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A System Dynamics Model for Developing the Software Industry: The Case of Egypt

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A System Dynamics Model for Developing the Software Industry: The Case of Egypt

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ABSTRACT

Studies have been conducted on the means of the development of the software industry. Most of them used traditional approaches that examine systems by taking each component of the system apart and analyze it separately and then formulate a general conclusion for the system as whole. These approaches, though its benefit, is not enough for complex systems such as the software industry because of the inter-links and overlapping among the components of the system. System Dynamics modeling offers the tools needed to draw more accurate study needed by such complex industry.

The main objective of the study is to develop a System Dynamics model of the Egyptian Software Industry and apply this model to generate time responses that may help the provision of holistic approach encompassing the myriad of variables & issues. The developed dynamic model will provide clues for leveraging and identifying potential problems.

The methodology adopted in this Study is based upon building a System Dynamics (SD) model for the Egyptian software industry using the classical software for System Dynamics modeling "STELLA". The study based mainly on the sources of information; include official international and local statistics, international periodicals, previous studies conducted by very well recognized institutions, as well as conducting interviews with various key figures related to software industry.

The study showed that software industry has high potential in Egypt, though software diffusion in Egypt is lower than that in developed countries. The study found that this lagging is primarily due to unbalanced distribution of qualified human resources, weak Internet infrastructure, lack of some business skill experiences especially in the global markets, and the weakness of financial support. The study emphasized that the current focus and interest of the Egyptian leadership in developing the software industry must continue at this stage to give it the required initial boost for growth. Additionally, certain strategies such as reconfiguring the educational system, developing programs to stop the industry brain drain, establishing an export development organization, and growing the local market potential. New tools such as offshore business development centers, software development parks are essential. It also concludes that long term impacts of strategies used should be considered, as some successful strategies in the short term, may lead in the long term to deterioration of industry and finally its collapse.

Keyword: System Dynamics, Software Development, Simulation and Modeling, Developing Countries, Information Technology, Offshore Business Development.

Part1: Egyptian Software Industry: Market Overview

1 Overview

Computers, information technology, the Internet, and international networks are increasingly being substituted for traditional, labor intensive processes (*Senn 1996, 15*). Basically, all these technologies fall into one category called " Information and Communications Technology (ICT) ". The basic ICT technologies are microelectronics, hardware, platforms, software and telecommunications. Software technology acts as enabling "glue" technology between hardware platforms, telecommunications, networks and the human users of ICT. The innovation ratio in software has always been lower than that of hardware and telecommunications systems (*Bozzetti 1999, 1*). This has encouraged many emerging and developing economies to put the global and local development of the software industry as a strategic option. India is the most prominent example of success with industry size of (6.5 billion $) (*Nasscom 2000*). Egypt has joined the club, as the Egyptian government has recently considered the software industry as a one of the strategic industries for Egypt to equalize the current huge trade deficit.

2 Major Factors Influencing the Development of the ICT Market in Egypt

The liberalization of the economy, the development of private sectors and gradual privatization have resulted in high growth in the ICT market. The Egyptian administration is the major player with computerization contracts of public firms, government bodies and schools. ICT needs have been increasing in the national economy. The private sector has a growing potential in banking and finance (with the privatization of the financial sector which will have positive consequences for the IT market), textiles and oil with the development of accounting software packages and desktop publishing. In the long term, the tourist industry, the country's primary source of revenue (3.3 billion US$ in the fiscal year 1996/97), will have a positive influence on the Egyptian Information Technology Market (EITM). Egypt has become a regional leader in software production in the Middle East (a high proportion is exported to Gulf countries).

The Egyptian government is still very active in dealing with IT problems and wants to play a dominant role in the Middle East. It has created a number of bodies to develop the sector: for example, IDSC (Information and Decision Support Center) was set up to develop a legal framework to support the computerization of public bodies in Egypt and develop a local software industry IDSC, now attached to the Prime Minister's Cabinet. It plays an important role in new legal texts (duty rights and copyright) and lends support to equipment projects (school computerization, etc.). Its role is to assist the different ministries by offering technical assistance and software development according to their needs. In the educational sector, the project to equip 6.000 public schools from 1998 to 2000 will bring about heavy investments on hardware. Among its effort to encourage investment, particularly in the field of IT, the government has launched a Technology Development program offering highly attractive incentive packages to national and foreign investors.

In the telecommunications field, 1998 has seen the beginning of the privatization process of the public operator and the liberalization of mobile telephony with the creation of two private operators: the law no. 19/1998 promulgated on March 1998 has corporatised Telecom Egypt and partial privatization (20%) has been announced. It is expected that to partially flow stocks for Egypt Telecom by the end of this year, 2000. The government has also decided to

allow a private company to install and operate the public payphone networks -the first time the private sector will be allowed to offer telecom services in competition with the national operator (*EITO 1999, 308*).

3 Egyptian IT Market (EITM) Trends by Major Products/Software/Service Categories

Valued at US$ 452 million in 1998, Egypt's market for IT alone has the capacity to more than triple in the next five years as the population grows and government privatizes industrial firms. Hardware represents 66%, software 12% and services 22% of the IT market. In Egypt, the computer market has experienced phenomenal growth and is increasing annually (26–28% for hardware and 18-20 % for software) even if it remains of limited size.

Egypt imports nearly all of its computer equipment as local production and it is confined to personal computer (PC) assembly only. In 1997, around 90,000 PCs were sold in Egypt, of which 5,000 were assembled locally, and the market is largely dominated by American firms. By upgrading the nation's telephone network, the use of modems for interconnecting systems has increased. Egypt has made advances in data communication and TLC equipment. The market for mainframes has reached maturity with small contribution; 40 mainframes installed in which the firms are already equipped and they keep the same supplier. On other side the market for minicomputers involves insurance and banking, while the workstation market is limited to the defense and engineering sectors.

Hardware demand is influenced by the public sector which represents 20% of national consumption before finance and industry: the government has initiated a program to equip schools and the administration with PCs, which accounts for more than 30% of local demand. SMEs in comparison account for less than 10% of the national demand.

The software and services market is estimated at US$ 152 million, of which 55% is developed locally, and has an annual growth of around 20 %. Egypt has a leading role in software publishing for the Arab world: 80% of software exports go to the Arab Gulf and especially to Saudi Arabia. As for hardware, the administration is the first consumer of software with a quarter of the market; oil, banking; health and tourism sectors present the most interesting opportunities. Promising software markets exist equally in office automation. The Egyptian government passed a law on intellectual property in 1994, which ensured that computer software was afforded specific protection, and the customs duty on software imports has been reduced from 30 % to 5% (*EITO 1999, 308-309*).

3.1 Egyptian Software Market Major Categories

Imported Software currently accounts for 55 % of software market revenues. Remaining sales are comprised of locally developed software (19%), tailored software (16%) and Arabization (10%) (see table 1 and table 2).

Table 1: Egypt IT Market Segmentation -- (*IDC 1996*)

Breakdown of IT Revenues	Market Share %, (1996)	Amount in million US$
Hardware & Peripheral	60	282
Software	23	108
Services	12	56
Networks	5	24

Table 2: Software Market Segmentation – (*IDC 1996*)

Breakdown of Software Market	Market Share %, (1996)	Amount in million US$
Imported Packages	55	36
Locally Developed	19	12.5
Contracts	16	10.5
Arabization	10	6.5

4 General Description of the Egyptian Software Industry

The Egyptian software industry is highly diverse and reflects nearly all of the company types found in more mature markets. There is a definite vitality in the software companies interviewed for this research. Estimates of the number of staff employed in the industry today (inside Egypt) are in the range of 5,000 (This estimate includes managers, programmers and project managers actively involved in the development and delivery of systems to local and international markets (*Harvard 1999, 7*). It excludes supporting IT staff present in industry and government organizations.)

- 2,000 in multinational firms such as IBM, Oracle , NCR
- 2,000 in Egyptian software and IT firms (average of 10 employees with around 130 firms in total).
- 1,000 in supporting firms providing training and consulting to the sector

While these numbers are not impressive if compared with other countries with more developed software industries, they do however, provide a foundation from which to start a serious development of the industry. It is also estimate that somewhere between seven to nine thousand technology professionals are supporting corporate and government IT operations in various roles (*Harvard 1998, 7*).

4.1 Size of Market

Harvard Computing Group estimates the size of the software sector at around $50 Million in 1998. This is consistent with estimates from the Egyptian software Association (ESA), multinational companies such as NCR and ICL peg the market a bit lower at $40 million. The most common figure cited for the size of the overall information technology market in Egypt is $300 Million (for comparison, the IT market in Israel and Saudi Arabia is approximately $1.2 Billion for each country).

4.2 Number of Firms

There are approximately 120 companies involved in producing software in Egypt. Firms range from 1 to 5 person; start–ups to relatively mature firms with more than 50 to 150 employees. The majority of companies are located in/and around Cairo, or Alexandria. Some new software companies will be formed in the new industrial areas of 10^{th} of Ramadan and 6^{th} of October cities (*Harvard 1999, 11*).

4.3 Trends and Growth

The expectation for growth in the domestic marketplace for IT products and services is expected to be in the 35% range. This represents very soft demand in the local market for services and products. Most of the demand is also at the high end of the marketplace, where multi-national firms are providing most of the services. If this demand remains soft, without

any stimulation from either government or industry, there are few reasons why leading and emerging companies should invest time trying to develop the domestic marketplace (*Harvard 1999, 10*).

5 Competitive analysis: Indian Experiences

The competitive environment is important to consider while formulating operations strategies and objectives for the software industry. Therefore it is necessary to study the experience of other nations in this industry to obtain a view of some important methodologies that are applied by these countries and that need to be similarly pursued or modified in order to succeed in establishing this industry. India, an example of a developing nation applying an industry driven approach with more focus on software services and establishment of SDPs is discussed.

5.1 Highlights on the Indian Experience

India with a population of nearly one billion has become one of the giant global players in the software industry in less than ten years. The Indian software industry has grown from US$ 150 million in 1988 to US$ 3.9 billion in 1998-99 where the nation's competitive advantage in the software business has been cost-effectiveness, world-class quality, high reliability, and rapid delivery and all of which is powered by state-of-the-art technologies. The Indian Software production can be characterized as taking an industry-driven approach rather than being a government-driven process controlled industry. This is evident in the existence of a strong National Association of Software and Service Companies (NASSCOM) that is considered the apex body of computer software and services industry in India.

5.2 Domestic Software Market

In 1998-99, the domestic software industry was valued at Rs. 49.5 billion (US $ 1.25 billion) not including the in-house development of software by end-users. This reflects a C.A.G.R. of 46.05%, which has been steadily improving in the last few years. The growth rate in domestic software market was 41.02% in the year 1998-99. The domestic software market is expected to grow to Rs. 73 billion in 1999-2000. With the rigorous enforcement of Copyright laws and increased government spending on IT, it is expected that in the coming years, the domestic market for software can even register more than 50% annual growth rates. Also, the government has implemented zero import duty on software. It is expected that by the year 2008, revenues of Indian domestic software market would equal revenues from India's software and services exports, touching US $ 35 billion by the year 2008.

5.3 Software Export Industry

The Indian software export industry has exhibited very impressive growth rates with a C.A.G.R. over the past five years as high as 60.71%. Software and services exports grew from Rs. 0.30 billion in 1985 to a total of US $ 2,650 million (Rs. 109.4 billion) in 1998-99, and it is expected that during 1999-2000, software exports will reach Rs. 167 billion. The software industry in India expects to reach an export level of US $ 6.3 billion by year 2000-01 and US $ 9.5 billion by the year 2001-02.

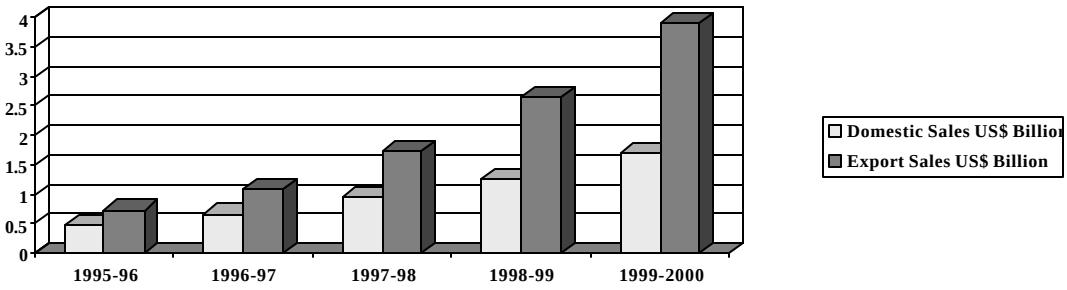

Figure 1: Indian Software Industry Revenues (*NASSCOM 2000*)

5.4 Break-Up of Software Activity

Following is a break-up of software activity of both the domestic and export segments in the year 1998-99. This further demonstrates that Packages are still at a low percentage, professional services "On-Site Services" are a high percentage of exports and Projects are more or less equally balanced in terms of percentage of domestic and exports markets.

Table 1: Break-Up of Software Activity for the Indian Industry (1998-99) (*NASSCOM 2000*)

Software Activity	Domestic Software		Software Export	
	US$ Million	Percentage	US$ Million	Percentage
Projects	356	28.5%	1,009	36.50%
Professional Services	63	5%	1,220	44.15%
Products & Packages	604	48.5%	218	7.90%
Training	58	4.5%	47	1.72%
Support and Maintenance	51	4%	117	4.25%
I.T Enabled Services	119	9.5%	151	5.48%
Total	**1,250**	**100%**	**2,763**	**100%**

5.5 Global Markets for Indian Software Exports

USA is India's main recipient of software exports at almost 61% followed by Europe at 23%. The six OECD countries (U.S.A, Japan, U.K., Germany, France and Italy) together have almost 71% of the market share of the worldwide software market. India's exports to these countries are also almost 79% of its total software exports.

Figure 2: Export Markets for the Indian Software Industry (*NASSCOM 2000*)

5.6 Human Resources Analysis

India has the second largest assembly of English-speaking scientific professionals in the world today after the US. It also has almost 4.1 million technical workers graduate from over 1,832 educational institutions and polytechnics, which train more than 67,785 computer software professionals every year (*NASSCOM 2000*).

The number of software professionals employed has increased to 250,000 in 1998-99 compared to 200,000 in the preceding year with almost 67% of whom are in software development and operations, 3% in domain expertise development, 11% in marketing and relationship development, 15% in client support and 4% in other activities. The overall median age of the software professionals was about 26.2 years. In 1999, 77% of software professionals in software companies are men and 18% are women.

5.7 General Analysis of the Indian Experience

When analyzing the Indian export revenues highlighted above and their distribution, it is noticed that exports to date have been dominated by export of software services, in the form of custom software work rather than export of software products in the form of packages (only 7.9%). This is mainly because of the high entry barriers to the package market versus software services. Additionally, Indian firms are not sufficiently familiar with the foreign package markets they seek to penetrate and distance from those market also makes it hard to keep up with changing needs and standards.

In regard to the destinations where the Indian software exports are heading, it is realized that India heavily depends on the US market as a major recipient of its software exports (61%). Not only is this because the US is the world's largest software market but also due to the fact that many Indian businesses have links through family members or friends who are US residents. Further, many of the Indian software developers are US trained and thus more US oriented and finally because immigration rules and residence permits are much easier in the States than in many other developed countries making it easier for Indian on-site software services.

Part 2: The Egyptian Software Model: Formulation

The model, that is developed in this study, is based on the data as well as the information and the assumptions of the Industry Researches, that recently conducted in the Egyptian software market (*Harvard 1999; USAID 1999*) and adopted by the government and industry leaders, and based also on the data collected through interviews with key persons in the industry. The main assumptions of the model concerning growth in the domestic and international Marketplace are:

- The targeted domestic Market growth is 35% over the next 5 years,
- The targeted International Marketplace growth is 200 % over the next 5 years, and
- The time frame of the model is 10 years.

6.1 Purpose of the Model

The objectives of the model are:

- To clarify knowledge and understanding of the current structure of the Egyptian Software industry,
- To identify the forces that have limited the growth of the industry, and
- To discover policies that will improve the industry growth.

6.2 Model Boundary

Each system has a closed boundary, within which the behavior of interest is generated. The model Boundary contains all components that are necessary for building the model. The main components of the Egyptian software industry are:

- Human Resources structure,
- Customer chain structure,
- Market Penetration structure,
- Time allocation structure,
- Salaries Structure,
- Service delivery operations structure, and
- Financial operations structure.

Their logical linkages can been seen in figure 2.

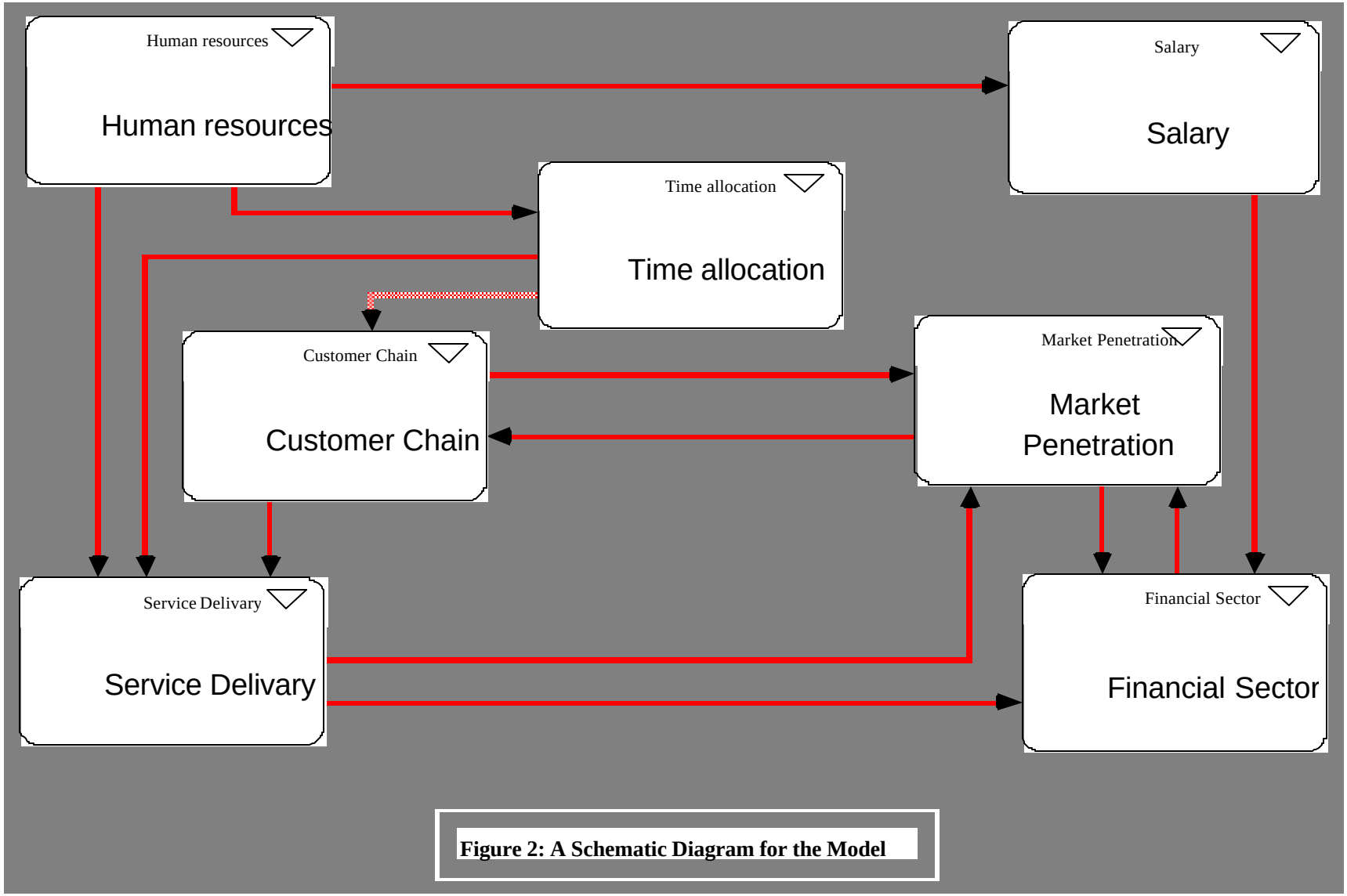

Figure 2: A Schematic Diagram for the Model

6.3 Macro Assessment for Growth of Egyptian Software Industry

To have a clear image of the targeted growth of the industry, and also to be able to extend the scope of the study, over the next 10 years and not only 5 years, a simple model will be formulated to determine the development of the market size based on assumptions of 35% domestic growth rate and 200% international growth for the marketplace (see also figure 3):

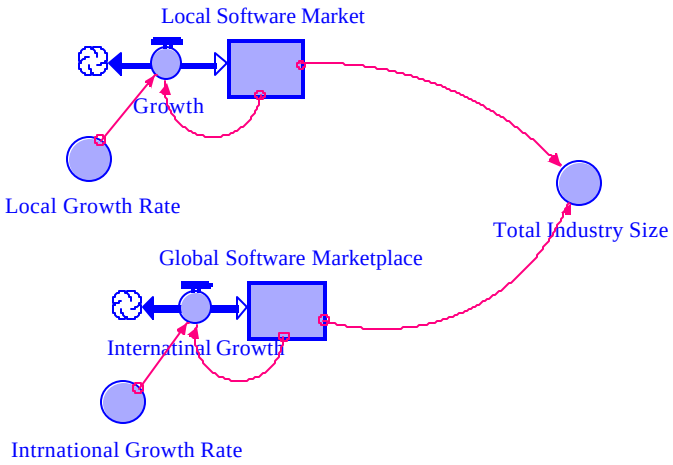

Figure 3: Macro Model for the Industry Growth

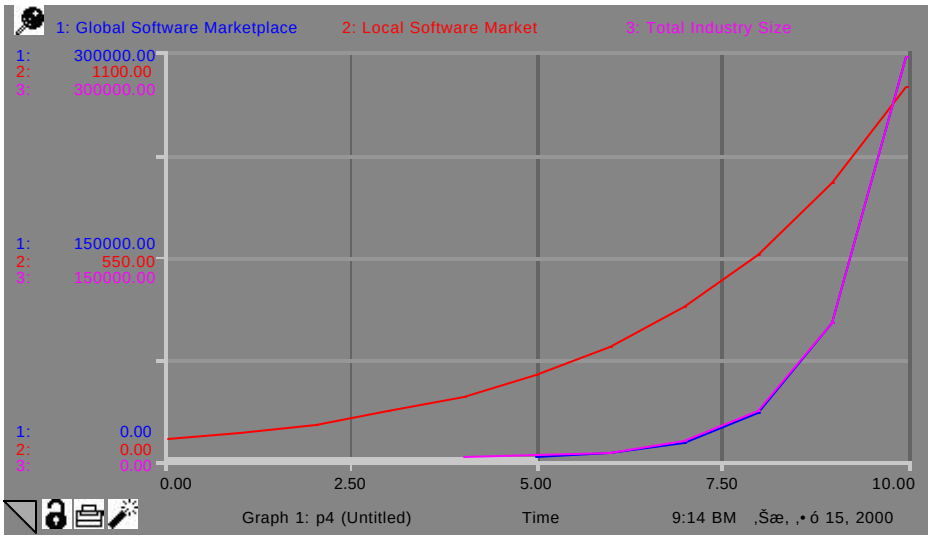

Figure 4: The Industry Growth Model Behavior

As seen in figure 4, the model behavior shows, based on the assumptions adopted by the Egyptian government, the local market size will reach US$ 225 Million in 5 years and US$ 1 Billion in 10 years. In the same time, the total industry size will reach in 10 years the US$ 300 Billion, which is not realistic. For that reason and to validate the model, modified figures for the growth rate for next 10 years will be applied as seen in figure 5.

Year	Growth Rate
1	200%
2	200%
3	200%
4	200%
5	200%
6	100%
7	60%
8	40%
9	30%
10	20%

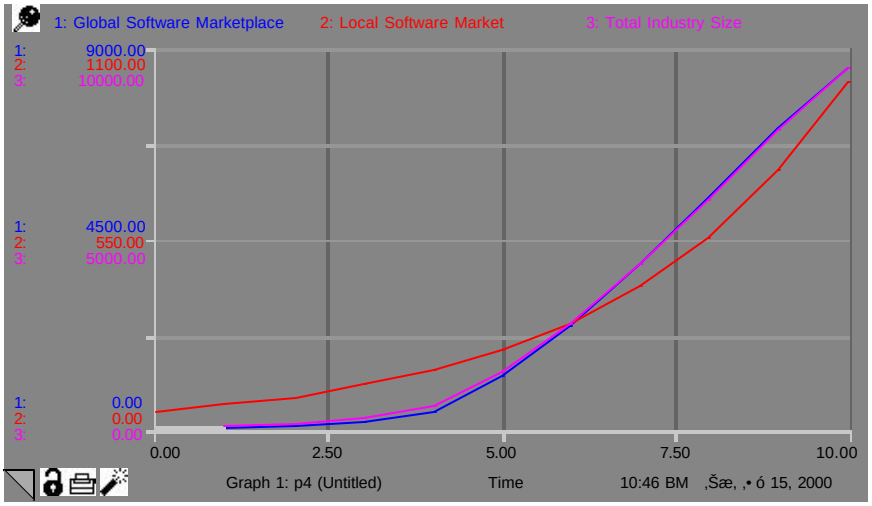

Figure 5: The Behavior of the model after adjusting the international market growth rate.

The model suggests by using the adjusted growth rate, the local market size will reach approximately US$ 1 Billion, and that international marketplace of nearly US$ 8.5 Billion. These figures may seem very high but compared of other successful cases such as India sound achievable. For Example Indian software industry grew from US$ 10 million to US$ 3.7 Billion. The Export part represents US$ 2.2 Billion of the total, in 1998 and it is targeted to reach an export amount of US$ 38 Billion in 2008 (*NASSCOM 2000*).

In the following sections, the structure of the complete model will be explored.

6.3.1 Human Resources Structure

The Egyptian Software companies depends mainly on the tailor-made applications. A small portion of the industry is providing multimedia products. Arabization software is still the specialty of few companies. In this paper the tailored IT services software sector will be considered as the major source of development of the industry, not only because of its current relative large share of the industry, but also because of its highly potential growth, globally and locally.

Table 3 illustrates the potential staff requirements based on the targeted expansion in the market place at 35% for domestic and 200% for export (*Harvard 1999, 26*). From the data listed in the table, it is obvious that Egypt has a serious shortage in senior staff, analysts, Project and product management as well as Sales and marketing. Also, the market demand for entry-level programmers is below the supply. From this profile it is obvious that increasing market share becomes a function of being able to fill these position.

Table 3: Estimates for the needs of the software industry staff in Egypt.

Employment Need	Number required	% of Total Required	Number Increase	%of Total Increase	Annual Shortfall	Demand Met
Project Managers	116	6	50	2.5	66	43%
Product Managers	29	1.5	15	.075	14	51%
Middle Management	145	7.5	100	5	45	69%
Senior Programmers	377	20	200	10	177	53%
Entry-Level Programmers	870	46	1500	75	+	172%
Business Analyst & Consultant	58	3	20	1	35	34%
Marketing Management	58	3	25	1.25	23	43%
Sales Managers & Staff	232	12	100	5	132	43%
Total	1885	100	2010	100	---	---

+ surplus

In general, there is no close link between Academic establishments and the industry. Some colleges have developed courses specifically to create graduates, who have capability to meet the needs, but most of them are post-graduate institutes such as the Information Technology Institute (ITI) and the Regional Information Technology institute (RITI).

6.3.2. Human Resources System Formulation

Figure 6 shows the structure of the Human Resource System. The levels of the system are the major human resources skills and expertise needed be the software industry. Three main processes exist in the structure of the software industry, and in every industry. The First is the entry to the industry. The Second is the promotion to a higher position. Third is leaving the Egyptian Software industry either to work in another industry inside Egypt, Specially related industries such as Computer hardware or medical equipment, or to work in software field but abroad. Based on the findings of the other studies and the interviews made with the industry key persons the following characteristics of the industry:

- Most of the companies spend in average one year of further training and coaching of graduates before they become productive staff (*Training Period).*
- The entry-level programmer needs from 4 to 6 years to acquire the skills qualifying to be a senior programmer (*Time to promo to Snr. Prgmr.).*
- A senior programmer needs, in average, of two years of experience before working as a business analyst (*Time to promo to Bus Anlst).*
- Sales staff should have at least 2 years of experience as programmers before working in sales (*Time to promo to Sales stf).*
- In average after two Years of working in sales, the one is usually promoted to sales management (*Time to promo to Sales Mgmt).*
- After at least two years of working in sales management, the sales manager can be promoted to marketing management (*Time to promo to Mkt Mgmt).*
- Business analysts and marketing manager usually spent 3 years in their position before being promoted to middle management (*Time to promo to Mdl Mgmt).*
- The entry-level programmer needs from 4 to 6 years to acquire the skills qualifying to be and a training on management to be promoted to Project or product management (*Time to promo to proj* or *prod management).*

- Project and product managers usually spent 4 years in their positions, before being promoted to middle management (*Time to promo to Mdl Mgmt).*
- Middle managers usually spent 4 years in their positions, before being promoted to Top management (*Time to promo to Top Mgmt)*.
- Human resources are allocated, mainly after getting the basic programming experience, to the different categories mainly according to the periods mentioned to acquire the necessary skills for the new position, *Time to promo,* and the needs of the companies, *Targeted fraction.*

Most of the people interviewed reported that there is a high leaving rate from the industry among the senior positions. The ratios of people leave the industry, *leave Fraction,* reach 50% among senior programmers, Business analysts, sales management and staff, Marketing management, and project and product management. They related that to two reasons. First is that senior staff leave to other countries, especially Arab countries, work in software there for higher returns. Second is that as the software become a major element in all high tech industries, there is a trend in these businesses, mainly high tech retailers, of recruiting from the software staff. They deliver them relatively higher salaries than those of software industry, to benefit from their Software experience, mainly in sales and customer support.

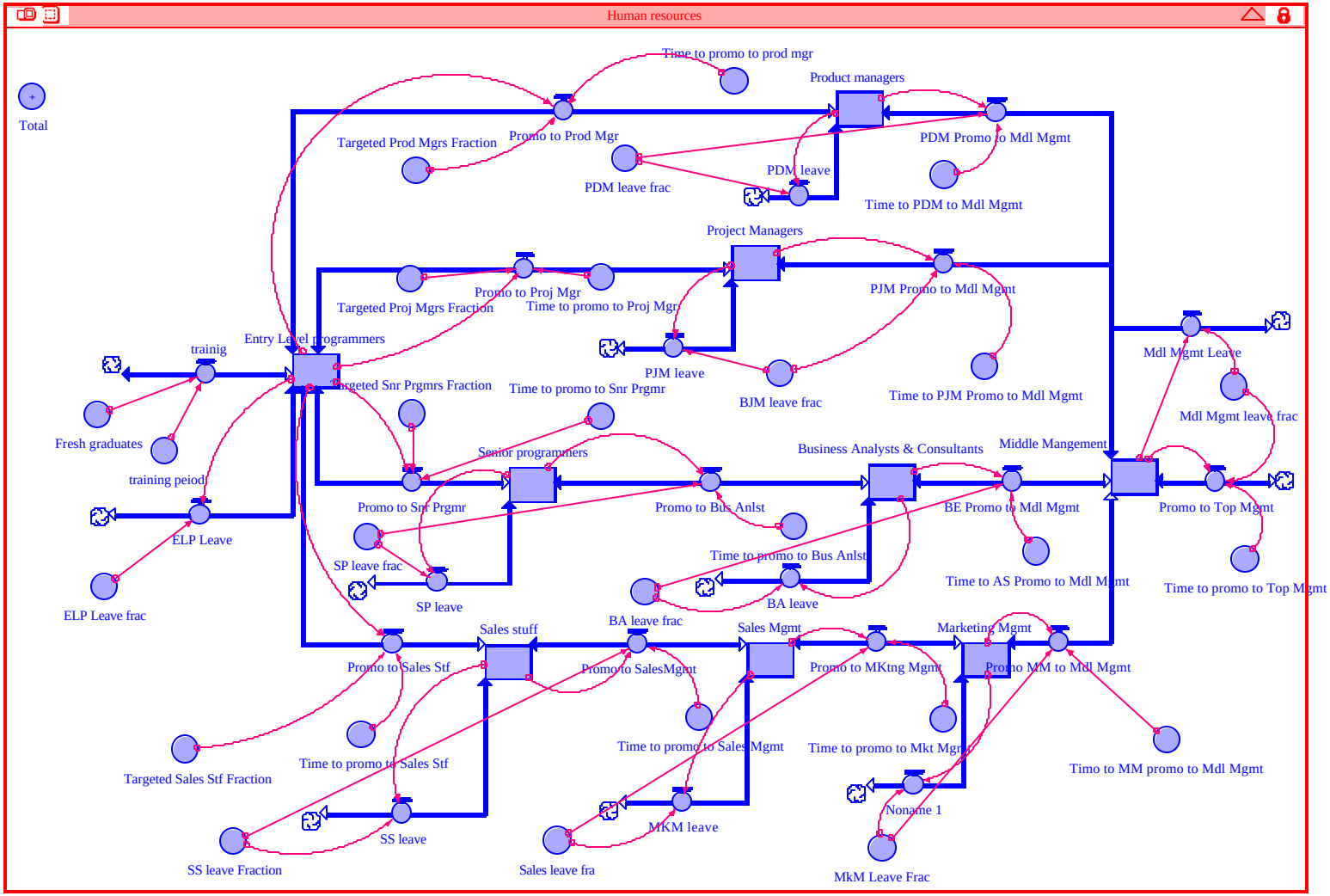

Figure 6: Human Resources Structure

6.4 Time allocation Structure

The purpose of this sector to translate the experience difference between seniors, either in programming or sales into difference of productivity in terms of standards hours. Some important assumptions for this particular structure include:

- The measuring units of productivity is "standard hour"
- Entry-Level programmers are only one-third as productive as senior programmers (1/3 Standard hour).
- Sales managers are double as productive as sales staff (2 standard hours).
- Marketing managers are tripling as productive as sales staff (3 standard hours).

6.5 Salaries Structure

This sector subsystem draws an image of the average salaries for the different levels of experience and skills in the software industry. In general, almost all of the industry key persons reported that the salary levels in the software industry, while increasing, is still well below the levels found in the other high tech industries in Egypt. Average salaries used in the model are collected and reviewed through the interviews. One interesting Comment repeated in interviews is that the crowding in entry level programmer stopped the salary rise wave, which dominate in the middle of 90s.Also the limitation for industry size did the same for senior staff. The majority considered the level of salaries almost constant.

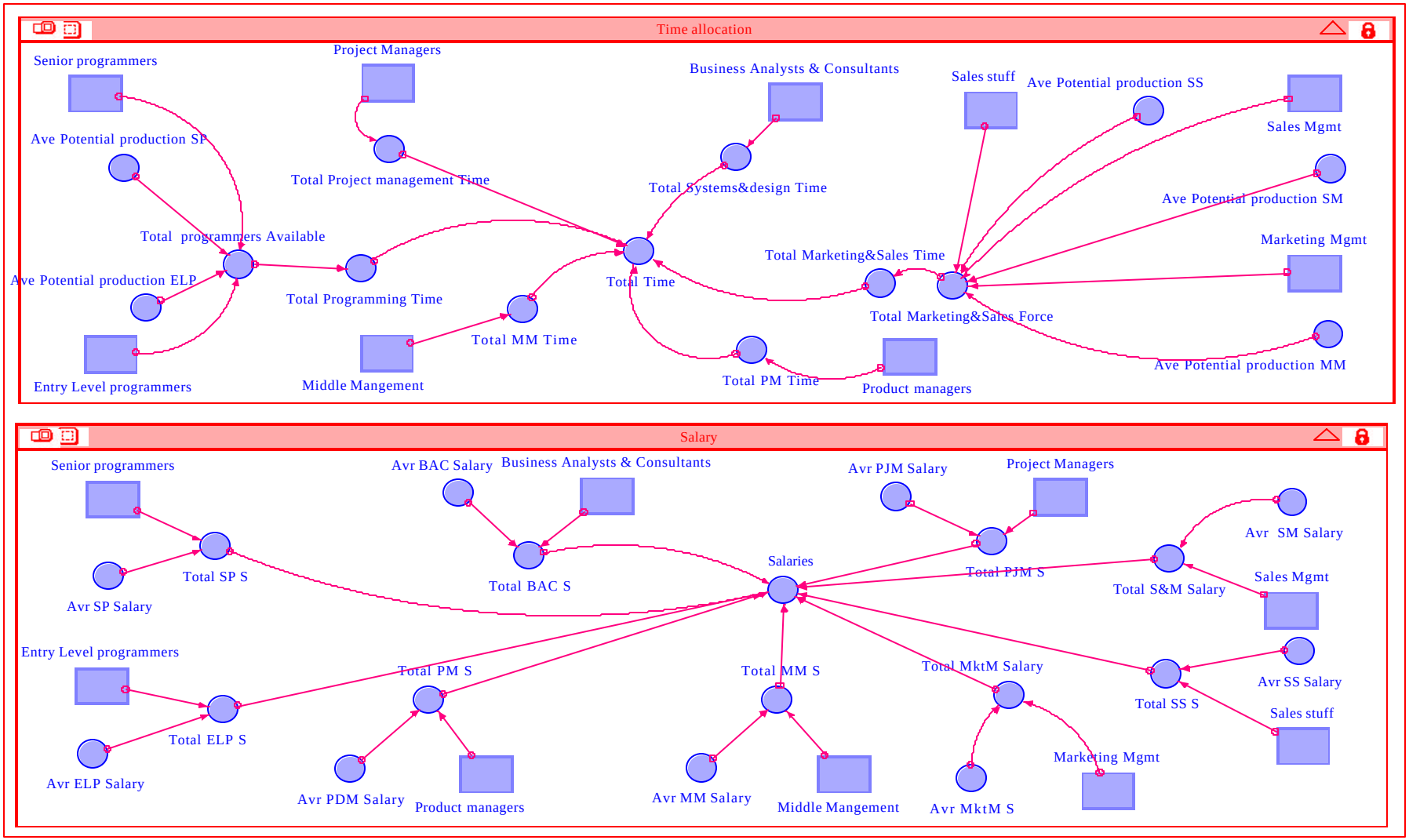

Figure 7: Time Allocation and Salary Structure

6.6 Customer Chain Structure

Figure 8 shows the structure for the customer main chain. This structure is organized to reflect how the software businessmen think about customer and the policies that they are currently applying. The customer chain model reflect the different states of customer, from being a potential customer then initiating contacts with him, then in case of success in contacts becoming active customer. The customer can either move forward or drop out at any stage in the chain.

80% of the sample interviewed reported that they give the utmost to customer maintenance then the customers those are currently in contact then at last comes initiating contacts with new customers. Responses about the average sales per customer varied very much between US$ 10,000 and US$ 150,000 annually. 75% of the population interviewed responded that, in case of having a customer of size of US$ 100,000 either still in contact or already contracted, One working day of one sales man weakly is the minimum manpower for winning or keeping that customer. The sample reported through the different stages of the customer chain, the drop ration is between 60% and 40%, and unanimously related this to the shortage of the qualified sales and marketing force.

The assumptions, based on the previous findings, of customer chain structure of figure 6.4 include:

- By multiplying the minimum required time for each customer, either just potential or active, we get the total required time for customers (*Min M & S Time to AC, Min Time to BCC, Min S & M Time to BC)*.
- The total marketing and sales available (*Total marketing & sales time)* computed from the time allocation section.
- The Marketing & Sales time is allocated to each category according to each category weight relative to the other categories.
- The ratio between the actual time allocated for each category and the required are represented by the adequacy converters (Adequacy *of M & S Time to AC, Adequacy of M & S Time to BCC, and Adequacy of M & S Time to PC)*.
- The drop out of customers in each stage is considered to be a function in the adequacy of M & S time available for this stage (*Potential Yield, Buying hit rate, and Becoming Inactive).*
- Satisfaction Level is another determinant for the drop out ratio and it will be tackled later in the model.

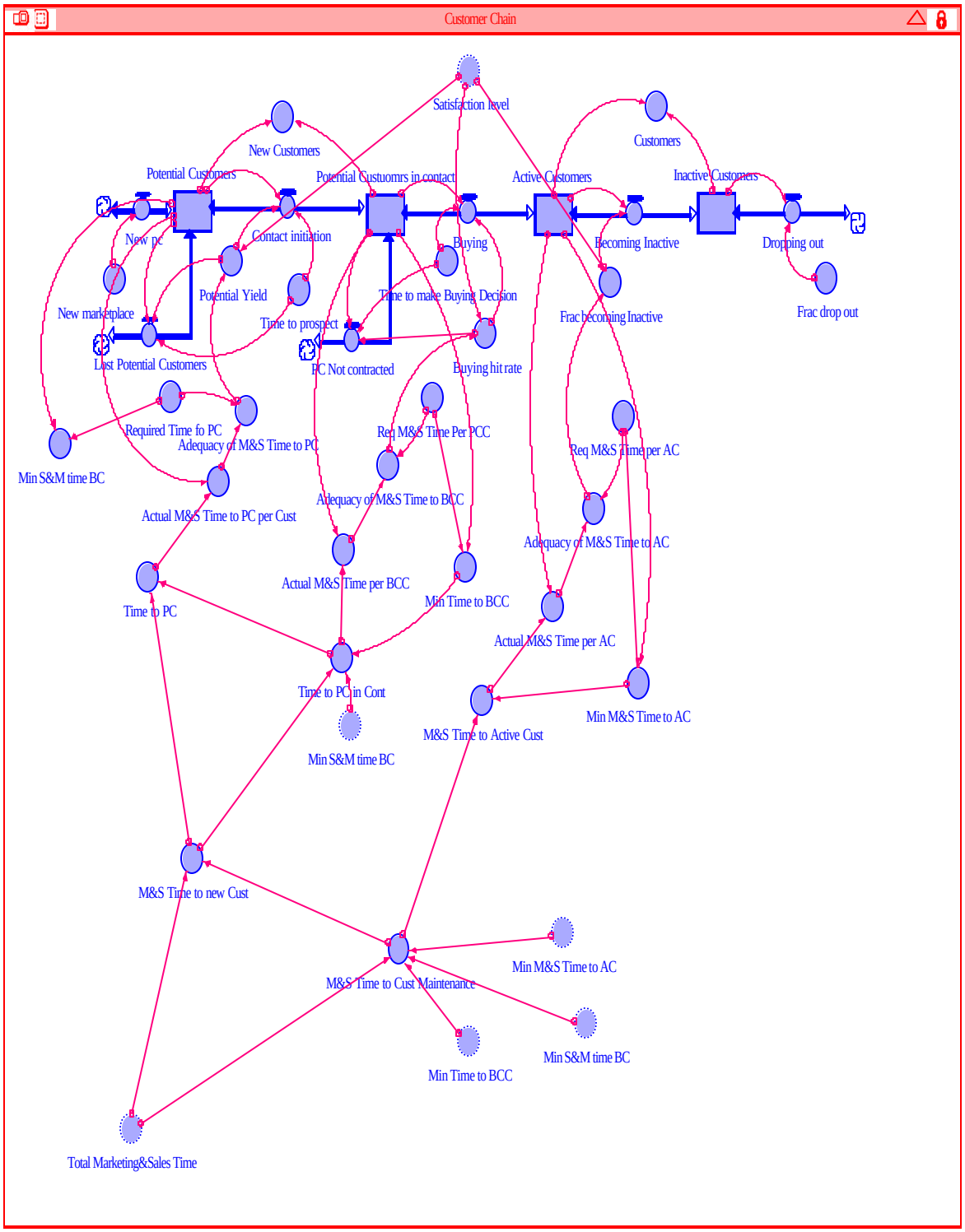

Figure 8: Customer Chain Structure

6.7 Market Penetration Structure

Figure 9 shows a simple model representation of the acceptance process both in local and international markets. As Software and Information Technology in general are new comers to both the Egyptian business Society and to the international market, we didn't find too much difference between the local and international penetration process. Despite the difference, the Egyptian software industry needs to establish a new product in both local and international markets, Software locally and Egyptian software globally.

In The Local Market, Three Parameters mainly affect the spread of Egyptian software Product. The first is the perceived performance by the early adapters. The acceptance level will be affected when the early adopters perceived the performance of the Egyptian software product satisfying. The level of acceptance will increase as the perceived performance increase. The second is the traditional tools of promotional marketing. The last one is increase number of the number of adopters. Acceptance is enhanced when information on the new technology is not only encouraging but plentiful enough to break down natural resistance. The acceptance level will have a positive effect on the productivity of the Sales Force.

The Egyptian software businessmen presence in the International Market is still very weak. Though the international exposure needs to use strategies different from those used in the local market, The producers still rely on the same three parameters of the local market though they have lower effect in the global arena. Most of the people interview, based on past experiences, saw that the international market presence is very costly and of low return. The use of Internet as a real business tool is still negligible. Most of the businesses have only a brochure-type of Internet homepage. They rely on exhibitions and business trips as tools of promotion. There is no physical presence in the international markets, as the business size can not support a permanent presence.

The satisfaction level in any market is determined mainly by two parameters. Acceptance level of the product in the market is one factor. As the gap between the local and international business communities is slashing, We assumed that the general acceptance level that spread among the customers, targeted and active, in both markets would be almost the same. This Acceptance level is determined by both local and international acceptance weighted according to the international exposure level. The second parameter is the delay time in delivering the service. The higher the Delay Time the lower the satisfaction level. Delay Time is determined by service delivery process, which will be explored in the next section.

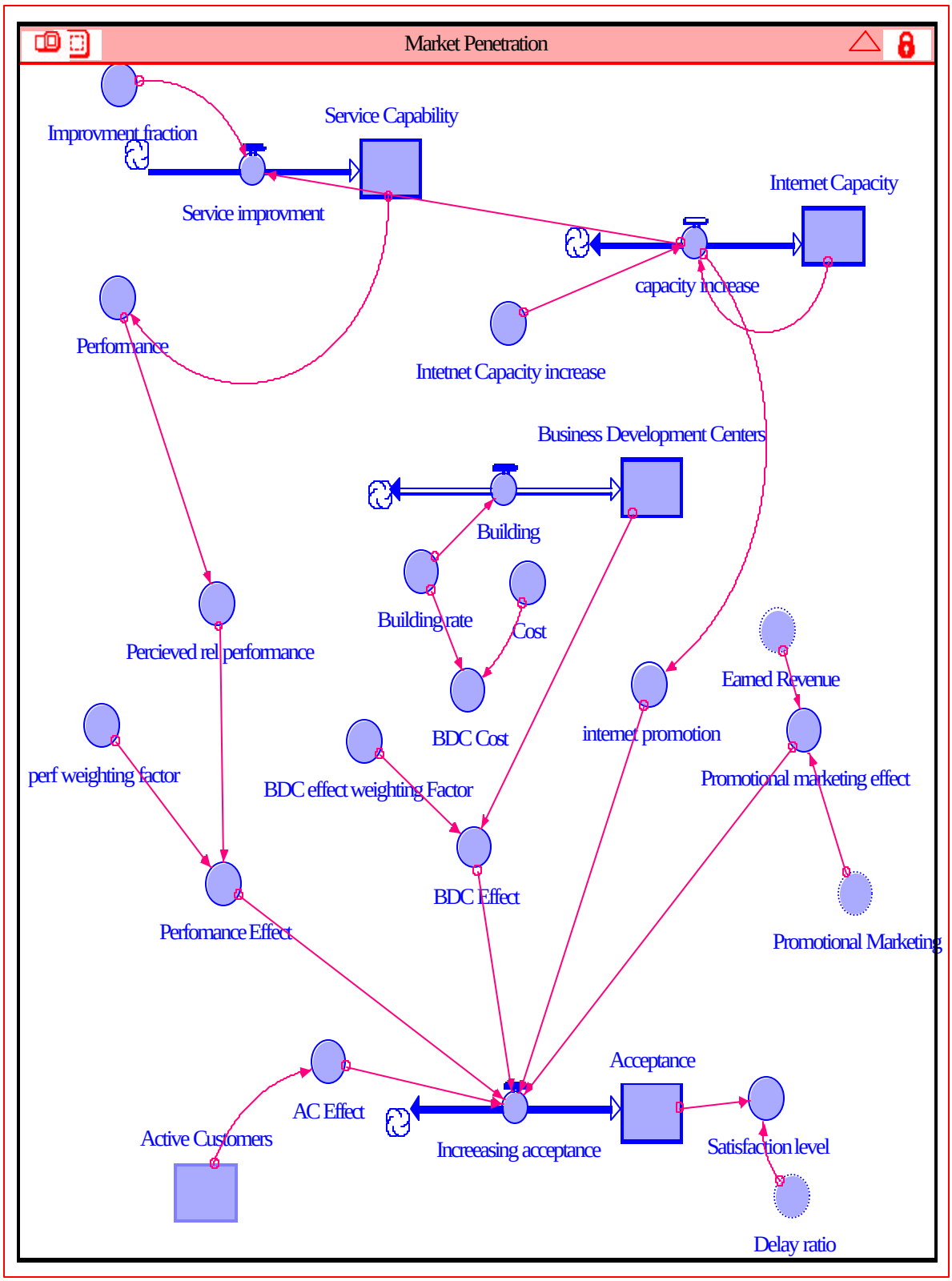

Figure 9: Market Penetration

6.8 Service Delivery Structure

Like the product production process, the service delivery structure (figure 9) integrates several smaller structures into operational depiction. The main stages of the software services delivery are: system analysis; System design; individual Module reviewing; defective modules reworking, final individual modules testing, Prototype production and testing, final system delivery. The structure shows the overlapping between the different stages of the service production processes.

As the assessment of the current size of software market is US$ 50 million, We assumed that the current number of active customer is 5000 customer with average annual purchases of US$ 100,000. The service delivery, and in turn market size, rate is determined be either demand from customers or available human resources in the industry. The delivery rate in all stages is limited by the minimum of those two parameters, *Services Backlog* or *available working time.*

Posing the question of time requirement for different stages of a project of a return of US$ 100,000, the following average rates for such a project were achieved:

- The average Analysis Time = 150 standard Analysis hours.
- The average Design Time = 150 standard Design hours.
- The average Coding Time = 1500 standard Programming hours.
- The average Reviewing Time = 400 standard Programming hours.
- The average Reworking Time = 600 standard Programming hours.
- The average Testing Time = 1000 standard Testing hours.

From the responses regarding allocation of the available programming time, based on the available human resources, the following averages were reached:

- Available analysis and design would be divided equally between the two activities.
- Available programming time would be allocated as following: Coding and reworking activities would be deliver the greater portion of available programming time; each of them is chosen to receive 35% of total available programming time. The other two activities, reviewing and testing, is said to take each in average 15% of the total programming time.

Another point that was emphasized in the interviews is that the composition of the programming staff affect aggressively not only on the productivity as tackled before but also on the defect rate in work. The higher the junior ratio the higher the defect rate. That was represented in the model through a table giving the average defect rate, according the business people, for the different composition of the programming staff.

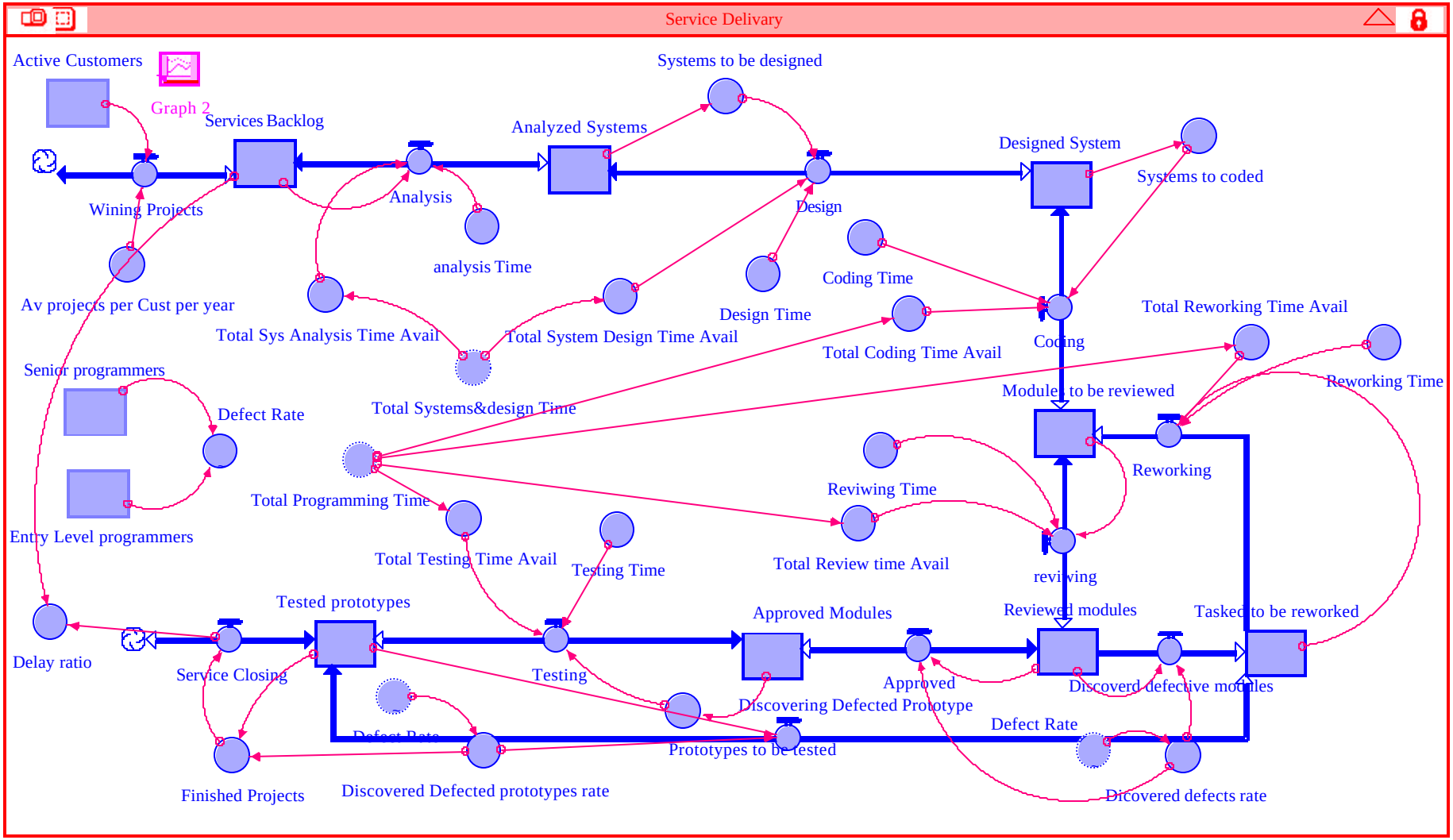

Figure 10: Service Delivery Structure

6.9 Financial Operations Structure

The financial structure (see figure 11) shows the major sources of capital inflows to and outflow from the industry. The first is the internal resource, which is the revenue. The other two are external investment and credit. As indicated in the industry analysis that the software industry is heavily dependent on private capital. Many firms start using family or friends money. Venture capital is still untapped source. Financing through credit is still weak owing to the low perception of banking sector to the software value. Salaries, Marketing, Facilities, and taxes represent the major cash outflows.

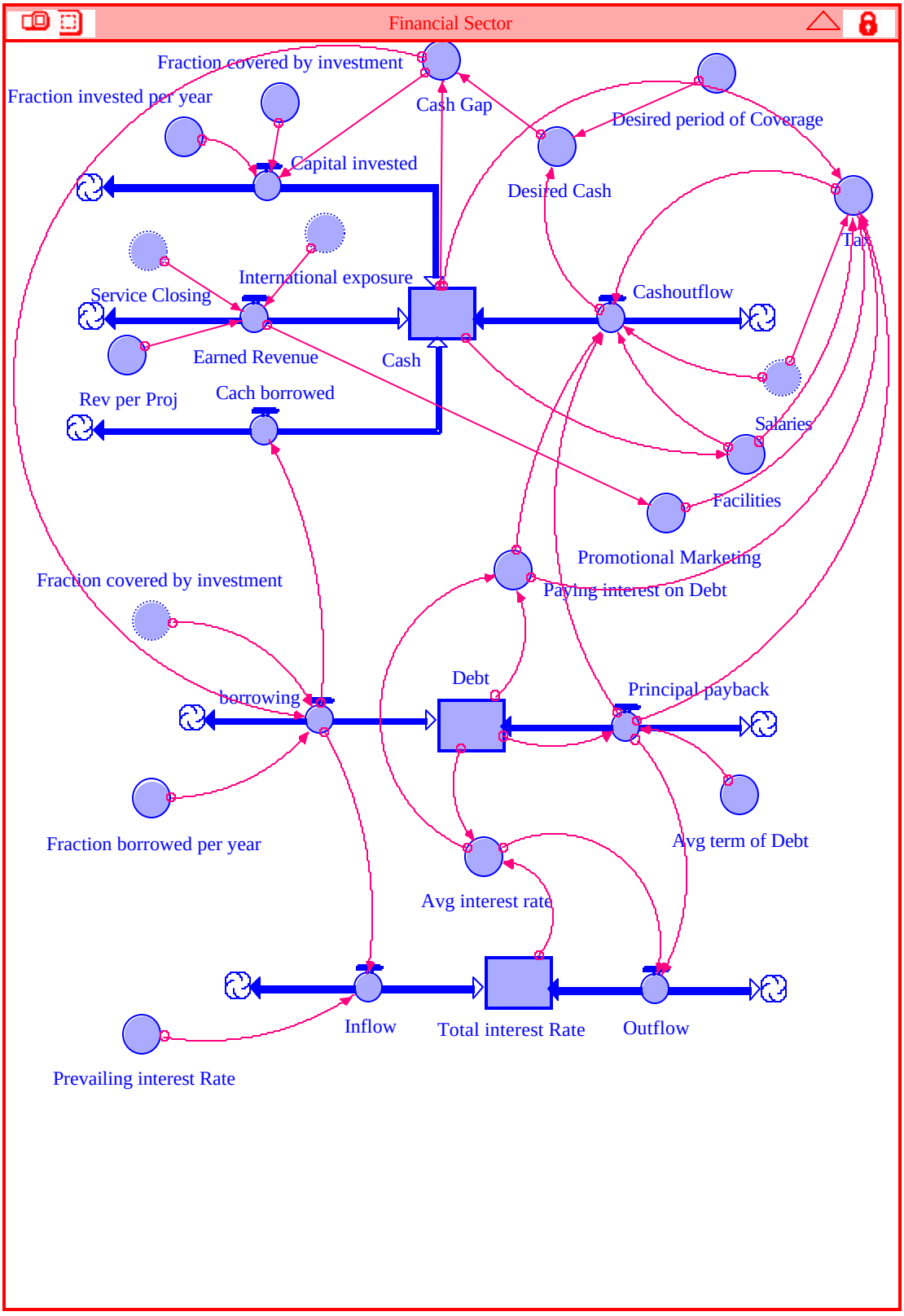

Figure 11: Financial Sector Structure

Part 3: The Egyptian Software Model: Results & Analysis

7.1 Human Resources System Behavior

The behavior of the system may seems surprising because of the rigorous efforts that have been started on developing training programs since nearly 5 years. Though the government and private sector continually establish institutions for training on the different skills needed by the industry, figures 12a, 12b, 12c show the simulation of the schedule of the human resource growth over the next 20 years. The system shows a typical asymptotic growth schedule. Over the first 5 years, though the growth, the average rate of growth in senior positions, *in programming, in marketing and sales, and in management*, is still well below the required number. The curve also shows also a persistency in the overproduction in Entry level programmers. The growth trend worsens as decline more during the next 5 years. During the last 10 years, The situation deteriorate as the size of different categories of human resources stabilized at positions maintaining the gap in seniors, *in programming, in marketing and sales, and in management*, and the over-capacity in Entry-Level programmers. Table 4 summarizes the simulated behavior of the system in contrast with the required growth.

Table 4: Average Annual Increase in Software Human Resources.

Employment Need	Annual Number required	Current Ann. Increase	Av. Ann. Increase (1 ˉ 5 years)	Av. Ann. Increase (5 - 10 years)	Av. Ann. Increase (10-20)
Project Managers	116	50	34	22	2
Product Managers	29	15	10	4	0.5
Middle Management	145	100	66	37	17
Senior Programmers	377	200	105	40	5
Entry-Level Programmers	870	1500	1800	250	100
Bus. Analyst & Consultant	58	20	35	22	3
Marketing Management	58	25	15	11	2
Sales Managers & Staff	332	100	173	70	9
Total	1885	2010	2273	456	138.5

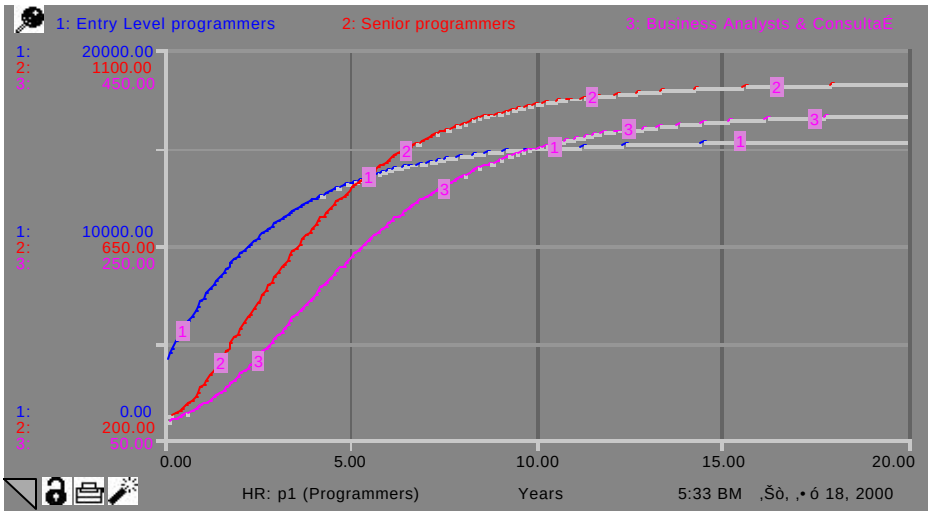

Figure 12a: Programming Staff Development

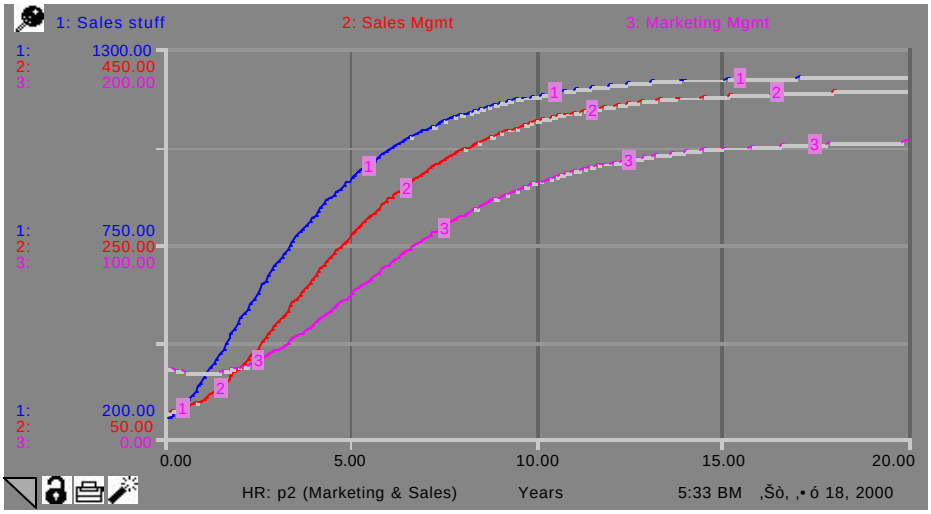

Figure 12b: Marketing & Sales Development Trend

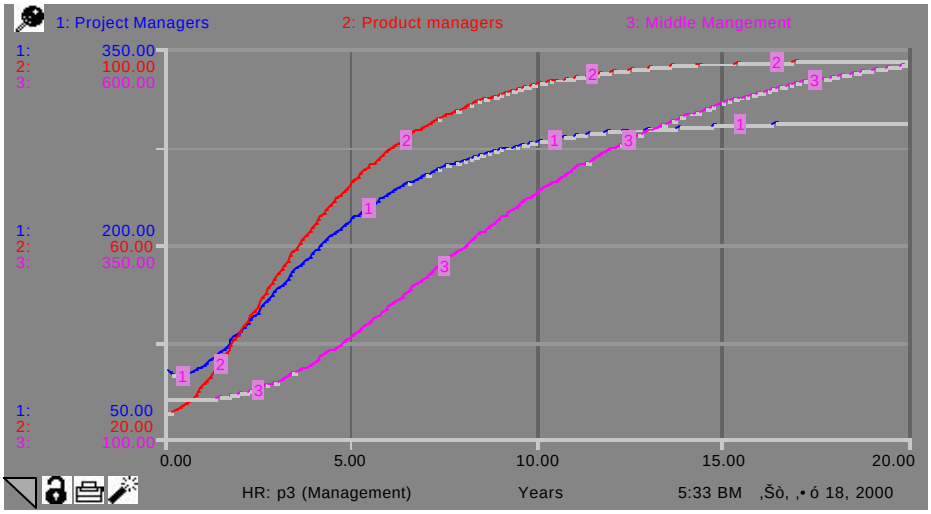

Figure 12c: Management Development Trend

7.2 Market System Behavior

The behavior resulted from the model for the development of the marketplace of the Egyptian software, though frustrating, but not surprising in the light of the human resources growth trend. As shown in Figures 13a, 13b, 13c., The number of active customer will continue growing but in much well lower rate than targeted. The total sales size will reach, according to the model, only about US$ 350 million.

Figure 13a indicates that the main source of growth is related to the rise in sales and projects with current customer, as their dependence on IT and confidence in the Egyptian software reliability increases. Market efforts to attract new customers are limited by the shortage in marketing & sales force. This has been reflected obviously in the very low rate of new customers' sales growth, which is nearly around US$ 1 million.

Figure 13b emphasizes the fact that the size of sales is a function in the sales efforts and time exerted with customer. The increase in the sales & Marketing Time dedicated to customer, reflected in the adequacy indicator, has been reflected by a rise of sales specially by the active, repeated, customers. This also an indicator that keeping current customer is more profitable than attracting new customers.

The oscillation in sales, though the continuous rise in satisfaction level shown in figure 13c, can be explained by two factors. The first is the decline in demand by repeated customer as they develop the main IT infrastructure. The second the weak growth of new-customer base for the Egyptian software industry

7.3 Service Delivery System Behavior

The behavior of the model explains the low level of sales growth. As the stages of the software production have a sequential nature, the delay on its early stages will limit the speed of the whole process. The limitation of Human Resources for systems analysis & Design processes represents a bottleneck for service delivery process (Figure 14a). This not only limits the growth of sales and increases the delay time but also affects negatively on the satisfaction level of customers. The decline in satisfaction level leads to a more decline in the sales growth.

Another impact of the shortage in the senior staff appears in the case of the ratio between Entry-Level and Senior programmers. The imbalance, owing to the high ratio of Entry-Level Programmers, results in a high defect ratio. This high defect ratio causes another crowding point in the rewriting and testing stages (Figure 14b). This another cause of the delay that expected to persist the software production process.

7.4 Financial System Behavior

Figure 4 gives an alarm that the software industry is not able to support growth without external sources of funding. Internal revenue, while increasing, is still not enough to support extensions needed to the industry for growth. The industry can not continue relying on personal and family capital as the sole, or even major, source of investment capital. As a result of the poor sources of finance of to the software industry, the low net income of the industry would persist and negatively affect the salaries and performance.

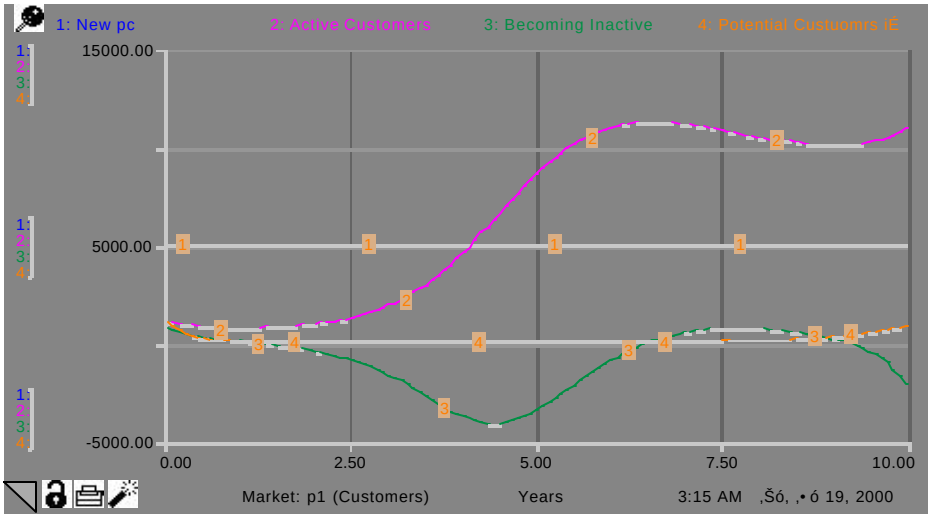

Figure 13a: Customer growth Trend

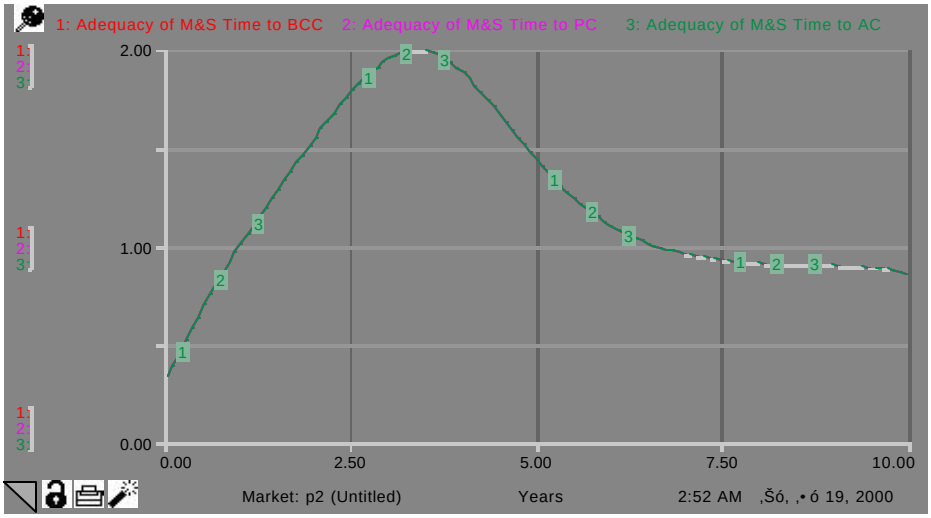

Figure 13b: Sales & Marketing Time to Customers Adequacy Trend

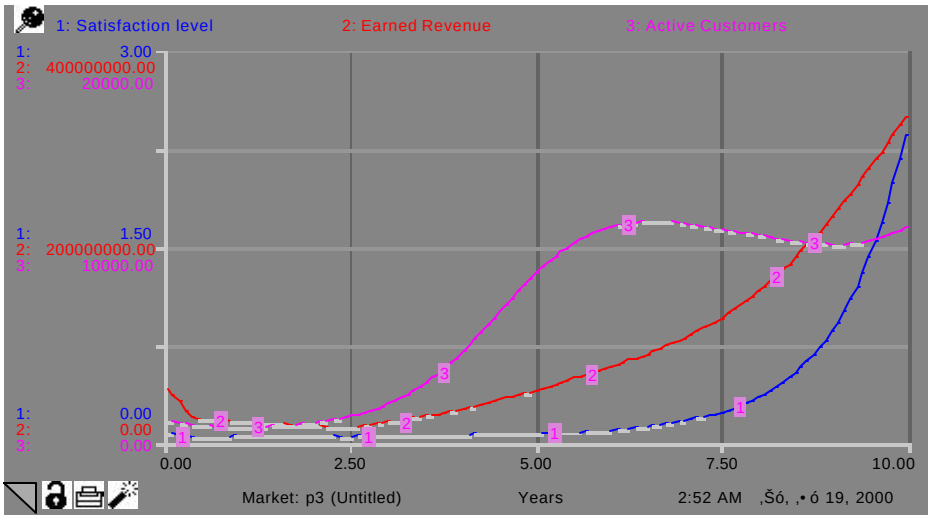

Figure 13c: Revenue Growth Trend

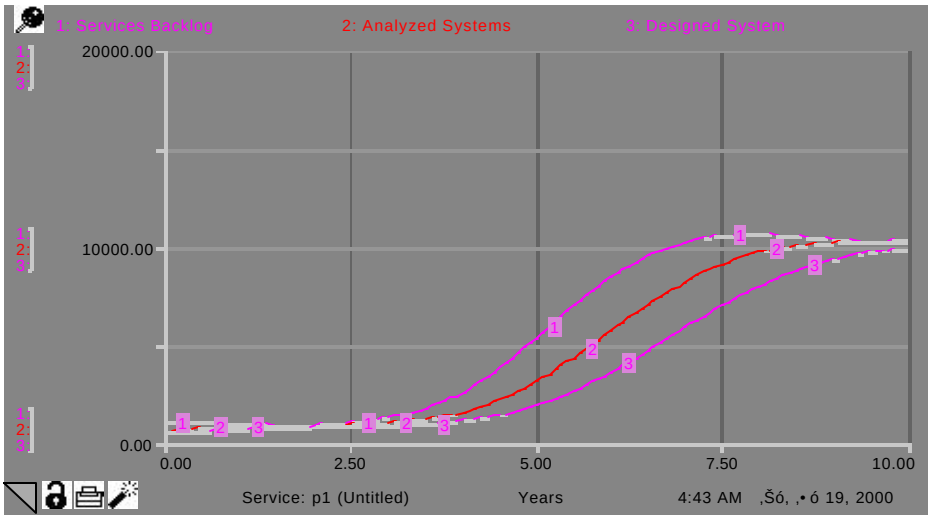

Figure 14a: Analysis & Design Operations performance Trend

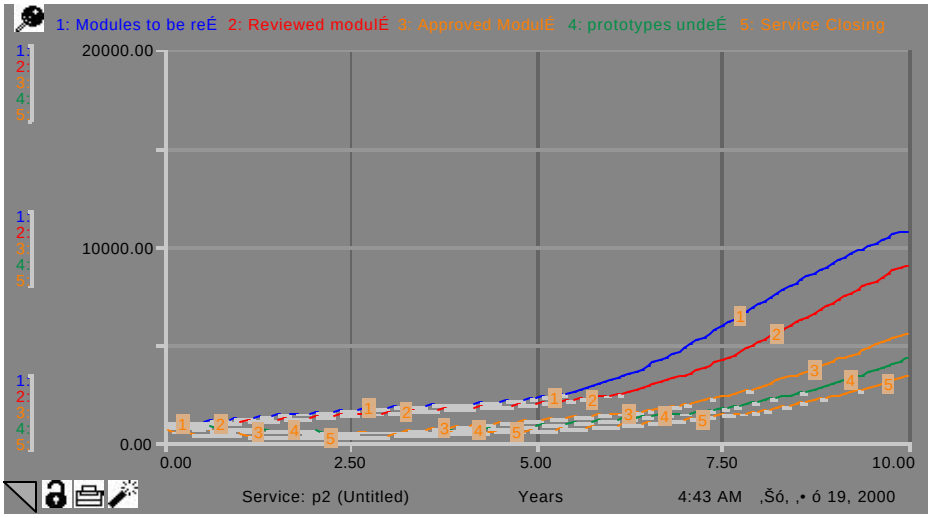

Figure 14b: Coding & Testing Operations performance Trend

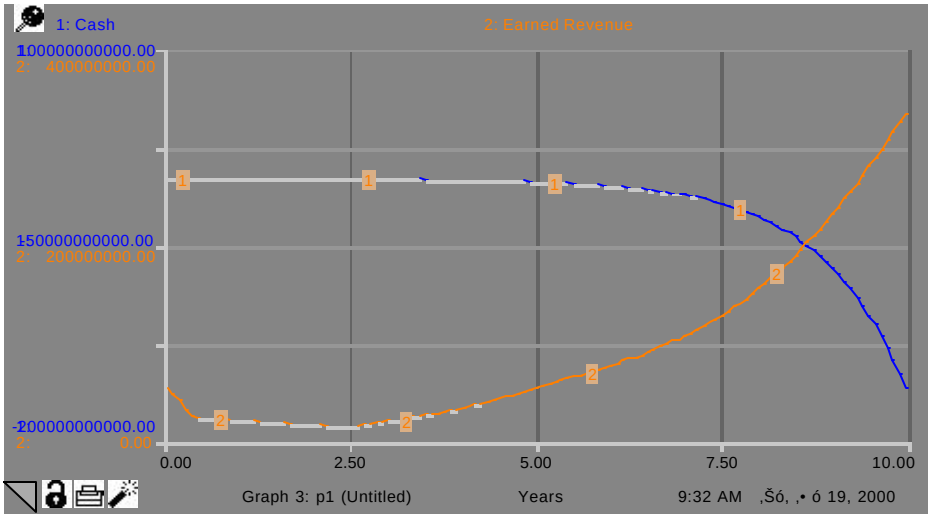

Figure 15: Financial Performance Trend

Part 4: The Egyptian Software Model: Analysis & Recommendations

Through the chapter we will try to explore the model more deeply in two stages. First, we will explore the imbalances in the system through: an overall analysis as a primary analysis; then a deeper analysis exploring the details of the system. Second, we will try to discover the suitable policy options, to treat imbalances discovered from the primary and detailed analysis, and examine their effect on the system. Three system dynamics tools will be used as needed:

- System Dynamics Principles
- Systems Archetypes: will be used when the subsystem behavior, or structure, reflect one of the well-known archetypes.
- Causal loops or Level-Rate Loops: will be used alternatively in analysis and redesign as needed.

The analysis of the model will be given in two equivalent forms - text and equations. Those readers who are not familiar with algebraic notations may wish to ignore the equations. Those readers who are conversant with equation terminology will find the equation form more precise than text.

8.1 Primary Analysis

Looking at the schematic diagram of the system (Figure 4), it is easily to recognize that there is no feedback to the human resources sector from the other parts of the system. These reflects the existence of two imbalances:

- The absence of a tight link between the Academic establishment and the industry. During the evaluation interviews, a second round of interviews with the aim of evaluating the results of the industry model, it was confirmed that most of the organizations do not have feedback mechanism from the market to adjust their courses or curriculum according to the industry needs.

- The absence of a feedback mechanism from the industry size, revenue, and the human resources allocation. Most of the People interviewed agreed on this. Moreover, their responses revealed important phenomena, the current gap between the available numbers of senior staff and Entry-level programmers make it more profitable for companies, in the short run, to train employ high number of them instead of recruiting a senior. This made salaries, in the software employment market, to be demand driven, i.e. determined by companies. This enticed the companies to fix the salaries at low level in comparison with industry returns. This is a valid policy for the current size of industry but it can not support the targeted growth.

8.2 Detailed Analysis

8.2.1 Human Resources System

The different subsystems of the human resources sector (figure 12a, 12b, 12c) share the Asymptotic growth behavior. Figure 16a shows the generic structure of the loops of the human resources sector. This is a typical a first order negative feedback structure (a goal-seeking system) with two negative feedback loops.

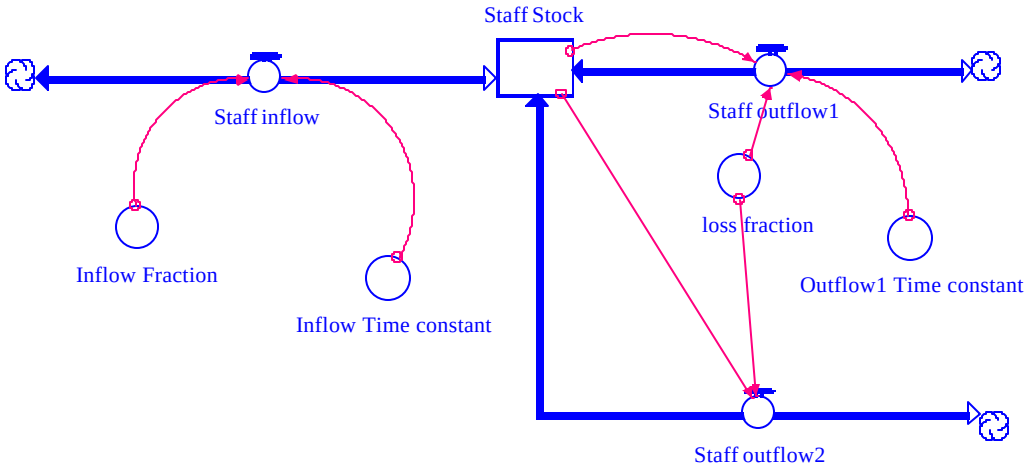

Figure 16a: Human Resources Generic Structure

Stock(t) = Stock(t - dt) + dt(Inflow) * dt + (- Outflow1) * + dt(- OutFlow2)*dt *(1)*
INIT Stock = A constant *(2)*
Goal for the stock = INIT Stock + Inflow *(3)*
Inflow = predecessor stock outflow * (Inflow fraction / Inflow Time constant) *(4)*
Outflow1 = adjustment gap * ((1-Loss Factor)/Time constant) *(5)*
Outflow2 = adjustment gap * Loss Factor *(6*
Adjustment gap = (goal for the stock) - Stock *(7*

It is easy to identify the goal-gap structure in this model. The goal is the upper limit any stock can reach; this could be determined exactly by the sum of the initial value of the stock and the linear input to the stock, i.e. Staff inflow + Initial value of staff stock (Eq. 3). The pace of accumulation of the stock is determined by three flows (Eq. 1):

- Staff inflow (positive effect).
- Staff outflow1 (negative effect).
- Staff outflow2 (negative effect).

The policy objectives for improvement of the human resources system behavior should be:

- Raising the value of the goal (Staff number limit) of the system stocks.
- Increasing the pace of the growth of the stock (staff growth).

For achieving the first goal, it obvious that the recommended action should address the stock inflow, as the stock initial value can not be changed (Eq. 3). Two options are available to increase the staff inflow (Eq. 4): lowering the time constant; and increasing the value the content of predecessor stock.

The first option is lowering the time constant. The time constant here is the time needed for promotion to the position from the previous one. The suggested policy is to shorten the promotion time among the different categories of the software human resources (for ex. from entry-level to senior programmer). The optimum way to do this is develop tailored training plan to the needs of

the senior position (senior programmers, sales and marketing, management). The training courses delivered should satisfy the domestic and international perspectives of the industry. Applying this policy option solely is not enough, as it will cause a limited increase the staff inflow by the value of the predecessor stock.

As the human resources system exhibit a ***"limits to growth, or success"*** archetype (The limit to the system is the annual number of the graduates), increasing the value of the predecessor stocks require increase in the number of graduates. Most of the studies refuse this option owing to excess number of entry-level programmers in the market. This argument will not be valid in case of applying the first policy option. Lowering the time constant will increase the outflow from the Entry-level programmers, leading to gradually drop the annual accumulation in this stock. This will allow increasing the number of graduates without fear of more Entry-Level programmer crowding in the market.

For achieving the second goal, increasing the pace of the growth, two actions should be taken:

- Lowering the pace of outflow.
- Increasing the pace of the inflow.

We have two generic outflows in the loops of the system. Lowering the pace of outflow 1 is not a valid option as it is at the same time the inflow to the successor stock. The reminder option is lowering the outflow 2, leave outflow,. The current high leave rate is a result of the fact that the Egyptian software human resources of software industries represent with other Hi-Tech Industries' HRs one pool feed all the high-tech industries in Egypt and the Arab countries.

Using the language of System Dynamics archetypes, This means that The Hi-Tech industries in the Arab countries exhibit ***"Tragedy of the Common"*** archetype, as the Egyptian human resource representing the common pool of this system. This needs to introduce a feedback from comparator with average salaries in other competitor industries to adjust salaries according to it. This action is supposed to give a higher control over the leave rate.

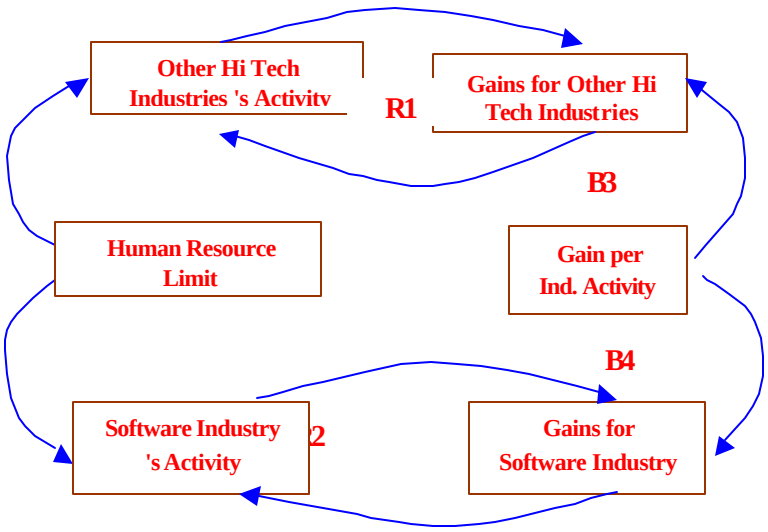

Figure 16b: Tragedy of the Common

- Introducing a positive feedback loop to the inflow to the system is the optimum way to change the current asymptotic inflow, as it is outflow of a stock exhibiting asymptotic growth, into S-shape inflow (remember: S-shape = exponential + asymptotic flows). This goes in line with the requirement revealed from the study to have a feedback from the industry to the education institutions. Having feedback from the industry will allow considering the leave rate effect on the Staff stock and adapting itself to compensate this loss. Linking the industry to the education institutions will also improve the environment to establish a good R&D System in Egypt.

Figures 17 and 18 show the modified structures of the Human Resources system and salaries systems respectively. Their behaviors are shown in Figures19a, 19b, 19c show its new behavior trend.

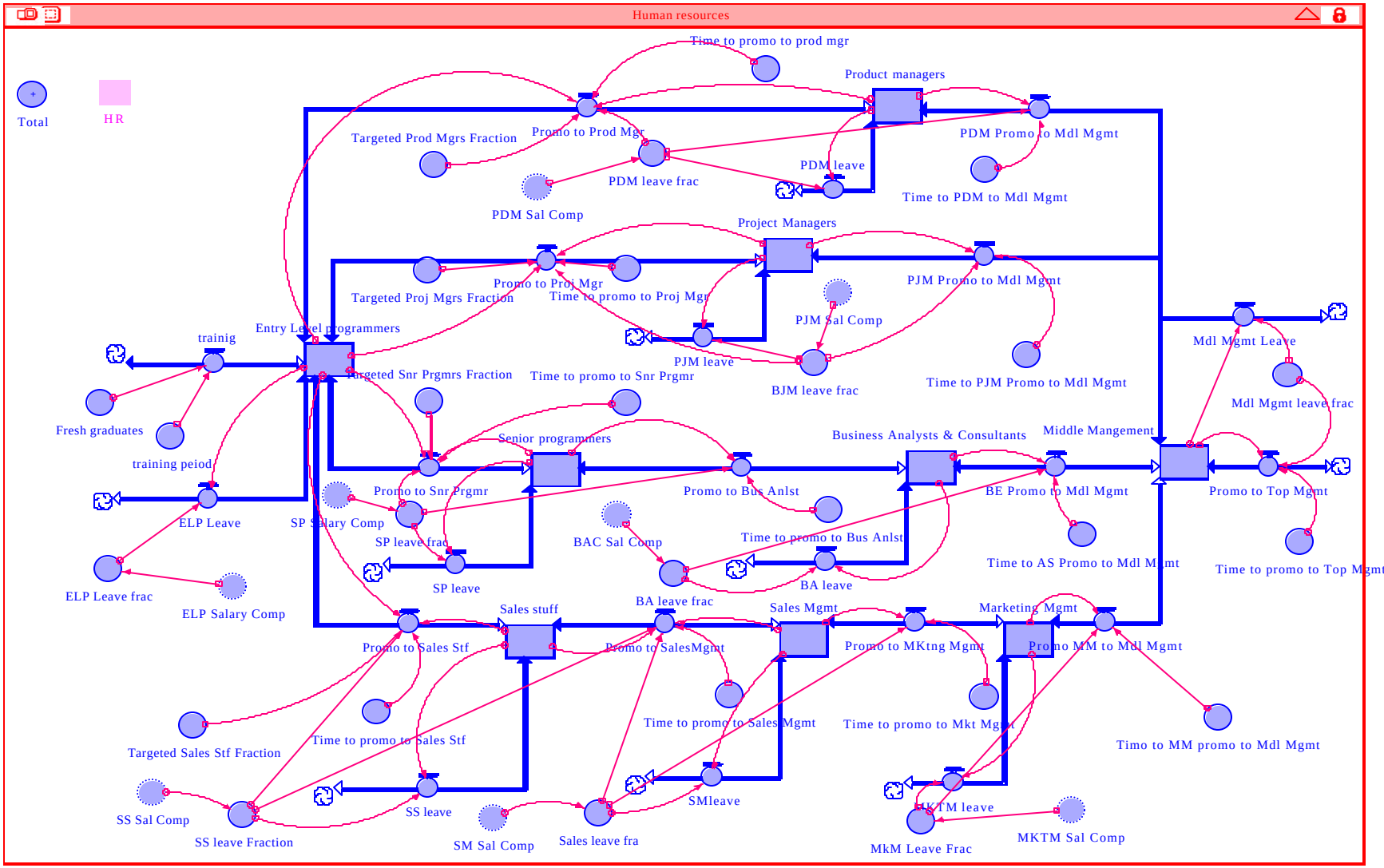

Figure 17: Modified Human Resources

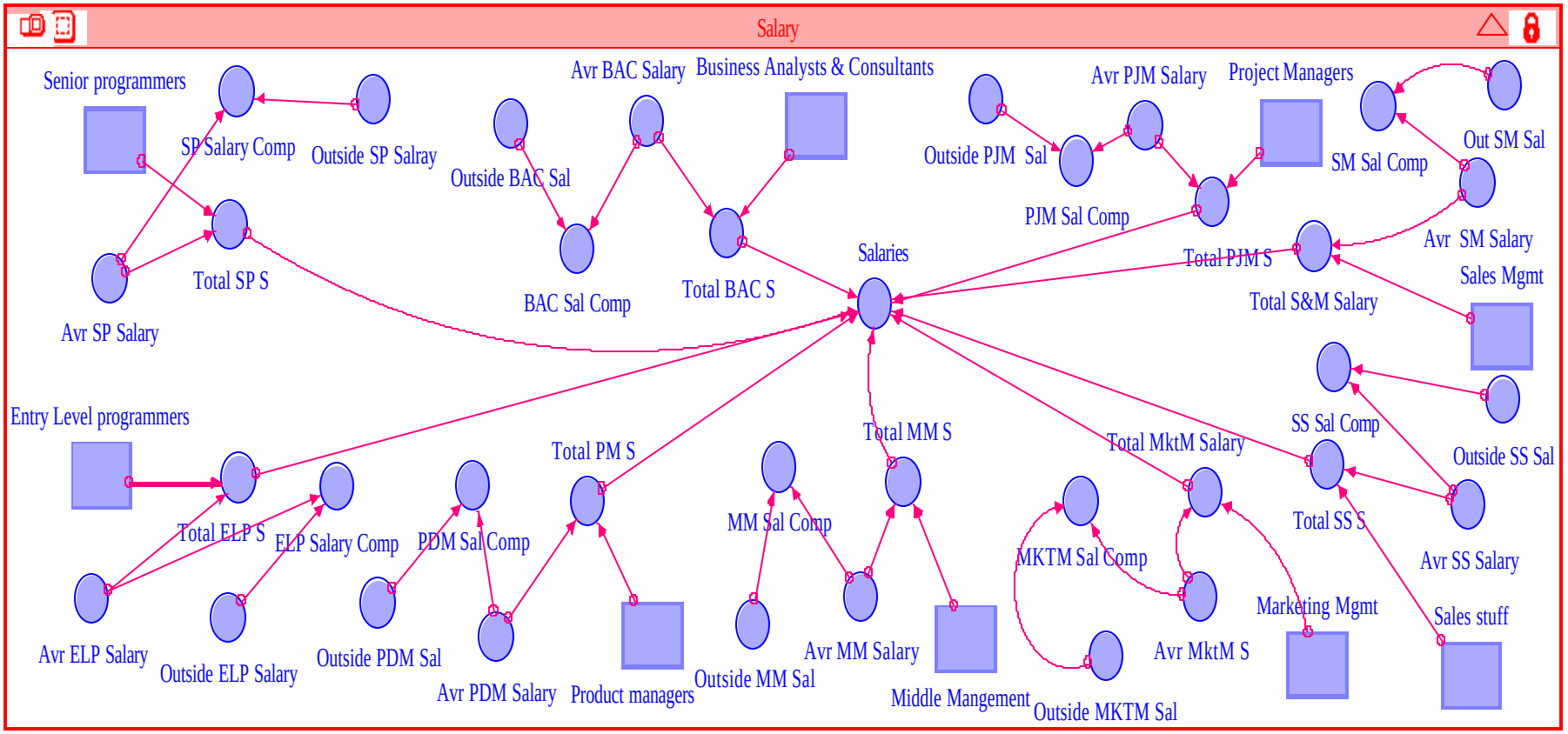

Figure 18: Modified Salaries Structure

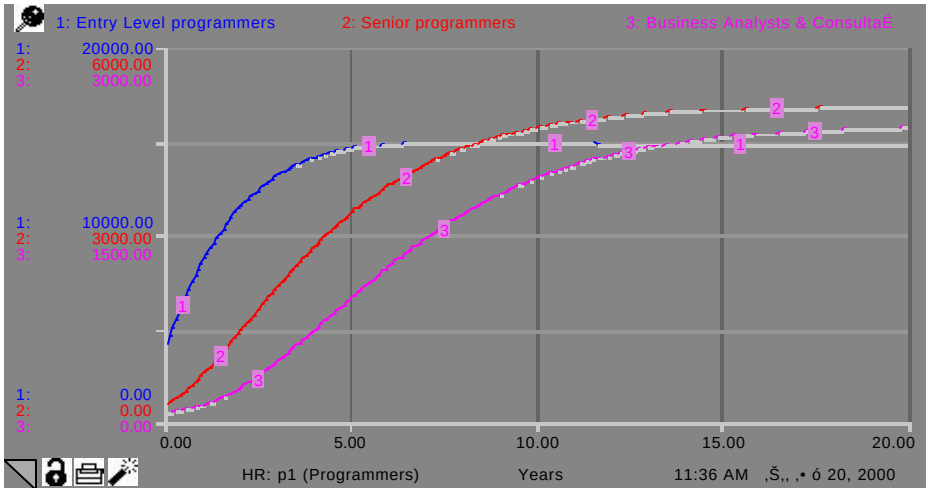

Figure 19a: Modified Human Resources Behavior

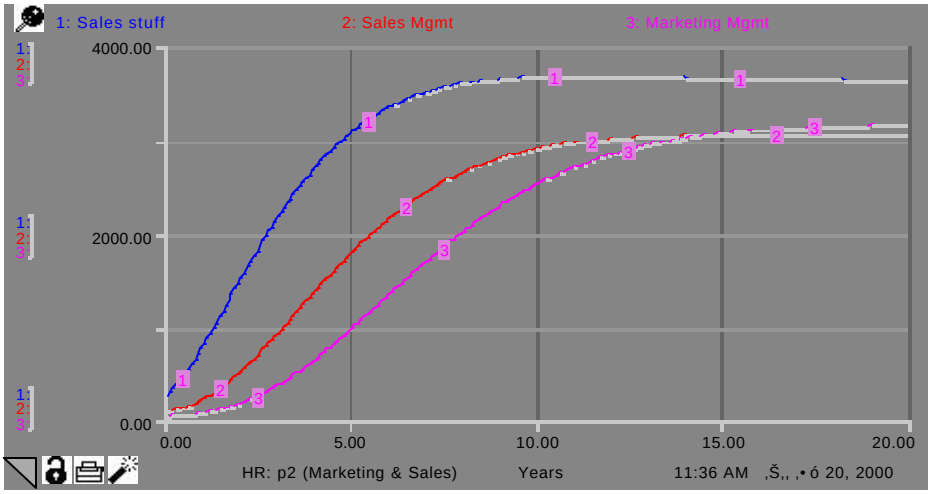

Figure 19b: Modified Human Resources Behavior

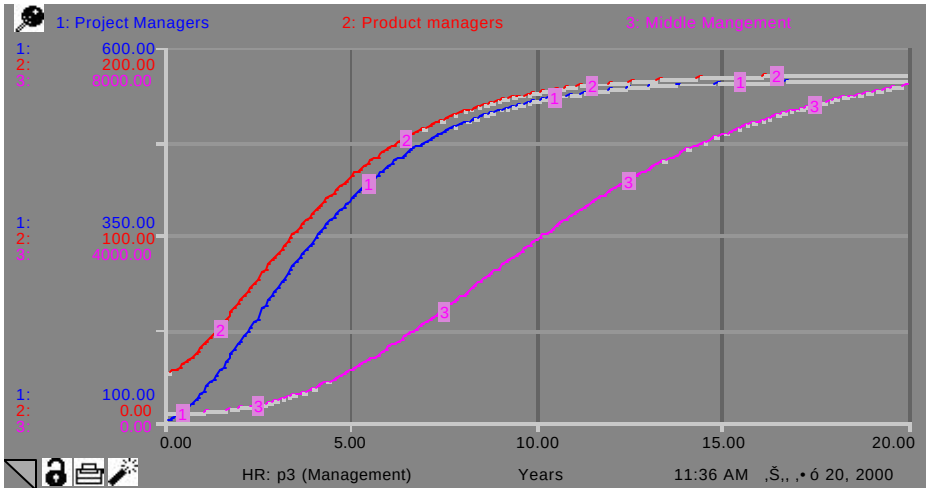

Figure 19c: Modified Human Resources Behavior

8.2.2 Customer Chain Structure

One important note, that the oscillation in the Customer chain and the adequacy parameters is reflection of the efforts exerted by the system to keep the balance between the changes in the numbers in the different levels of the customer chain and between the marketing & Sales force. This called ***"Balancing loops with Delay"***. The oscillation is a characteristic of the system.

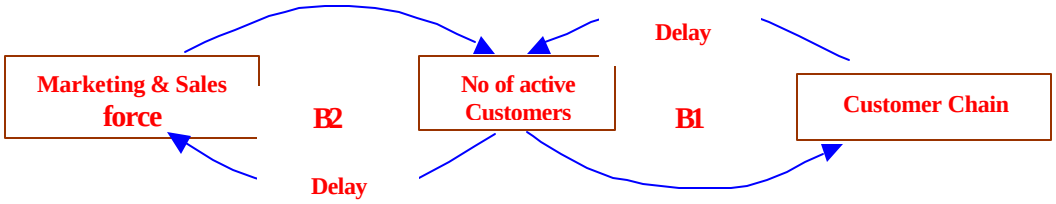

Figure 20: Balancing Loops with Delay

The main improvement could be done to the system is, in contrast with the common mental model, to lengthen the cycle, i.e. Delay. Increasing the delay in the system has two advantages:

- Lowering the bandwidth of oscillation.
- Higher ability to detect changes and to react to them.

The best way to avoid sudden changes in sales is by minimizing the drop in the current customer base. It can be deduced from the behavior of the customer main chain (Fig. 14a) that a large portion of the increase in sales can be traced to former customers who return. This happened naturally due to improvement in service delivery and customer service, so what would the case if regular contacts organized with those inactive customers. Certainly this would increase the number of active customers for lesser cost than attracting new customers. Putting a zero lost customer as quality objective and establishing a permanent system working on reactivating lost customer is a very profitable policy.

Figures 22 shows the modified customers chain, and figure 23 shows the new behavior. Examinations made to the system proved that, though the larger portion of the improvement is related to the modifications made to the human resources structure, this modification has a positive effect on the number of active customers through reactivation of idle customers. The fluctuations in the behavior are normal result of the trial made by the industry system to maintain the stability between the customer growth and the available human resources.

8.2.3 Global Perspective & E-Commerce

The size of the international marketplace of the Egyptian software relative to the local sales, 1 to 10, shows that the local and Gulf market is still the favorite place to work for the Egyptian software entrepreneurs. Interviews confirmed these results. Most of the people related that to failed experiments, the higher profitability of the local market, and the obstacles to export. Using the language of the System Dynamics this behavior called ***"Success to the successful "*** Archetype. The success of the local market is a result of dedicating higher resources to it. This has enticed companies to devote more resources the local market. This has led to diminishing the resources devoted to the international market, and as a result lowering the probability to success in it. Literature suggests reallocation of the resources among the two loops according to the real

potential. Comparing the size and growth rates and available opportunities the international market should receive higher priority.

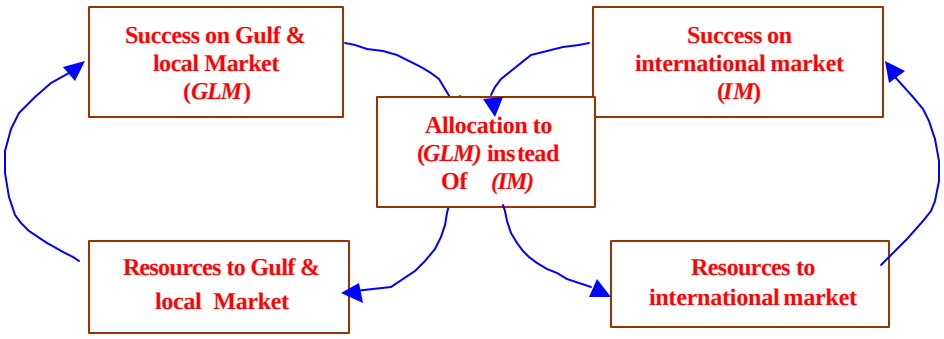

Figure 21: Success to the Successful

Most studies and people interviewed put E-Commerce as the main strategic driver for the development of export-based software industry. To achieve this, Three related policy options recommended by the studies developed for the software industry: Improving the Internet Infrastructure; Developing Offshore Software Business Development Centers in the major markets; and Establishing Software Development Parks.

8.2.3.1 Internet Infrastructure Improvement

The first and major technology infrastructure change would be improvements in the Internet Infrastructure. Speed and availability of the Internet represents a significant obstacle to future offshore development plans of the software industry.

The problem of the Internet in Egypt comprises two classes of deficiency with the quantity and quality of the Internet access (*Harvard 1999, 21*):

- Connections from Egyptian Internet Service Provider to the Internet.
- Connections from software companies (subscribers) to Egyptian Internet Services Providers.

The solution to the first problem aspect is clear but the major obstacles are financial constraints. As it is critical that the total bandwidth connecting Egypt to the Internet be increased to support higher speed access within the country, it is a must that government gradually upgrades the Internet Bandwidth of Egypt.

Two major policy options are available to improve the subscriber access to the Egyptian Internet Service Providers (*Harvard 1999, 21-25*). The first is based on using wireless links to provide greater bandwidth without the requirement to lay new cables. The second recommended Scenario is built on different foundation. In this scenario, this IDSC/RITSEC backbone, or that of a privatized company, is deployed throughout the Cairo metropolitan, where most software companies are based, and eventually throughout the rest of the country.

The trend is towards relying on the first option, specially, Upon launching the Egyptian Satellite "Nile 102" in 12 September 2000. Figure 24 compares the financial impact of the two scenarios on the Software industry.

It is obvious that, on the long run, The "Backbone extension" scenario is advantageous than satellite Scenario. The financial advantageous of that scenario revolve around flexibility and cost saving it comprise:

- The subscriber in this scenario can get better performance at lower cost by having short connection the extended backbone instead of bearing the satellite connection establishment cost.
- The switching, among ISPs in the satellite scenario, is considerable as it requires a new dedicated link to the new ISP.

This has been reflected, in the model, on the cost that will be beard by the industry for the Internet Capacity extension. Though the two Scenarios wouldn't show a difference in the first period but owing the high running costs, taking into considerations a ratio of transfer among ISPs of 20%, show deterioration in the financial position in the Satellite Scenario.

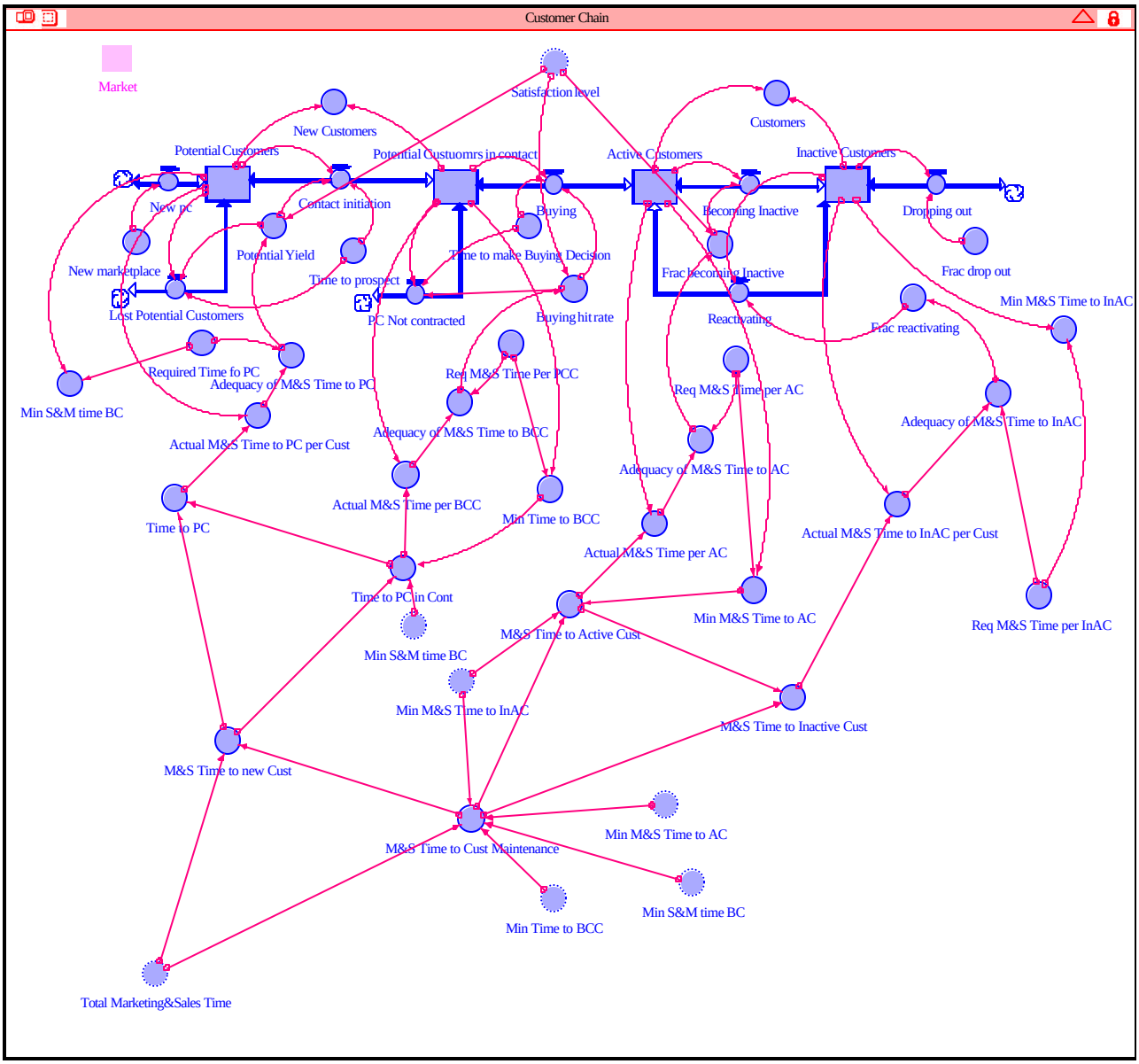

Figure 22: A modified Customer Chain Structure.

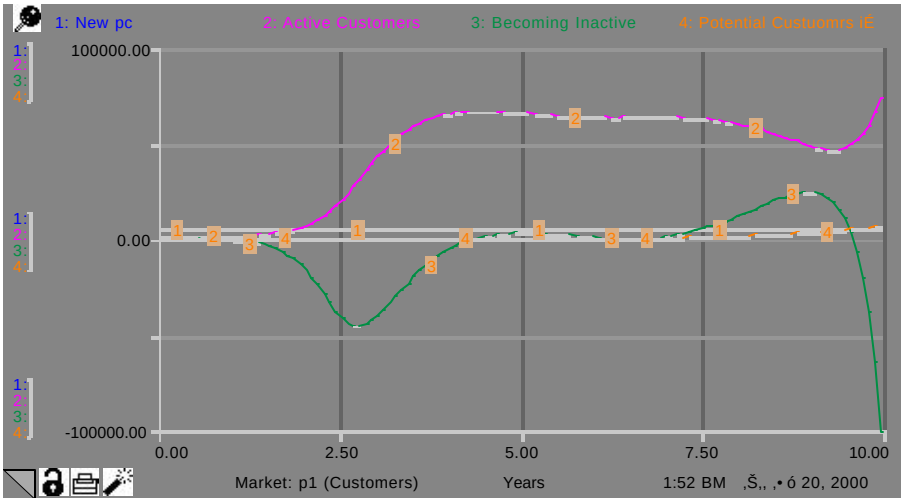

Figure 23: Modified customer chain structure behavior

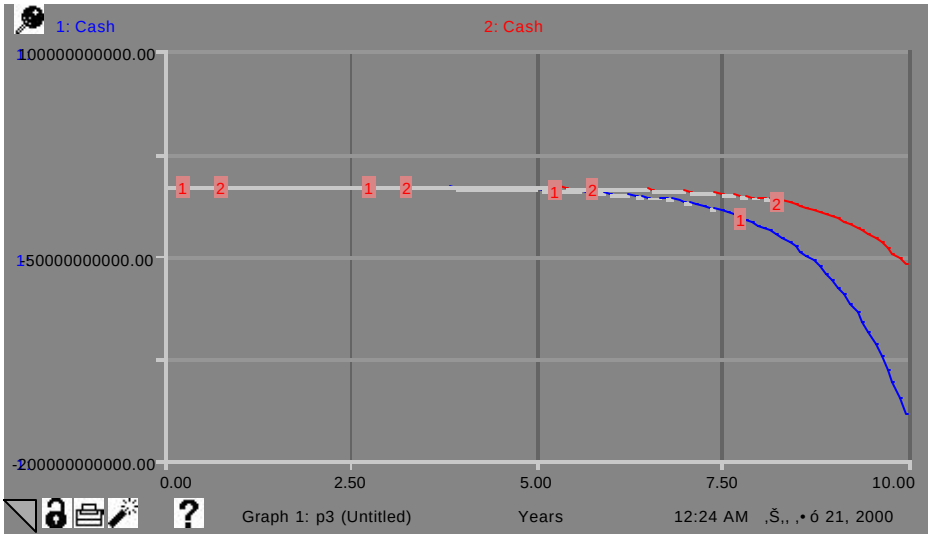

Figure 24: Financial implications of the Internet infrastructure Scenarios

8.2.3.2 Offshore Business Development Centers

One area of critical importance for the Egyptian software industry is to develop local presence in the overseas markets. Egypt will not be able to develop an effective software industry if the only strategy used is offshore programming with senior management visiting the target countries and clients from time to time. A program for bringing Egyptian companies to the United States and Europe though establishing Joint Offshore Software Business Development centers (OBDCs).

These centers will provide for the companies: marketing and direct sales support; Business analysis and design, operations support; project support; Technology support. The entire person interview agreed on the importance of these centers. Those of them who have international experience, mainly in the Gulf area report that local presence doubles its overall productivity in that country

It is obvious the Egyptian software industry will spread its presence in USA and Europe gradually. This needs to prioritize the locations to hold SBDCs. In the United States, the primary locations for centers recommended by studies include:

- The Northeast Corridor (Boston, New York).
- Mid- Atlantic (Washington).
- Southeast (Atlanta).
- Mid West.
- West (Dallas, Austin).
- West Coast (San Francisco, Los Angeles).

The Northeast would make the most sense as it offers the largest overlap in business operations hours (Usually 7 hours difference). Permitting an early start to contact during normal hours in Egypt. Also there is a major shortage of skilled IT labor currently in the Northeast, and a market that continues to grow to show very high demand of staff (*Harvard 1999, 97)*.

For the aim of prioritize the location of SBDCs in Europe we prepared a study a locations priority list in Europe. The study resulted in the following priority list:

- Germany
- France
- United Kingdom
- Italy
- Switzerland.

8.2.3.3 Software Development Parks

The Software Development Parks and programs have been successfully implemented in Ireland, India and Israel. The model recommended for Egypt should (Harvard 1999, 81-85):

- Improve the productivity of the participating companies through facility and infrastructure improvement.
- Improve knowledge and employee productivity by promoting communication and collaboration
- Improve the sales and marketing functions of industry, by providing world class support services.

Locations of the parks, to be successful should be based on the following criteria:

- Proximity to the airports.
- Proximity to major highways.
- Proximity to major software educational institution.
- Proximity to affordable accommodations for graduates.
- Availability of economic facilities.
- Access to modern telecommunication infrastructure.

The modification of the time allocation structure and market penetration structure are shown in figure 25 and 26, respectively. The behavior of the modified models are shown in figures 27-30. They show the impact of the enhancements recommended on the revenue of the industry. It is important to note that implementing these enhancements means achieving return appeared in the simulation. It rather means that we raising the ceiling of growth to nearly US$ 15 billion.

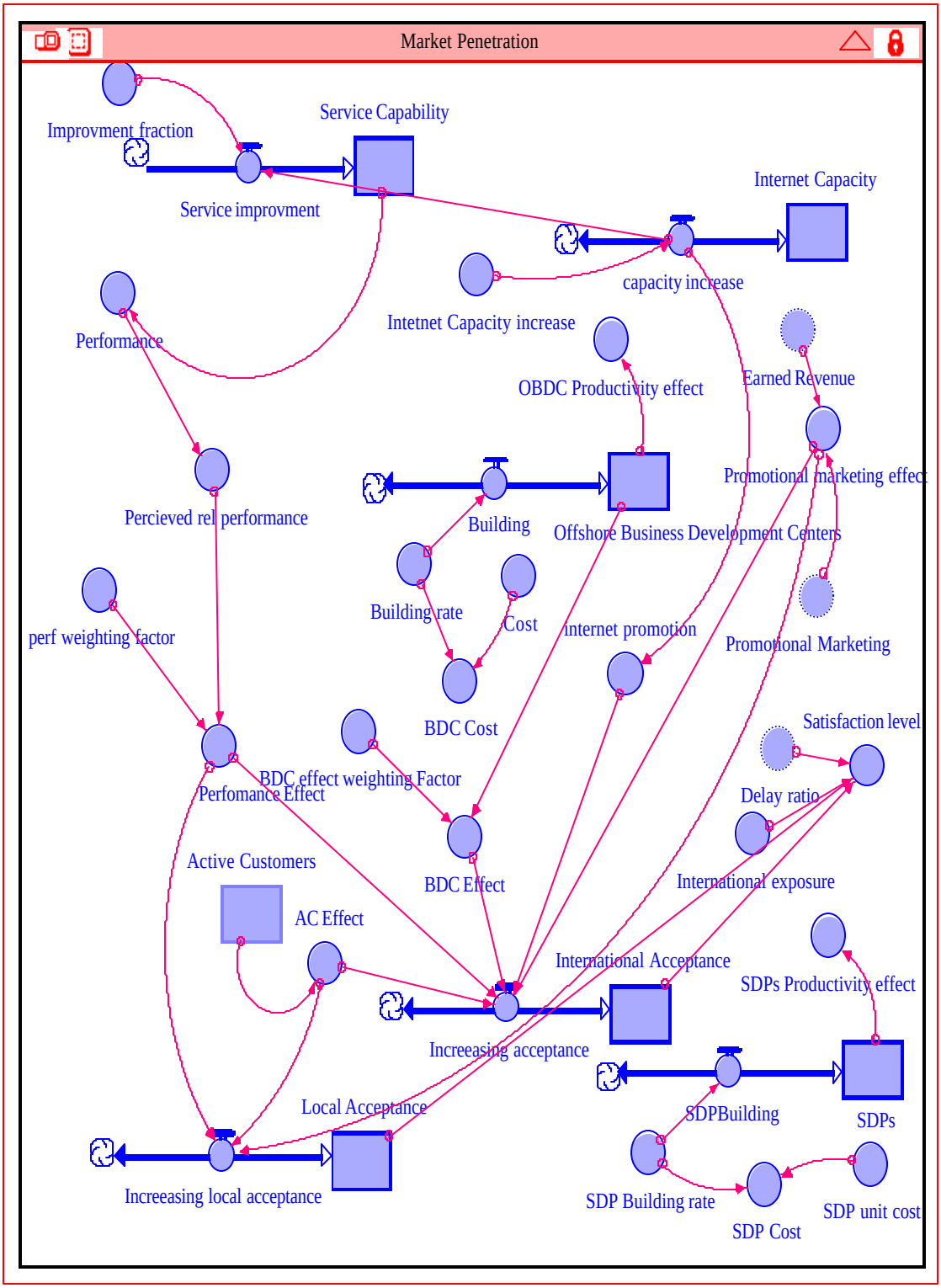

Figure 25: Modified Market Penetration Structure

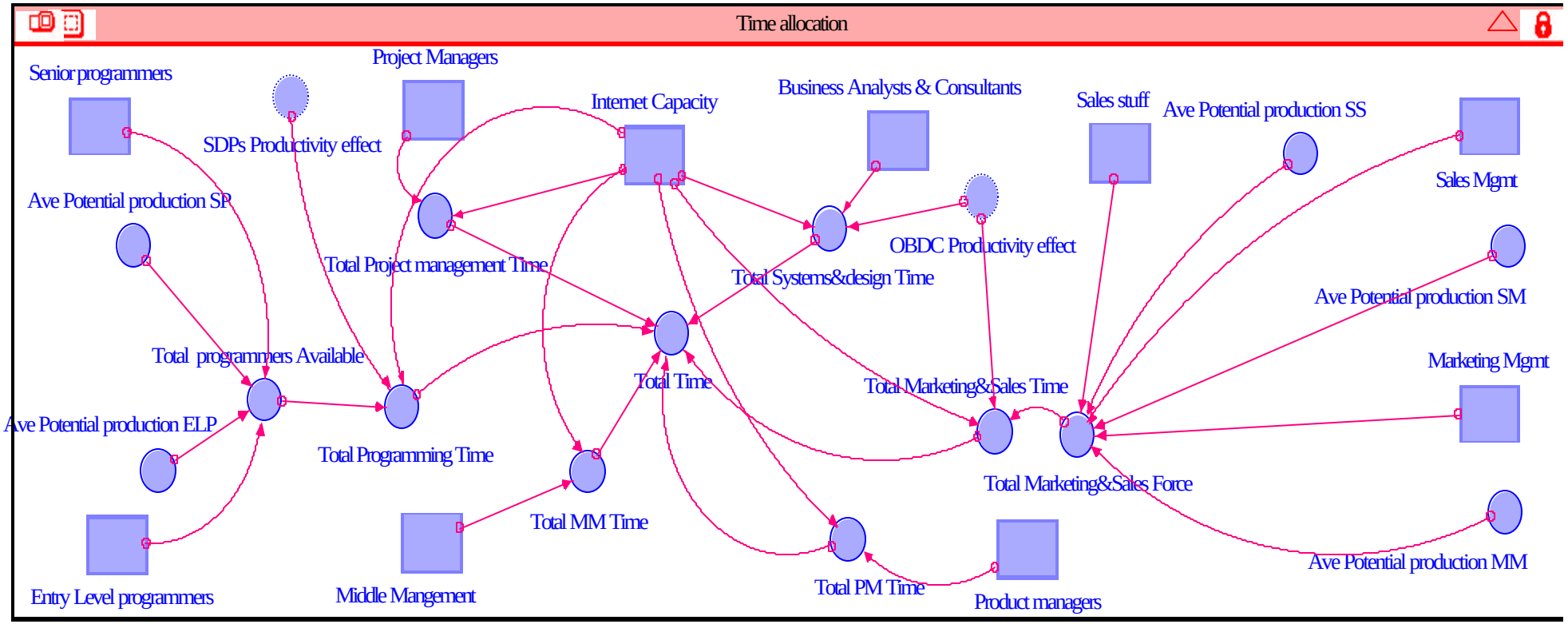

Figure 26: Modified Time Allocation Structure

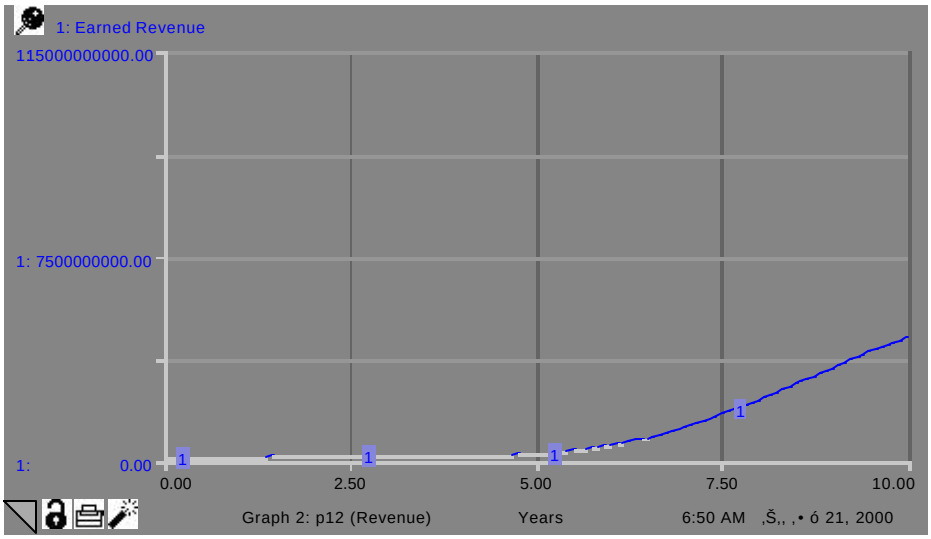

Figure 27: Earned behavior before Global Adaptation

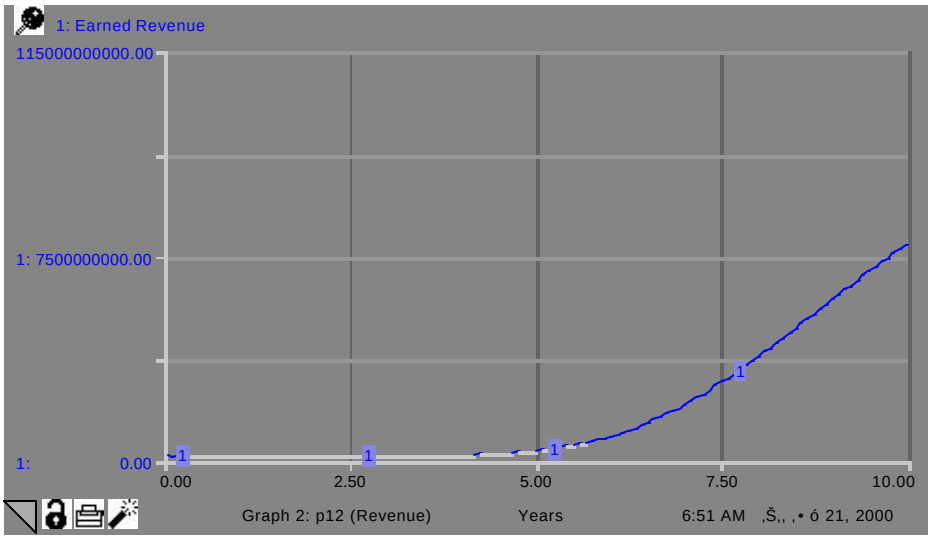

Figure 28: Effect of Internet infrastructure Enhancement on Earned Revenue

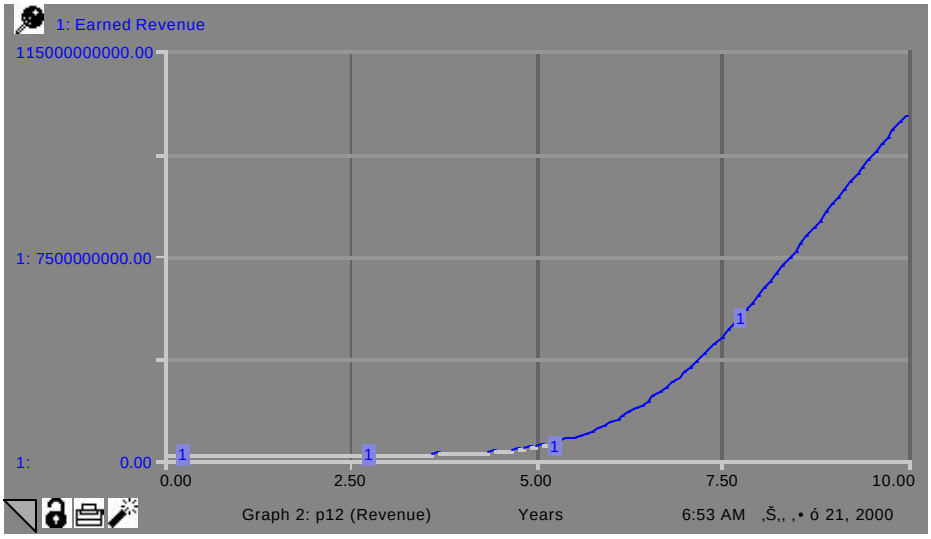

Figure 29: Effect of OBDCs on Earned Revenue (after Internet Enh.)

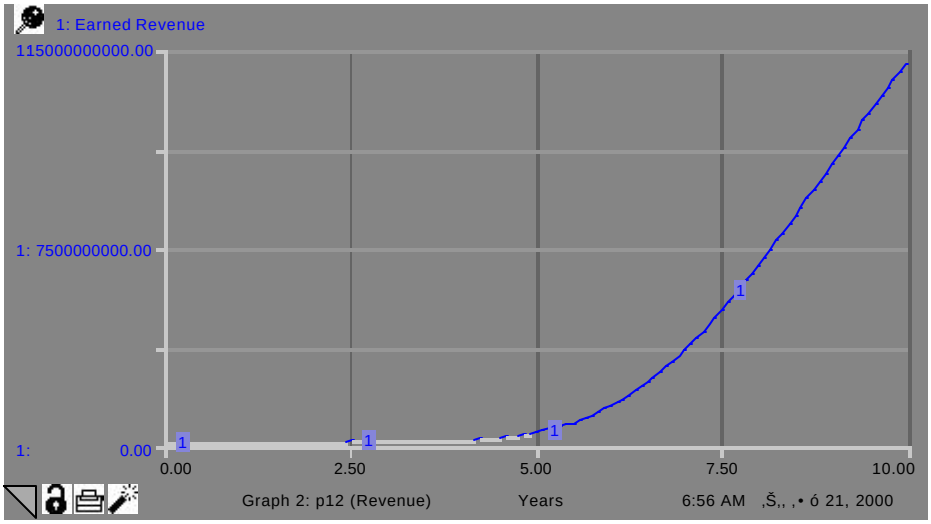

Figure 30: Final Behavior of Revenue after introduction of BDCs

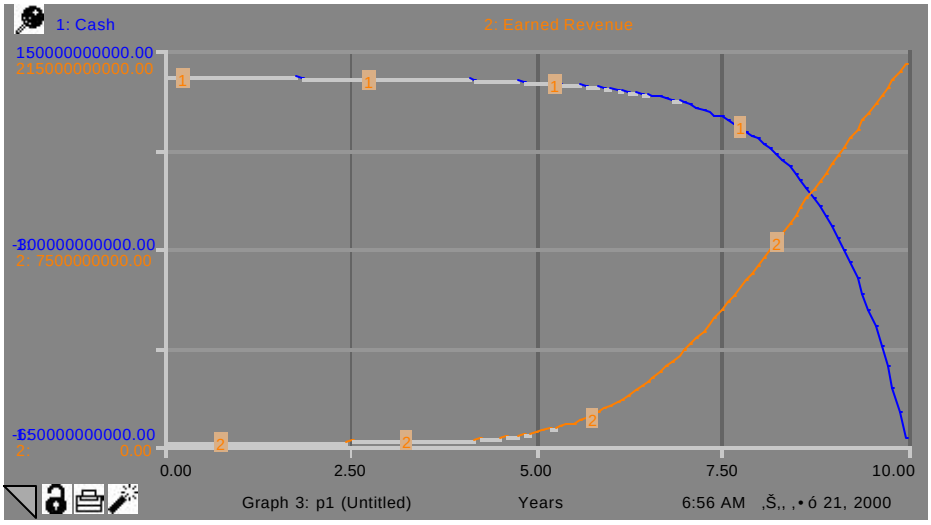

Figure 31a: Financial Sector Performance (Self-financing)

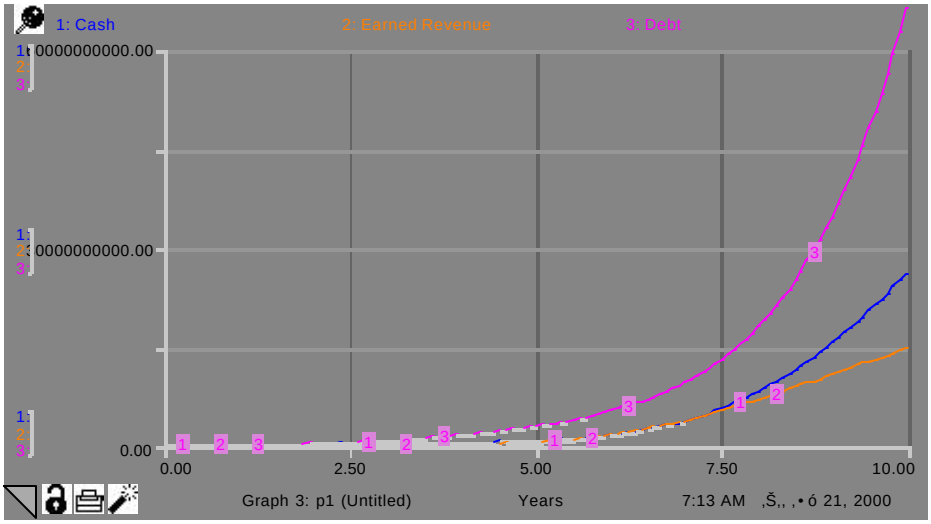

Figure 31b: Financial Sector Performance (Credit + Self-financing)

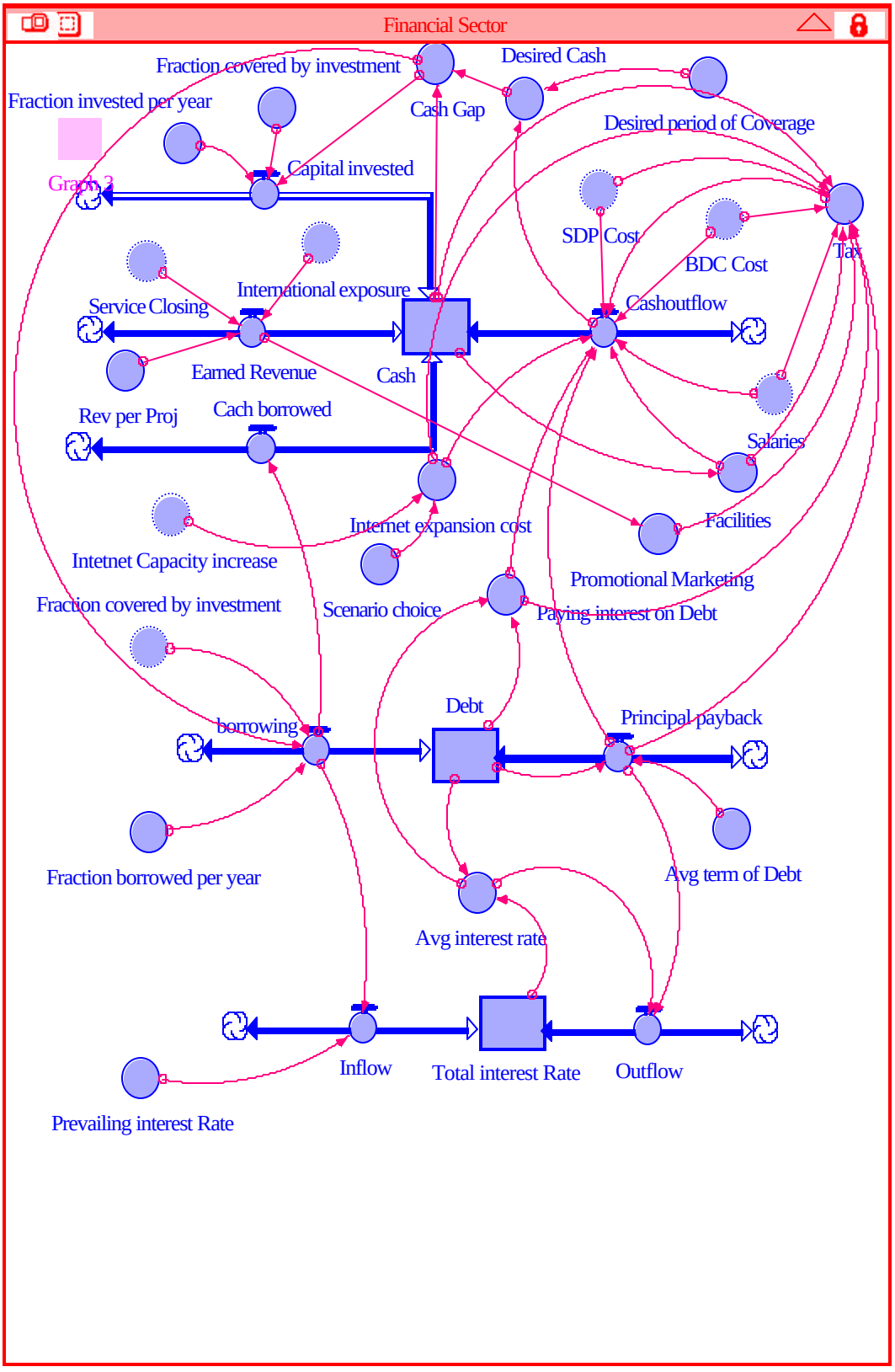

Figure 31c: A Modified Financial System

8.2.4 Financial System

Figure 31a suggests that the Egyptian software industry is not able to self-finance its future extensions proposed in the previous sections. This will lead to deterioration in the financial position of its companies and finally to its collapse.

The second option, which is the trend now, is to rely on credit. Figure 31b shows that the future impact of borrowing is worse than previous scenario. If the industry continues in the current trend it will exhibit the archetype known as ***"Organizational addiction"***. As the industry revenue deteriorate in the future owing to the heavy debt-repaying load, it will resort to more borrowing to be able to sustain. Finally the industry will collapse.

Creating a portfolio includes a combination of sources: Venture capital; Credit; Government support; and Industry revenues are the safest future expansion-financing source. Figures 31c,d show on of these investment portfolios and the financial position in case of implementing it.

From above, a modified model has been constructed to overcome the imbalance (see section 8.1) resulted from the absence of tight feedback link from the system to the human resource structure (see figure 32).

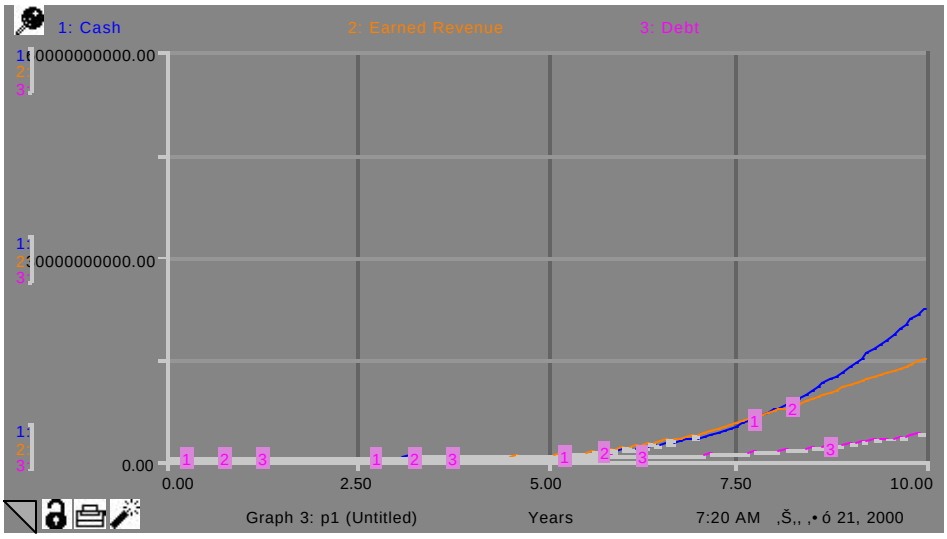

Figure 31d: Financial Sector Performance (Invest 50% + Credit 25% + self fin. 25%)

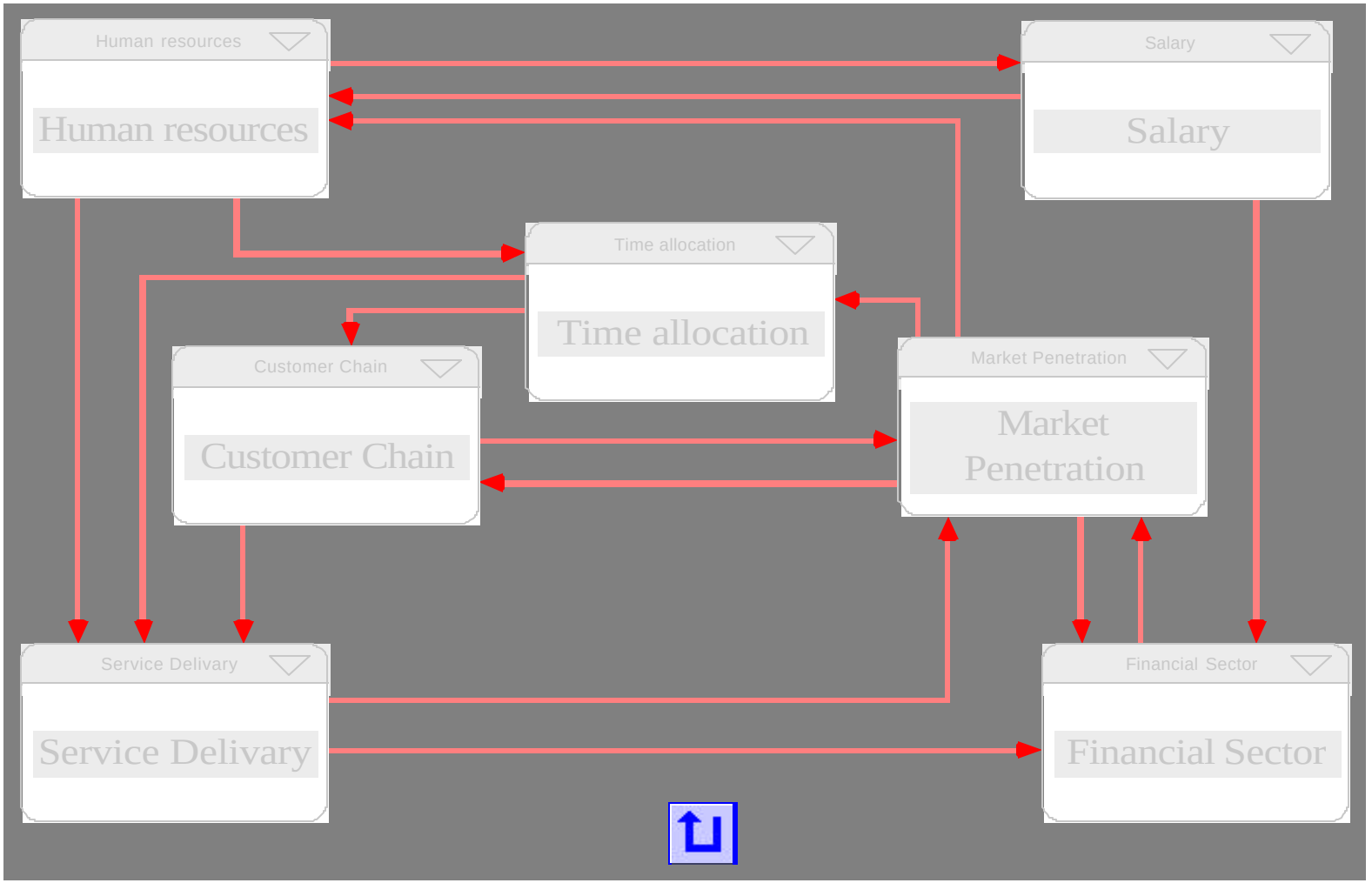

Figure 32: Schematic Diagram for the enhanced Model

Part 5: Conclusion

Software Industry has high potential in Egypt, though Software diffusion in Egypt is lower than in Developed Countries ones. This lagging is Primarily due to unbalanced distribution of qualified human Resources, weak Internet infrastructure, lack of some business skill experiences especially in the global markets, and the weakness of financial support. The current focus and interest of the Egyptian leadership in developing the software industry must continue at this stage to give it the required initial boost for growth. Additionally, certain strategies should be adopted and implemented in parallel:

- Enhancing of the educational system from both perspectives quality and quantity by developing tailored training plan to the needs of the senior position (senior programmers, sales and marketing, management). The training courses delivered should satisfy the domestic and international perspectives of the industry.
- Increasing the number of graduates In condition that the previous strategy is adopted, or this will lead to more unbalanced distribution in market.
- Linking the salaries according to the revenues to the industry and adjusting in comparison with other Hi-Tech Industries in Egypt and abroad.
- Linking the industry to the education institutions will improve the environment to establish a good R&D System in Egypt.
- Targeting the international market in the software services segment should be addressed as a strategic priority.
- E-Commerce is the main driver for the developing of export-based software industry. To achieve this, Three related policy options recommended by the studies developed for the software industry: Improving the Internet Infrastructure; Developing Offshore Software Business Development Centers in the major markets; and Establishing Software Development Parks.
- Two major policy options are available to improve the subscriber access to the Egyptian Internet Service Providers (Harvard, 1999). The first is based on using wireless links to provide greater bandwidth without the requirement to lay new cables. The second recommended Scenario is built on different foundation. In this scenario, this IDSC/RITSEC backbone, or that of a privatized company, is deployed throughout the Cairo metropolitan, where most software companies are based, and eventually throughout the rest of the country. The second scenario is more cost-effective on the long run.
- Egyptian software industry should develop local presence in the overseas markets. A program for bringing Egyptian companies to the United States and Europe though establishing Joint Software Business Development centers (SBDCs).
- The Software Development Parks and programs have been successfully implemented in Ireland, India and Israel. The Egyptian model should adapt to the local conditions of the Egyptian Environment.
- Setting up an IT regulatory authority similar to the TRA and under one umbrella.

- Setting up an export organization to coordinate the efforts exerted to promote the Egyptian Software exports.

- Creating a portfolio includes a combination of sources: Venture capital; Credit; Government support; and Industry revenues is the safest future expansion financing source

The Commitment of Government and Private Sector in the implementation of these strategies and policies is necessary in the industry set up phase to exhibit an image of commitment and relay a message of national policy direction toward the success of the Egyptian software industry.

Suggested Future Enhancements to the Model

This model represents only a base to start a project for building a more comprehensive model for the Egyptian Software industry. We suggest building detailed models, linked with the this developed one, for:

- A suggested structure for Offshore Business Development Centers (OBDCs).
- A suggested structure for Software Development Parks (SDPs).
- The targeted International Markets.
- The Local Market.
- Software-related E-Commerce practices.

Competitiveness Development Highlights

Plan Subject Area	Action	Responsible Party	Importance	Time frame
Internet improvement	Enhancing Egypt-Internet Connection	G & I (BOT)	H	2001-2002
	Backbone Extension	G & I (BOT)		
Human Resource Development	Salaries & Incentives Restructure	I	H	2001-2002
	Establishment of Professional Training Centers	I		
Education System Changes	Educational Institution Enhancement Increasing the Annual Number of fresh graduates	G & I Private and Public Universities	H	2001-2002
Software Business Development Centers	Gradual Establishment in USA & Europe (Average of 10 Companies with the support of the Government can establish one center)	I & G	H	2002-2005
Software Development Parks	• Developing Studies for determining the suitable locations and components.	I & G	H	2002-2005
	• Government Led plan for the establishment.			
Effective Software Export Organization	• Unifying the existent competent bodies software industry. • Coordination with the export governmental bodies	G & I	M	2001-2002
	• Creating reference Database for the industry			
	• Business Mission & Conferences and alliances			
Domestic Growth	Governments Purchasing	G & I	M	2001-2005
Financial Support enhancement	• Credit Facilitation • Ventura Capital	G & I	M	2001-2003
Laws	IPRs	G	M	2001-2002
	Taxes			

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