

Technology production is quite significant. Nation's technology production and effective usage are inevitable fields in order to attain the achievement in national economy. In this sentence, growing software developed population up as India or being a production center as Far East are not mentioned. Emphasized point is that innovation and encouragement of inventions are the effective ways in order to enable sustainable development (p. 239)

Several arrangements should be prepared in order to develop the software industry; (p.30)

- Preparing the appropriate legal arrangements for software production and exportation, providing employment encouragements, financial support for SMEs in order to purchase software systems, taking precautions in order to hinder the illegal software system usage.
- Because of the insufficiency of present technopark law, new arrangements should be prepared.
- Providing tax exemption to software firms for institution taxes and to employees for income taxes.
- Evolution of software production as other properties production and re-preparing the related law contents.
- Software industry related services exportation should be added into scope of Eximbank credits.
- The software products should be in the scope of leasing.
- Decreasing the VAT ratios for software products.

In order to increase the exportation; (p. 31)

- Encouraging the multinational firms in order to invest and making Turkey a software export based country.
- Providing tax incentives, decreasing the bureaucratic obstacles during the foundation of the companies, and obtaining custom advantages.
- Supporting exportation tendency of firms and preparing necessary arrangements.
- Collecting the national software firms in a sole structure in order to advertise the national potential to abroad markets.
- Exportation of human capital to abroad countries in order to increase the experience.

2 years IT (software/hardware/system based) courses should be activated in technical high schools. (p. 383)

In order to provide the development of software industry, domestic market should attain to sufficient size and the related arrangements should be done (p. 36)

Financing problem is one of the most important obstacles in order to open the software houses to foreign markets. Because of not accepting the software industry as a strategic sector, there are no sufficient special incentives in this direction. (p. 36)

Attracting the world's qualified workforce, this is the necessity of software industry, by creating new sources and financial incentives. (p. 212)

These three reports have quite significant determinations and suggestions regarding Turkish ICT industry and software industry as well. In order to classify these reports with a broad glance on Richard Heeks' "Software Strategies in Developing Countries" model, Approach E could be the most appropriate one. Because, in these reports, especially in "Information Society Strategy-2006-2010", importance of domestic and export markets are clearly emphasized, in addition, specifically niche markets are also analyzed as major target fields for national software industry.

5.2.4 Suggestions for Turkish Software Industry

Taking precedence, application the most appropriate strategy for emerging national software industries depends on determination national comparative advantages and global competition factors of the sector. Thus, nations could meet the global demand via guiding their comparative advantage within strategic policies. In this way, Richard Heeks approaches could be studied in order to direct software industries of emerging countries, as Turkish software industry. In this perspective, E Approach-Packaged and Service-Intensive; Abroad and Domestic Market Oriented (Richard Heeks, Software Strategies in Developing Countries Model) offers quite significant opportunities for emerging industries, also for Turkey. In this approach, national software industry focuses on niche sectors in order to catch-up the value added opportunities and benefits of these sectors (telecommunications, embedded systems, finance, tourism etc.) via avoiding the direct competition with existence multinational software companies, for instance, Microsoft, Symantec, Oracle etc.

E approach also disperses the business risk of software industry to both of domestic and export markets. Thus, if Turkey selects to approve E approach strategies, should follow a balance strategy which includes both domestic market oriented projects; focus on SMEs end-user packages, government institutions software systems etc. and export oriented projects to abroad markets within niche sectors. In addition, domestic market oriented software development projects provide significant experience, skills and capital accumulation for export oriented software development projects. Therefore, local operations are quite strategic for abroad operations achievements.

> As the Irish learned, innovative technical ideas often come from software workers in domestic industries. In turn, the export industry grows out of the domestic industry. And vice versa, since the export industry needs a domestic market to experiment with new ideas, test products, and serve as reference sites, national indigenous industry and domestic market should be developed; otherwise the export success could not be attained. (Tessler et al, 2002: 9)

Hence, embedded software systems could be another focus point for developing software industries, if automobiles and consumer electronics are the key production sectors of these nations, as Japan and Korea. In this perspective, Turkish software industry should tend to embedded software systems of automobiles and white goods, because Turkey has significant rate of automobile manufacturing capacity with Fiat, Ford, Hyundai, MAN, Mercedes etc. and these companies use embedded software systems in their motor vehicles and components.

Table 5.17 Automotive Sector Foreign Trade ($)

	Export	Import	Balance of Foreign Trade
1993	558.684.423	3.351.321.792	-2.792.637.369
1994	794.608.391	1.323.985.631	-529.377.240
1995	1.246.045.278	3.145.657.812	-1.899.612.534
1996	1.371.819.090	4.361.039.638	-2.989.220.548
1997	1.249.719.843	6.287.501.651	-5.037.781.808
1998	1.675.163.905	6.649.278.628	-4.974.114.723
1999	1.998.484.447	4.992.745.233	-2.994.260.786
2000	3.274.874.483	8.275.930.780	-5.001.056.297
2001	3.475.090.251	2.573.788.825	901.301.426
2002	4.319.298.588	3.908.220.371	411.078.217
2003	6.095.219.893	7.345.408.458	-1.250.188.565
2004	9.906.235.689	13.278.198.489	-3.371.962.800
2005	11.398.847.618	13.946.660.978	-2.547.813.360

Source: http://www.tuik.gov.tr, 2006; web site data.

Table 5.18 Motor Vehicles Export (TUIK)

	Automobile	Minibus, Midi bus	Bus	Small Lorry	Van	Tractor	Total
1993/ Unit	7.812	200	922	55	65	125	9.179
1994/ Unit	12.707	330	825	722	244	54	14.882
1995/ Unit	32.715	470	1.008	1.328	495	25	36.041
1996 / Unit	25.716	1.288	1.959	590	461	962	30.976
1997/ Unit	20.715	1.033	2.139	936	409	759	25.991
1998 / Unit	18.185	2.981	2.741	734	280	2.088	27.009
1999/ Unit	73.320	5.561	823	949	838	4.413	85.904
2000/ Unit	83.314	3.606	2.706	6.603	700	4.893	101.822
2001/ Unit	151.393	3.074	3.400	36.694	4.233	2.351	201.145
2002/ Unit	166.851	2.159	3.698	76.617	1.324	3.329	253.978
2003/ Unit	225.534	1.688	3.904	109.042	1.889	12.685	354.742
2004/ Unit	320.321	2.467	3.898	180.684	2.664	10.327	520.361
2005/ Unit	337.373	6.333	4.773	199.233	5.144	8.335	561.191

Source: http://www.tuik.gov.tr, 2006; web site data.

As illustrated in above tables 5.17 and 5.18; Turkey has attained significant amount of motor vehicles exports. For instance; Turkey exported $9.906.235.689 valued in automotive sector, and 520.361 unit motor vehicles, (include automobiles, minibuses, busses, vans, tractors) in 2004, and exported $11.398.847.618 valued 561.191 unit motor vehicles in 2005. In these vehicles, embedded software systems are used in many sub-systems and components. Therefore, if Turkish national software firms focus on this field, there will be significant opportunity for national indigenous software industry.

In addition, white goods (durable goods) production is another important sector for Turkish economy. Such as, Arçelik, Beko, Vestel etc. are well known white goods producer firms for both domestic and abroad markets.

Table 5.19 White Goods Production (1.000 Units)

Products	**2001**	**2002**	**2003**	**2004**	**2005**
Refrigerator	2.483	3.318	4.286	5.308	5.538
Washing Machine	1.030	1.654	2.459	3.963	4.382
Dishwasher	223	346	399	657	783
Oven	1.100	1.341	1.574	1.715	1.660
Total	**4.836**	**6.659**	**8.718**	**11.643**	**12.363**

Source: http://www.beysad.org.tr, 2006; web site data.

Table 5.20 White Goods Industry Foreign Trade (1.000 USD)

	2001	**2002**	**2003**	**2004**	**2005**	**Change 2004/2005%**
Export	574.124	853.022	1.290.528	1.651.736	1.947.176	17,9
Import	285.476	249.52	362.794	550.263	734.170	33,4

Source: http://www.dtm.gov.tr, 2006; web site data.

As illustrated in above tables 5.19 and 5.20; in 2004 11.643.000 unit white goods production and $1.651.736.000 valued export, in 2005 12.363.000 unit white goods production and $1.947.176.000 valued export was attained in Turkey, with 17,9% export growth rate between 2004 and 2005. These products also include embedded software systems, as motor vehicles. Hence, national software firms should invest in this filed in order to get value added opportunities in embedded software systems of white goods, as in automotive sector.

Table 5.21 Software Technologies Significance Coefficients[3]

Points	Software (Design) Technologies	
22,57	**STF1**	**Embedded Software**
18,76	STF2	Component Based Software
	STF3	Software Upgrade
3,29	STF4	Learner Software
34,52	**STF5**	**Network Software**
1,31	STF6	Open Source Software
4,78	STF7	Data Mining
5,95	STF8	Natural Language Processing
2,69	STF9	Software Architecture Platforms Independent (Java, vb.)
6,80	STF10	Misty Logic
13,13	STF11	Artificial Intelligence
17,69	STF12	Development and Simulation Tools
2,35	STF13	Quantum Calculating
15,60	STF14	Layered Architecture
15,53	STF15	Human-Machine Interface Software
6,92	STF16	Computer Graphics
7,20	STF17	Cryptology / Cryptography
5,70	STF18	Distributed Systems and Parallel Programming
184,79		Total

Source: TUBITAK, 2004

In addition, Vision 2023 Technology Foresight Project, Information and Communication Technologies (ICT) Panel Final Report indicates the importance of embedded software systems for Turkish software industry. Network software systems (34,52%) and embedded software systems (22,57%) are the most significant fields in all software design technologies in this comprehensive study.

[3] STFs mean that Software Technology Field.

Moreover, [4]SOA (Service oriented architecture) systems industry could be another focal point for Turkish software firms, because this field includes infinite opportunities and probabilities within software industry.

From market perspective; export oriented Turkish software firms should focus on especially Turkish States, Russia, Arabian Countries and Mediterranean markets, because these countries have similarities regarding culture and history with Turkey.

> Turkey's regional markets present a significant potential for IT exports. Today, Turkey constitutes only 4% of the Middle East, Central and Eastern European software and services markets, which are expected to achieve an annual growth rate of 13.5% through 2010. Expansion into these markets will ensure growth of the sector and creation of value added for Turkey, and may significantly increase the export volume and the associated market growth. (State Planning Organization (SPO), 2006: 16-17)

> Middle East Countries have considerable potential for information technologies investments, also for software industry, too. Especially in Iraq, United Arab Emirates, Iran, Saudi Arabia significant economical growth and expenditures for high technologies are expected because of increasing rate of petrol revenues. (http://www.dtm.gov.tr)

Turkey also should focus on European market, because European countries have much expensive workforce and lack of qualified young work potential, because the population is growing older in Europe year by year. In this perspective, Turkey should invest in human resources and focus on software export activities via targeting European software market. Turkey should tend to Ireland and Indian software industry markets, too. Namely, Ireland is losing workforce wage cost advantage, so Turkey could be new agent country between US multinationals and European market via corporate and income tax incentives. In addition, Turkey is much more advantageous than India, because India is far away from western

[4] Architecture is not tied to a specific technology. It may be implemented using a wide range of technologies, including REST, RPC, DCOM, CORBA, Web Services or WCF. SOA can be implemented using one of these protocols and, for example, might use a file system mechanism to communicate data conforming to a defined interface specification between processes conforming to the SOA concept. The key is independent services with defined interfaces that can be called to perform their tasks in a standard way, without the service having foreknowledge of the calling application, and without the application having or needing knowledge of how the service actually performs its tasks.

SOA can also be regarded as a style of information systems architecture that enables the creation of applications that are built by combining loosely coupled and interoperable services. These services inter-operate based on a formal definition (or contract, e.g., WSDL) that is independent of the underlying platform and programming language. The interface definition hides the implementation of the language-specific service. SOA-based systems can therefore be independent of development technologies and platforms (such as Java, .NET etc). Services written in C# running on .NET platforms and services written in Java running on Java EE platforms, for example, can both be consumed by a common composite application. Applications running on either platform can also consume services running on the other as Web services, which facilitates reuse.
SOA can support integration and consolidation activities within complex enterprise systems, but SOA does not specify or provide a methodology or framework for documenting capabilities or services.
(http://en.wikipedia.org/wiki/Service-oriented_architecture)

countries and after 11th September terrorist attack, India is not an attractive and reliable location for U.S., as in the past. Turkey could tend to replace India with assistance of this opportunity.

By state perspective; Turkish governments should declare the software sector as a national strategic sector via comprehensive plans, as tourism and textile. The second step, government should introduce financial support opportunities; venture capital, seed capital or other financial funds. For instance;

> there are said to be over 50 venture capital funds operating in Israel and more than $4 billion was invested in high technology start-ups in Israel in 1998. (http://www.worldbank.org)

By institutional perspective, The Ministry of Science and Technology should be founded in order to determine the standards of e-government approach, preparing, auditing and evaluating the related strategies and policies, setting the necessary law infrastructure, setting and directing the network between related institutions etc. In addition, S&T ministry should direct government software industry bids and should accept only national software systems and define this concept in their tenders. In addition, government and military should be major customers via supporting and funding e-government projects, inducing innovation and R&D oriented projects. This policy will encourage the national software industry and contribute to capital accumulation and business experience.

By educational perspective, IT-oriented universities and related departments numbers and scope should be increased in order to meet the business market demand (software engineers and programmers); professional software institutions have to be established and software engineering departments should be founded in engineering faculties. In addition, private institutions and certification programs should be organized via government support.

Furthermore, Turkey should increase number of software development technoparks in Technology Development Regions in order to provide reciprocal business network between these firms and enable the know-how transfer and information sharing. Also, Turkish government should offer necessary recruitment and incentives in order to attract the Turkish engineers and programmers who work for abroad companies, especially in US. This policy enables know-how and business culture transfer from Silicon Valley to Turkey.

Standardization is another problem for especially export oriented software industry in Turkey. Turkish software firms should take the degree of CMM quality

certificates in order to facilitate business for abroad markets. International software quality and standardization certificates facilitate the international sales and marketing activities via wining the target customers' confidence.

Moreover, piracy is another critic topic and software piracy rate 66% should be decreased to world averages, 36%. (IDC, 2005: 69)

VAT ratios should be decreased for national software products, because in Turkey IT products (hardware and software) are seen as luxury goods, yet. In addition, financial credits should be provided for SMEs in order to purchase and use national software packages (ERP, CRM etc.) in their organizational business processes. This project will provide two main advantages; Turkish economy will increase the efficiency and productivity of main businesses via using software systems in their business operations (SMEs form 99,89% of Turkish enterprises, 2002, TUIK) and national software industry will get a new significant domestic sub-market.

Summarize,

> A Globally Competitive IT Sector; *"IT sector active as an international player"*
> The focus will be on expanding into foreign markets by developing sector competencies via public-private partnerships and with project based services in the field of IT services, and on vertical solutions with highest competitive advantages in software. (State Planning Organization, [SPO], 2006: 20)

CHAPTER VI

CONCLUSION

Information age has been transforming traditional aspects of human life especially on economic and sociologic perspectives for two decades. While this period affects individual relations, also country based international relations are adapted to this new world platform. Although theoretical scope is quite different than industrial age, mode of production is fundamentally similar with industrial revolution, based on capitalist economic system principals. Therefore, innovator and producer nations are also the decision takers and leaders of the free market. In this respect, countries aim to be in leader group in order to take advantages and opportunities of this new term.

Hence, the countries, adapt to these developments via their national policies and strategies in order to obtain advantages on productivity, efficiency and also welfare.

> In recent years, developing countries and the international development community have started taking concrete actions to incorporate ICT into their economic policies and development agendas. Many countries are preparing and implementing national e-strategies that emphasize the ubiquity of connectivity as well as new applications in areas such as e-government and e-business. The Millennium Development Goals (MDGs), drawn from the United Nations Millennium Declaration and adopted in September 2000, have several specific targets involving ICT. Nevertheless, improving the identification and measurement of the actual effects of ICT in development remains an important challenge going forward, especially in light of the rapid pace of change in the sector and the dearth of concrete, long-term data across countries. (Worldbank, 2006: xi)

Meanwhile, ICT variable takes one of the major roles in information age transformation period with sub-groups; hardware, software and ICT services.

> World ICT market has attained to nearly €2 trillion volume and forecasted that ICT market will grow 3.9% and attain to nearly €2.1 trillion. Between 2005 and 2007, in ICT subgroups, software and IT services market are the fastest growing sector with 6%. (European Information Technology Observatory, [EITO], 2006)

In order to decompose ICT into main sub-systems; hardware, software and also ICT oriented service industries appear. Although these three are quite

significant in global ICT perspective, software industry provides significant opportunities especially for developing and emerging countries. Meanwhile, the latecomers have responsibilities regarding determination and application of appropriate strategies in order to achieve the predefined goals and objectives within competitive global software industry. For instance; attaching importance to national education, support of academic researches, encouragement R&D activities, providing sufficient financial subsidies and incentives etc. are the milestones of national software industry achievements.

Furthermore, there are several model countries which have attained to significant export rates by applying these mentioned national software policies and strategies. In this study, India and Ireland and their strategic policies are strived to be analyzed in this scope. Ireland, also Celtic Tiger, attained to software export achievements via main advantages of educated English speaking workforce, technologically developed telecom infrastructure with lower telecom fees, significant state support, financial and tax incentives, proximity to European countries, historical relations with US.

> The industrial hearth of the Celtic Tiger was its connection to the global information economy and the growth and boom in the ICT industries in the 1980s and 1990s, respectively. Foreign investment remained central to the Irish industry, but indigenous industry – supported by the state- also became increasingly sophisticated and internationally competitive. Furthermore, public-sector employment expanded significantly, local demand was critical to growth, and all of this was managed through and increasingly dense network of institutions of "social partnership" extending across almost all spheres of the political economy and integrating local actors, state agencies, and European Union programs. (O'Riain, 2004c: 9)

> Ireland's long-term goal was that Irish nationals employed by the MNC's would learn the high-tech business first-hand, and then move on to create their own high-tech businesses. After 20 years, it became obvious that this strategy had not worked as planned, in spite of its success in slowing the emigration of talent and increasing both employment and exports. (Tessler et al, 2002: 4)

The MNC's created new jobs, however not for the most creative and software-knowledgeable people, for instance they hired folks to answer technical support questions at call centers. Therefore, Enterprise Ireland was founded in 1993 in order to eliminate this problem and create and support national indigenous software industry. Specifically there were two main programs; venture capital procuring program in order to encourage indigenous software entrepreneurship and R&D programs for software development projects. Thus, this is clear, effective national software industry strategy has to be complementary with its domestic and

export markets. Sole export strategies prevent the diffusion of ICT awareness in all the country and not contribute to competitive perspective and also national economy of the country, as in Ireland multinational firm investments.

From Indian software industry perspective,

> in fact, competing globally in low-growth, low-knowledge, labor-intensive industries is not a long-term strategy unless the country is committed to forever being at the bottom of the economic ladder. (Tessler et al, 2002: 8)

Because, software publishing revenues were $200 billion worldwide, digital content were $100 billion, global market of software services over $400 billion in 2001. For instance, India was the leader software service exporter country and software services export reached to only $7.5 billion in 2001. This statistics illustrates that Indian software industry undertakes the low value added service side of global software industry and gets only 1.88% share in global market of software services according to 2001 statistics.

Thus, Indian state has realized this contradictory and commenced to tend to national software industry in order to undertake all phases of software development projects in India (included high level design phases) not only low level phases of multinational firms software development projects. On the other hand, dependence to only one market is quite risky for export market oriented software industries. For instance, Indian software industry is quite dependent on U.S. market and this is a clear disadvantage of India, because whenever U.S. has economical or sector problems, the effects occur in Indian software industry, too. Therefore Indian marketing strategies should be developed and markets should be diversified within different regions.

Finally, multinational software corporations of developed countries keep high value added design phases of software development projects in their home countries and outsource low value added phases to these countries in order to take workforce cost advantages, tax incentives, geographical market position advantages etc., because these MNCs do not wish to lose control of these strategic operations. This is a clear strategy in order to hold and own real value of the projects in their home countries. Thus, Ireland (multinational subsidiaries) and India software firms generally offer low value added services to global software industry; such as localization, packaging, supporting services, call center services, coding, low-level design, and software testing for years. These routine and non-innovative tasks, which are repeated and low valued activities, have caused to limit the learning potential of Irish and Indian national software firms. Although increasing employment

and export revenues in these countries, multinational software firms exploit these countries' sources.

Despite these negative effects on Indian and Irish software industries, MNCs played the most important role about the appearance of software industry conscious in these countries and being known internationally in global software industry, especially during industries' emerging periods. In addition, Indian and Irish software firms are also responsible for MNCs exploitation (low value added operations of MNCs), because governments should have supported and encouraged the national software industries (for project development, higher value added operations) since before 1990s. Unfortunately, the importance of national software industries was realized and began to be supported comprehensively, merely in the ends of 1990s. Thus, the exploitation of MNCs could have been decreased and higher value added operations could have been achieved much more in national industries. This position is one of the main deficiencies for both of Irish and Indian software governments.

Turkey has to attract software multinational corporations via ICT oriented education, tax incentives, government strategic plans etc. in order to invest in Turkey. Thus, these corporations will begin to outsource several software development phases to Turkey (mainly low value added operations) and this approach will provide the software awareness infrastructure in country. Meanwhile, Turkish indigenous software industry has to be encouraged in order to achieve higher value added operations of software industry, especially for niche sectors; finance, health, telecommunication etc., because the national software industry is the key point in order to have an advanced software industry.

> At the risk of some exaggeration, one can say that MNCs came to Israel to do R&D, to India for inexpensive skilled workers, and to Ireland to leverage tax incentives and access the European market. (Arora, Gambardella, 2004)

Table 6.1 Patents granted to domestic investors, 1976-2001

Country	Patents granted to domestic investors employed by domestic firms in ICT and software		Patents granted to domestic investors employed by domestic firms (other technologies)		Patents granted to domestic investors employed by MNCs and subsidiaries in ICT and software		Total
Period	*Before 1990*	*After 1990*	*Before 1990*	*After 1990*	*Before 1990*	*After 1990*	
India	3	29	61	503	51	165	812
Ireland	18	55	126	360	79	221	859
Israel	286	971	1028	3479	189	525	6478

Source: http://www.uspto.gov, 2002; web site data.

Table 6.1 indicates the importance of innovation capability and high value added R&D activities in ICT and software industry. As seen, Israel is the leader country in R&D oriented projects of domestic investors within 3Is. India and Ireland indigenous software industries are not as successful as Israel's ones. India has only 812 patents between 1976 and 2001, Ireland had 859, however, Israel attained to 6.478 patents. If a nation aims to have an advanced national software industry, she has to increase the R&D operations and innovation capability for indigenous software industry.

In this perspective, conclusion comes to the following argument that "core and periphery" approach is valid for global software industry, as well. It is obvious that, periphery countries (for instance; Ireland and India firms) deal with mainly low value added phases in software development projects, however, core countries (for instance; US and Israeli multinational firms) complete high value added phases in home countries by using their own resources. This is a clear strategy in order to hold and own real value of the projects in their home countries. For the following step, after software development projects are completed, multinational firms market the final software goods to these periphery countries, which complete the most phases of software development projects because of their competitive costs, with additional considerable profit rates. (As the strategies of Microsoft, Oracle, Sun etc.) Hence, exploitation, which begins during project development and production phases, continues in marketing stage, too.

In this position, much more specifically, Geray's "[5]desktop imperialism" approach could be considered in order to emphasize the relation between developing countries and multinational firms within global software world.

[5] Desktop Imperialism defines core countries' actions and strategies in order to market new accumulation regime's new products and ICT products (hardware, software, contents, services, applications) to periphery countries via numerical network with begining high income part of society.

According to him;

> Weaken the desktop imperialism in periphery countries is possible via national local investors' catching-up local production capabilities by conscious effort and being competitive in this new market. One of foremost targets of center countries is to obstruct the countries which could be rival countries for them. (Geray, Başaran, 2005: 188)

> The World Bank prepared a country report on Turkey in 1992. The report recommended elimination of monopoly in telecommunications, separations of telecoms from the post, corporatization of telecommunication entity, setting up an independent regulatory body, liberalizing value added services, improving human capital formation, informatization of public sector management (World Bank 1993: 199-204). The World Bank report concluded that Turkey "can catch-up more advanced economies" by becoming an "information-based economy, which is defined by parameters of good usage in a competitive market created by imports. The discourse of the report recommended Turkey to stay away in generating knowledge for improving local production capabilities in informatics goods through industrial policies. Turkey was offered to take advantage of "subsidies," which are given by other "more advanced" countries to their own companies, by importing and lifting tariffs. (Geray, Başaran, 2006: 7)

In conclusion, if Turkey aims to be one of the leader countries in software industry, she should aim to develop and support indigenous software industry in order to undertake high value added phases of software development operations within its own borders and should not serve for low level operations of multinational countries. Hence, the effects of "desktop imperialism" could be weakened for Turkish software industry.

Attaining to real success will occur within this approach; otherwise Turkish software industry is exploited by multinational software firms, as in India and also in Ireland (multinational subsidiaries part) within global software world.

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