Decision Support Systems for Business

FINAL REPORT

DSS For H&R Company's Investment

Instructor: Aslı Sencer Erdem

Istanbul - December, 2006

TABLE OF CONTENTS

I. INTRODUCTION

During the past thirty years since the conception of DSSs the business environment has changed in several ways. The most significant changes include globalization of economy and the growing complexity of economic relationships, flattening of organizations and growing employee empowerment and increasing need for fast response in the dynamic competitive environment. In addition explosion of information accessible through electronic networks, emergence and growth of electronic commerce and better-informed and empowered customers have changed during that time.

By reason of growth of global and regional economies and growth of workforce need, investments to human capital have increased in recent years and population employment and unemployment issues have become especially urgent. While the management consulting industry has enjoyed rapid and unparalleled growth during the last 20 years, the growing numbers of management consultants and their pervasive influence in modern organizational life have made them subjects of decision making. Taking external consultancy for works outside of the departments or works needs complex knowledge become very common, so to make investment decisions, to make human resources management decisions and so on the companies prefer to use consultancy companies. Looking at the European consulting market by the type of service Alpha Publications (1996: 6) provides the following overview for the European market as a whole.

Estimates of market shares of different types of services in 1995

Type of Service	Proportion of revenue in Europe (%)
Information technology	43.8
Strategy	14.4
Human Resources	14.3
Operations	13.3
Finance & Administration	5.4
Marketing & Sales	3.8
Others	5.0

Source: Alpha Publications 1996, p. 6

If we consider development of consultancy companies in Turkey we should examine labor force development. In dynamic developing societies like Turkey, intensive changes can be observed in the labor market and in jobs and careers. These changes, particularly in qualification requirements, can cause career maladjustments and require individuals to gain extra qualifications if they are to succeed. Discrepancies can grow between the education and training system and the actual requirements of the labor market. Since choices of job and career as well as of training are not made through a systematic process of orientation in Turkey, many individuals have jobs which they have chosen unwillingly or by chance. This leads to such problems as frequent job changing, job dissatisfaction, lack of job motivation, and reduced productivity. These problems not only affect negatively the enterprise for which the individual works, the sector and the country's economy, but also reduce national competitiveness. With expected economic growth in country, it may be expected that employment, and therefore the need for career information and guidance, will increase as well.

There has been a significant increase in human resources and career development services provided by the private sector in Turkey. Recently there has been an increase in outplacement services as well. Many organizations make use of some private human resources companies, especially in the placement of higher and medium-rank managers.

Heidrick&Struggles is one of these companies that a global Human Capital Solution Company which provides solution to Companies during employment process. H&S collects CVs from people and establishes a database to use the database during selecting candidates for a position. Also Companies get Consultancy from Heidrick&Struggles to select candidates for a position in the company. H&S opened a head office in Istanbul and nowadays H&S Company consider opening offices in different cities in Turkey. H&S want to use a DSS to distribute Company's Portfolio among different Cities. While making the decision, they want to use Macroeconomic variables to estimate hiring amount in the city. Then, H&S Company tries to estimate how many companies get consultancy from H&S Company during engagement of Employees. All the estimations give a picture whether the City is profitable for an investment.

I.1 Mission of Project

• Determining profitable portfolio of cities for an investment.
• Selecting the cities which provides highest rate of return.
• Catching when a city has a growing trend and will be suitable for investment in the future by increasing investment fractions.
• Calculating expected rate of return from an investment to a portfolio
• Searching cities according to different criteria.

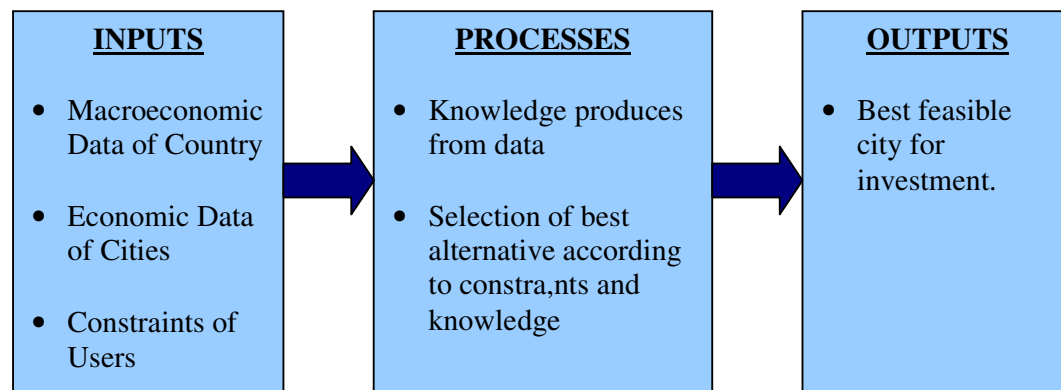## I.2 Users and Analysis of Decision

H&S Company Managers decide whether to add a city to portfolio or not. Similarly, they might make estimation that the city will be profitable in the near future and the company takes position according to future trends. In contradictive situations, company might consider to close the office in a city if the trend shows decline. The evaluation of an office's performance made quarterly. That is an a city which has an open office of H&S is evaluated quarterly and the company decides to expand the investment or lessen the Company operations in the city or even closing the office according to knowledge derived from the data.

Huge amount of Data for all cities are available. But the data has no meaning if they are not analyzed. Firstly data should be filtered or adjusted to be used in analysis. Then constraints should be developed to give scores to cities according to knowledge provided by data. Data contains many details: Number of firms in the city, number of newly established firms, number of firms which are closed, capacity utilization rates and so on. All the economic variables have meanings and results are sensitive to those variables. The weight of all the variables should be measured.

- The system is used by manager who is responsible for new investment locally and globally because new investment is a strategic decision.
- The system offers search for cities by entering different criteria
- The system offers displaying investment amounts to cities according to minimum variances for the given real expected return.
- Data is updated every year so new investment decision should be repeated.
- The system uses two level of data:
  - o Macro country based data
  - o City based data
- The constraints of the system which users can enter are:
  - o GDP
  - o Economic growth of the city
  - o Unemployment rate of the city.
- The system evaluates every alternative, if an alternative has multiple goals; such alternatives are examined and balanced off against the others.
- The system displays optimum portfolio of cities for investment according to given constraints.
- The system offers to get the highest level of goal attainment from a given set of constraints and resources.
- The system uses such data
  - o Unemployment rate which based on country and city
  - o Economic growth which based on country and city
  - o And so on
- After data collection, regression process start
- According to constraints and regression analyses, result with minimum variance for the given real expected return is displayed.
- Possible problem of the system:
  - o If there are a lot of constraints, the number of alternative decreases or may be equal to zero.

1.3 Scope of Project

The system gets constraints from users, optimum result display according to collection of data.

INPUTS	PROCESSES	OUTPUTS
• Macroeconomic Data of Country • Economic Data of Cities • Constraints of Users	• Knowledge produces from data • Selection of best alternative according to constra,nts and knowledge	• Best feasible city for investment.

II. LITERATURE SURVEY

The Project has different dimensions but it is basically a DSS which provide help for a Capital Investment. An international Human Resources Consultancy company tries to determine entering a city or not by defining some criteria. To achieve this goal, a general economic model, risk analysis frame work and risk analysis of capital investment should be included in the Model. "Economic modeling and risk analysis are two processes that constitute an important body of knowledge necessary for performing appraisal studies of capital investment projects. A number of methods and techniques have been developed to address such studies." (Mohamed, 2000)Investment Projects have different characteristics according to the sector which they will be used. The General Situation of the Economy must be taken in to account while making estimations about the sector. The model and the tools will be developed for the model should be suitable for the selected sector and should contain the special knowledge gathered from the Economic variables. Also before modeling the most critical variables that can affect the decision process should be find out. Estimated cash flows, required time to recover the investment, inflation rate, interest rate and other macroeconomic variables also considered while building the DSS for the capital investment. Moreover, the investment will be made in domestic Currency in YTL by converting US Dollar to YTL. Expected cash flows generated by the investment should be calculated in US Dollar terms.
(Abdel-Aziz, Ahmed Mohamed)

Robert Solow Developed a model, named Solow model, for Estimating the Economic growth in the future and determining the steady-state of the Capital in which economy reaches an equilibrium point where total depreciation is equal to total improvement in the Capital Stock. In steady-state the economy is not growing and production just covers the depreciation of the Capital Stock. The model is one of the fundamental models and it is developed in 1960s. Then it is expanded by other economists. In Solow's model, the rate of saving, population growth and technological progress are exogenous, they are independent and determined in outside of the model. Productions are a function of Capital and Labor. Capital is the materials used while making production and Labor is the Working People Population in the economy. Saving Rate and the Human and Physical Stock of the economy are main determinants of the economic growth in Solow's model. People save a Fraction of their income and the saved money invested in the economy. Capital per worker plays an important role in the economic growth. Production function in time t is:

$$Y(t) = K(t)\alpha \, H(t) \, \beta \, (\, A(t) \, L(t) \,) \, 1 \text{-} \, \alpha \text{-} \, \beta$$

Where α is the Capital share in income, H is the Human Stock, β is the income share of Human Stock, A is the technology Level, L is the labor force,
Although it is not the same in the real life, Solow's model help us to understand the nature of the economic growth and it provides a base algorithm which can be Expanded later and will be used to get a Mathematical result for using in models. (Mankiw and all)

The Solow Theory is only a base for understanding the nature of economic growth. In Real life cases in addition to Solow's Endogenous Growth theory, special effects are taken in to the considerations like Business Cycles. Regional Economic Growth is a bit tricky to understand and evaluate since the region or the city might be differ from the General Economy in the Country. Solow's Theory is so general that it can not be

6

applied in specified sub regions. A region might exhibit no economic growth while the Country in General performs a huge economic growth. Human and Knowledge Capital is a very important asset of an economy. Knowledge capital is the People's knowledge level of production and exchange methods. Knowledge Capital increase with Education, Research and Development investments and People's engagement with certain production methods. Human and Knowledge Capital can change place inside a Country and it affects a regions economic productivity but it doesn't affect Country's overall economic performance. Government investments or Governmental encouragements in a specific area, a resource discovery or a resource might come to end in a region. All the similar factors change the Capital Stock, Human Capital and Knowledge Capital in the region. Then economic productivity in the region will change. Also educational and social policies can change economic status of a region. In that case, a future trend is possible to emerge. "Total Factor Productivity Growth is an improvement version of the Solow's Growth theory. It studies the sources of the productivity growth at sectoral level as their determinants are diverse and this would provide further insight into how sectoral activities could affect national performance." (Kong& Tongzon, 2006) For this reason, many studies had been done at the sectoral level. Understanding a region's Economic performance is highly depends on investigating the sectors in that region. There are different sectors and each of these has different characteristics.
Some of the Big Sectors are:
1. Wholesale
2. Retail
3. Catering Trade
4. Transport and Communication
5. Financial and Insurance Services
6. Real Estate and Business Services
7. Community, Social and Personal Services
8. Non-profit Organization
9. Manufacturing
10. Hotels

Output of the sectors are measured as value-added to prevent double counting. Input data should be collected as time series and some of the characteristics are Size of Sector, Capital, Labor and Quality of services. The total number of establishments is used as a proxy for the size of the sector. The total number of employees in each sector is used as a proxy for the quantity of labor. In addition, the current model has introduced an important economic variable that will adjust for the quality of labor. Wages has been used as a proxy for quality of services. The operating expenses are used as a proxy for amount of capital used in each sector to generate income. In order to address the effects of business cycles on TFPG, a proxy for capacity utilization rate needs to be formalized. (Oguchi, 2004) presented some methods to remove the effect of the change in productivity due to business fluctuations. When all the indicators are taken in to the account, the economic growth and the root of the economic changes can be determined. The Economic activity might be due to efficiency change, technical change or quality service of human capital that translated to efficiency of human organization in production capabilities. (Finegold and all), (Kong& Tongzon), (Moomav and all)

Investment climate is measured by the statistics variables which are macroeconomics level. These variables indicate the past and future data about the environment to investor. At the below, we can see a list of the statistics of variables:

TFP: Total factor productivity

Employment Growth: Employment growth rate from the previous to the current year.

Investment Rate: Investment rate, constructed as the ratio of new investment to capital stock in the previous year. Capital stock is measured as the book value of fixed assets.

Sales growth: The growth rate in sales revenue from the previous to the current year.

Domestic private: The share of ownership that is domestic private, including managerial ownership and ownership by private individuals.

Foreign: The share of ownership that is foreign.

Mean share of nonpermanent labor: The city–industry mean of the share of labor that is non-permanent. Proxies labor market flexibility.

Mean share of employment that use computers: The city–industry mean of the share of firm employment that uses computers.

Mean share of R&D personnel in employment: The city–industry mean of the share of firm employment that conducts research and development.

Mean bank access: The city–industry mean of the dummy variable of having access to bank loans.

Mean share of regulatory burden: The city–industry mean of the share of senior managers' time in dealing with regulatory requirements.

Mean score of corruption: The city–industry share of the corruption score, which is constructed as the principal component of two variables: 0.58 * (bribe/sales) + 0.60 * (share of contract value used as bribe to get a business contract).

Mean loss of sales due to transportation or power problems: The city–industry average of the firm's loss of sales due to transportation or power problems (in percentage).

ln (firm age): ln (firm age plus one).

ln (city pop): ln (city population).

ln (city GDPpc): ln (city-level GDP per capita).

Consultancy is preferred by the institutional companies. Companies outsource Consultant or a Consultancy company while selecting employees for a position. "In Istanbul more than 200 Human Resources Consultancy is established. Much of them begin operation in last few years." (Yalçın, 2006) In Turkey, there are other Cities which have significant economic activity and attract foreign investment. In Recent weeks, for example, Citigroup said yesterday it would pay $3.1 billion for a 20 percent stake in Akbank, a premier Turkish bank. The investment may also serve as a steppingstone for Citigroup to buy a larger stake. As part of the deal, Citigroup was granted right of first refusal over the sale of any future shares by Sabanci Holding, Akbank's largest shareholder, which has a 34 percent stake. Citigroup must get permission from Sabanci before it buys additional Akbank shares. "It's a good way to go in a higher-risk environment," said David A. Hendler, a banking analyst with CreditSights, an independent research firm in New York, noting the turbulence of the Turkish economy. "You might want to first get your feet wet before you jump in full force. It's a longer-term investment that may lead to a full takeover down the line if both parties are amenable to it." (Dash, 2006) After engaging with a foreign partner, the banks which operate in Turkey might begin to get consultancy while employing a manager in a City. Akbank for example might want a consultancy firm which operates in Eskişehir to find Candidates for a Management Position. (Dash) , (Maio) , (Kitay& Wright)

The old philosophy of business doing in-house is old school. As more and more

companies break this mentality, they will start to outsource their accounting function to accounting firms, which will in turn outsource more of their workload, create in a domino effect. (Duffy& Hugh, 2006)

Outsourcing has become increasingly attractive for many organizations. In such relationships, a company contracts with a vendor that rents its skills, knowledge, technology, service and manpower for an agreed-upon price and period to perform functions the client no longer wants to do. (Adler, Paul.S.)

Nowadays, many companies outsource manufacturing, distribution, accounting, payroll, human resources, IT, as well as many other functions. Many firms outsource to their human resources' functions to human resources company. According to the research in 2000, the HR outsourcing industry had revenues of $21.7 billion, accounting for more than 8% of total HR spending. Some observers see outsourcing as a key trend (perhaps even the key trend) shaping the future of HR. They envision HR departments focused entirely on strategic activities, all performed with an in-house staff consisting of a small number of high-level contributors, perhaps only internal consultants, HR systems designers and HR executives — leaving all the transactional and administrative activities to vendors for which those processes are core.

Changes in the broader business environment are affecting nearly every aspect of how companies manage their human resources, altering the balance of pros and cons for outsourcing HR business processes. There are six factors that lead to HR outsourcing trend. Firstly, intensifying competitive pressures have forced companies to be more aggressive in cutting costs, often by reducing head count. HR functions have had to manage such downsizings, while also trying to be innovative in attracting and retaining valuable employees. Secondly, HR departments themselves have become the target for belt-tightening efforts, and they must now find ways to provide more value at lower cost. Many have argued that the key is to focus on activities that are essential and outsource the rest. Thirdly, the legal environment of HR has grown increasingly

complex, and HR managers have struggled to keep up with the regulatory changes, particularly in the areas of health care, stock-related compensation, overtime-pay calculations, pension reform, benefits eligibility for contingent workers and the marriage tax penalty. This has driven the demand for outsourced employee services from vendors that are subject-matter experts. Fourthly, mergers and acquisitions have become increasingly frequent, creating huge HR challenges. Globalization poses a comparable challenge, requiring HR departments to address the needs of employees in, and moving between, different countries. Finally, of the various forces affecting HR, the development of technology is perhaps the most significant. The Internet and new generations of software have revolutionized HR information systems, significantly improving HR productivity, increasing control of employee benefits, streamlining compliance efforts, facilitating the management of payroll functions and lowering the cost of recruiting. The information from such systems is easier to modularize than that from paper-based systems, making outsourcing more attractive.

Three main HR-outsourcing industry segments have emerged: consultants, administrative-service providers and technology enablers. HR consultants provide expertise on issues such as compensation, stock-option-plan design, employee benefits and workplace diversity. Administrative-service providers handle payroll and benefits processing and will themselves sometimes outsource certain niche activities such as the management of workers' compensation and COBRA. Technology enablers help companies that want to continue managing their back-office HR processes in-house (perhaps after purchasing either customized or packaged HR software) but need

assistance to do so. Companies can offer all services but some companies offer only one specific service. For instance, IBM's PricewaterhouseCoopers is a vertically integrated generalist, offering a full range of HR services that spans consulting, administrative services and technology. By contrast, PayChex, a specialist in payroll and tax processing for small businesses, does not build systems for clients, nor does it offer consulting services. (Adler, Paul.S.)

The benefits of outsourcing vary by project but often entail:
Lower Upfront Costs and Increased Control of Fixed Costs. Outsourcing often enables companies to avoid investing in hiring/retaining employees, purchasing office equipment, and reducing office space requirements.
More Flexibility. Most outsourcing initiatives provide more upside production capabilities fewer aches and pains.
Increased Focus on What You Do Best. By outsourcing non-core aspects of your business, you can simplify your business. (Adler, Paul.S.)
Acquire Outside Expertise. Specialized suppliers can attract and retain scarce technical experts: knowledge depth, following the trends, frequent customer interactions. (Adler, Paul.S.)

Threats of outsourcing can be enumerated as reliability, dependency, loss of control, loss of critical skills, unexpected costs, inability to respond to changing requirements, and organizational resistance. A survey of 125 medium- and large-sized companies in 2000 found that the most frequently mentioned factors discouraging HR outsourcing were perceived higher cost and lower quality — and fear of losing control.9
Another study of 150 companies in 2001 found that the most common problems of HR outsourcing were poor service, costs higher than promised, contractors with insufficient knowledge about the client and unanticipated resources required to manage the relationship. (Adler, Paul.S.)

How, then, should a company decide what and when to outsource? An extensive review of the literature has identified six important factors: dependency risks, spillover risks, trust, relative proficiency, strategic capabilities, and commitment versus flexibility.

When we look at the clients of human resource companies, we can see that large sized businesses are motivated to outsource more than small ones. While large sized companies are seeking to cut costs, the small one is doing it to minimize capital investment, lower business risk, and keep the business simple. (.outsourcing threat.opp)
Of the total market for HR outsourcing, large clients (more than $500 million in revenue) account for 55%, midsize organizations ($50 million to $500 million) for 17% and small companies (less than $50 million) for the remaining 28%. In general, large corporations are the main customers for integrated HR services, whereas smaller firms tend to outsource only the payroll function. (Adler, Paul.S.)
HR outsourcing DSS uses macroeconomics indicators in Turkey. These variables help to make decision on which location is an appropriate for HR outsourcing. Such measures require contributions from various fields of expertise and may take considerable time to draw up and implement, thus requiring long-term planning. Long-term planning and policy making have become important for such companies to give best decision.

Macroeconomics Indicators in Turkey:

Key Economic Indicators
- CPI Inflation, monthly (%)
- CPI Inflation, year (%)
- GNP Growth (%)
- Capacity Utilization Rate (%)
- Industrial Production, (%)
- Nominal XR (average YTL/$)
- Real XR (1995=100)
- T-Bill rate (%)
- Sovereign Spread

Public Sector (% of GNP)
- Primary Balance
- PSBR
- Total net Dept
  - External Debt
  - Domestic Debt

External Indicators (million $)
- Current Account Balance
- Current Account Balance/GNP (%)
- Trade Balance
- Export
- Imports
- FDI
- CB Reserves
- External Debt

Banking Sector (%)
- Total assets/GNP
- Claims on public sector/assets
- Claims on private sector/assets
- Credits/assets
- FX deposits/Total deposits
- FX loans/Total loans
- TRLIBOR(%) (O/N)

Capital Market
- ISE market capitalization/GNP (%)
- ISE National-100,EOP, (January 1986=1)

Employment Indicators (%)
- Labor market participation rate
- Unemployment rate

In our literature survey, we think that there are many similarities between banks' branch location selection approach with our project. In our project, such researches made important contribution to us by approaching to this problem. Littlefield (1968) describes an estimation technique for future deposits and loans for a proposed bank office which utilizes certain household data and projections for future employment and residential growth.   (Littlefield, 1968) Olsen and Lord (1979) used regression analysis to determine local supply and demand levels in another effort to project deposit levels at potential branch locations. (Olsen& Lord, 1979) Other researchers (Lundsten, 1978) looked at market shares for banks rather than facility profits. Davidson (1969) utilized an elegant Management Science model to demonstrate its application to locating branch banks. Sloan (1981) uses a computerized branching model to analyze decision. Bell and Zabriskie (1978) demonstrated the use of computer mapping to generate a visual representation of locational potentials. Alexander (1969) presented a through framework for analyzing and applying census data to the location decision. Bauhoffer (1973) also suggested ways in which census data could be employed. Lord and Wright (1981) applied spatial measures to determine the proximity (and clustering) of potential competitor banks. Soenen (1974) reviewed the use of gravity models and discussed the relevant quantitative factors of decision making with respect to bank location.

Possible threads in branch location selection decision are over presentation in inherently weak markets, under presentation in inherently strong markets; mediocre location mixes within attractive markets, "thin", non-reinforcing local networks, inadequate tactical explication of local strengths, poor site selection. These structural weaknesses are compounded by procedural ones: poor measurement Systems, limited results-tracking, inappropriate division of marketing responsibilities, undifferentiated goals and targets, intuitive pricing methods, geographic, not economic, organization.(branch location page 2)

Main factors in branch selection are market selection, location selection, local network design, site selection, tactical exploitation of location. A market is defined here as a local area whose boundaries enclose consumers and small businesses in behavioral unit. A location is defined here as an area within a market. The site is the actual address of the branch-its physical position in relation to its surroundings.(branch location page 3)

In our project we examined Modern Portfolio Theory (MPT) was developed and refined in the 1950s by Dr. Harry Markowitz, who received a Nobel Prize for his work Due to the most generally accepted theory of how markets, asset classes and styles interrelate, MPT is based on the premise of efficient markets. This premise holds that if many independent investors all seek the best returns at an acceptable level of risk, and if they are all aware of the same widely available information about investment options, then the price at which each security is traded must be the best possible estimate of the security's true value. Investors accept risk only because they believe they will be rewarded with an equal or greater amount of return. Each level of risk carries a corresponding expected rate of return-and vice versa. According to MPT, investment decisions are governed by expected risk and return, and all investors are generally risk-averse. This means that given a choice between two assets with similar expected returns, an investor will select the less risky one. Like this we try to find best city with minimum risk to our customer. (BIC, 2006)

Portfolio is "a collection of investments held by an institution or a private individual" or " a group of assets held by an investor". However these definitions generally are used in finance. The concept of portfolio also is widespread in different areas such as marketing

and education. In strategic management and marketing, a portfolio is a collection of products, projects, services, or brands that are offered for sale by a company. In education, portfolio refers to a personal collection of information describing and documenting a person's achievements and learning. We think that first definition, which is "a group of asset held by an investor", can be applied to every area. In our project, our assets are cities in Turkey. Example of application of portfolio approach in non-finance area is IT project portfolio. An IT Portfolio is comprised of a set or collection of initiatives or projects. Portfolio management focuses attention at an aggregate level. Its primary objective is to identify, select, finance, monitor, and maintain the appropriate mix of projects necessary to achieve organizational goals. Portfolio management involves the consideration of the aggregate costs, risks, and returns of all projects within the portfolio as well as the tradeoffs between them. If we look portfolio management considering the MPT, in the theory mean-variance analysis used to analyze elements portfolio. In the mean-variance to make investment, the role of correlation analysis comes to the forefront as one of the critical elements in determining the risk-reducing benefits of adding new cities to an existing investment analysis. (BIC, 2006) Example of this approach applied to software project is that the Federal Chief Information Officers (CIO) Council's (Best Practices Committee -- Community of Practice for IT Performance Management) in 2001 assessed two portfolio methodologies as they were applied to two major federal IT initiatives: the Balanced Scorecard (BSC) and Applied Information Economics (AIE) approach. These methodologies were applied by Veterans Affairs (VA) to make decisions on investments in an Information Security Program (ISP). There were seven types of ISP investments (projects) as follows: Public Key Infrastructure, Intrusion Detection, IT Systems Certification and Accreditation Program, Simplified Sign On, Antivirus, Computer Incident Response Capability Training, Education, Awareness, and Message Building. All seven of these ISP investments have various risk and potential investment returns.

A portfolio analysis starts with information concerning individual securities. It ends with conclusions portfolios as a whole. The purpose of the analysis is to find portfolios which best meet the objectives of the investors. Various types of information concerning securities can be used as the raw material of a portfolio analysis. One source of information is the past performance of individual securities. A second source of information is the beliefs of one or more security analysts concerning future performances. A portfolio analysis must be based on criteria which serve as a guide to the important and unimportant, the relevant and irrelevant because it is impossible to derive all possible conclusions concerning portfolios. There are four steps in application of Markowitz theory: first, separates efficient from inefficient portfolios; second, portrays the combinations of likely return and uncertainty of return available from efficient portfolios; third, has the investor or investment manager carefully select the combination of likely return and uncertainty that best suits his needs; fourth, determines the portfolio which provides this most suitable combination of risk and return. (Markowitz, Harry)

If we summarize the correlation coefficients of portfolio analysis, coefficients run from positive 1.0, a perfect and positive correlation, to 0.0, an independent relationship between the two assets, to negative 1.0, indicating a perfectly opposite or negative relationship. (Putnam, 1999)

Moreover we read the application of the Markowitz portfolio optimizer to problem of international diversification. In the book what type of data should be prepared and which weights they have is listed as an example. The tables prepared and mean-

variance analysis is made. The Solver is used to solve problem. "Once you have entered the two constraints you ask the Solver to find the optimal portfolio weights… The model can be used to find optimal mixes of securities for targeted levels of returns for both restricted and unrestricted portfolios."(Investments, 2005)

At the end of the literature survey, we search for the features of HR companies what are the strengths and weaknesses of them and when they make investment which factors affect their decision. We find which data we need to make analysis. In addition we examined the Robert Solow's model to determine formula of our model. We look for similar cases to take it as a sample. So we find the bank's branch location selection and Modern Portfolio Theory developed by Markowitz.

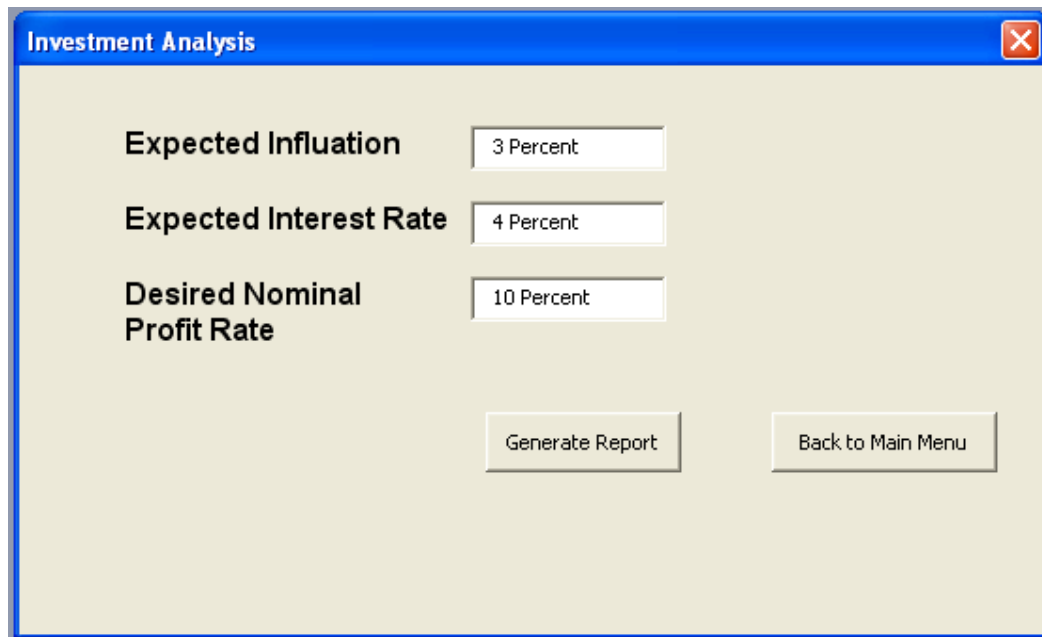# III. DATA SOURCE AND FLOW MECHANISMS

Firstly, we discussed which data will be used in our project. We should reach Turkey's general economic variables and cities' economic variables. Then we search the internet for a web side provides Economic statistics. Republic of Turkey, Prime Ministry Turkish Statistical Institute provides historical data about the population and economic activities in Turkish Cities. The web site provides data about economical and social status of the cities but not all the cities covered in all cases. Most of the time information of the biggest 25 cities is included.

IV. DEVELOPMENT OF THE DSS

Along with the developments in business world, the need to reach correct data and using it efficiently became an important issue for managers. So different tools and systems have developed to improve the decision process and to outcome for a manager making an important decision. Decision support systems (DSS) are the area of information systems (IS) devoted to supporting and improving human decision making. The DSS field began in the early 1970s as a radical alternative to large-scale management information systems (MIS). Over time, major changes in information technology (IT) have enabled new decision support movements. Financial modeling software and spreadsheets created a boom in personal decision support systems in the early 1980s; five years later, multidimensional modeling and OLAP technology enabled the deployment of large-scale executive information systems. Advances in storage technology and data modeling in the mid-1990s led to the data warehousing and business intelligence movements. (Arnott & Pervan, 2005).

IV.1. DSS Architecture
In our model, which is developed for Heidrick&Struggles Company, we tried to help the manager of the company to distribute company's Portfolio among different cities. The manager should enter interest rate, inflation and the expected rate of return from the investment in coming screen.

These are the inputs for generating the report since the related data about the city is already entered to the excel files. Firstly the real return is calculated by the formula

Real Profit = Nominal Profit –1+ (1+nominal/1+inflation)

The real profit is send to the algorithm for calculation process. Then the system returns the investment amount to cities and the minimum variance for the portfolio can be achieved.

If the manager expects high rate of return, the variance of the portfolio will be higher because the risk of the investment should be higher to generate higher return to the company and vice versa.

In the other menu, the manager can search for cities by entering different criteria. For example the manager might want to find cities which have average growth of 5 percent and number of working person is greater than 70.000. System searches the related columns and finds the cities which fit wit the related search. Thus, the manager finds different type of cities by performing e few searches.

In brief, in the investment optimization menu user enters estimated or expected inflation, expected interest rate and the nominal expected rate of return. System calculates the real expected return and sends the value to the algorithm for calculations. Then, the DSS returns the investment amounts to the cities and the minimum variance for the given real expected return. In the city search menu the manager can search for cities by defining criteria.

IV.2. Model and Algorithms

In the interview with Bertan Badur, we discussed how an investment model can be developed for such a situation. He claimed that all the data for a city in a correlation with all others. If a city has high population, number of working people will be higher, and economic production also will higher in the city. He advised us to make regression analysis only with two data and economic growth in a city will be key indicator. Economic growth is the main determinant because if a city grows high, there are always opportunities in the city. Although some cities have low population but high economic growth, they are profitable because there is a high rate of return in the cities. That is the company might not need to invest high amount of money like big cities, and in return they generate high money as a return for their investment.

After gathering such information we performed regression analysis. The first regression analysis is done to see the relationship between number of working people and GNP. How GNP can explain number of employed people.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,995045075
R Square	0,9901147
Adjusted R Square	0,9776147
Standard Error	11362,40609
Observations	81

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1,03449E+12	1,03449E+12	8012,825053	3,48549E-81
Residual	80	10328341778	129104272,2		
Total	81	1,04482E+12			

	Coefficients
Intercept	0
3279427	0,010053659

The Regression result is obtained from 1995 years data for 81 cities. Number of working people for monthly pay is taken as Y dependent variable and GNP as taken independent variable X. R value is very high, almost one, and from this regression it is obviously derived that number of working people is directly correlated with GNP in the city.

Then for supporting our basic idea that a city's economic growth is directly related with number of working people we perform regression analysis in City base.

Regression Analysis for Adana

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,971131
R Square	0,943095
Adjusted R Square	0,743095
Standard Error	7788,044
Observations	6

ANOVA

	df	SS	MS	F	Significance F
Regression	1	5026140269	5026140269	82,86627	0,000807681
Residual	5	303268167,5	60653633,49		
Total	6	5329408436			

Data are between 1995 and 2001. Dependent variable is number of working people and Independent variable is GNP in Adana. Like the regression analysis before, the regression result of Adana indicate that there is a strong correlation between the number of working People and GNP.

We performed Regression analysis for 4 more different Cities.

Adıyaman

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,865434
R Square	0,748975
Adjusted R Square	0,548975
Standard Error	1180,341
Observations	6

ANOVA

	df	SS	MS	F	Significance F
Regression	1	20784339	20784339	14,91835	0,01811
Residual	5	6966030	1393206		
Total	6	27750369			

Bursa

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,937415
R Square	0,878747
Adjusted R Square	0,678747
Standard Error	35064,14
Observations	6

ANOVA

	df	SS	MS	F	Significance F
Regression	1	44551910536	44551910536	36,23597145	0,003836
Residual	5	6147470145	1229494029		
Total	6	50699380681			

Denizli

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,9966
R Square	0,993211
Adjusted R Square	0,793211
Standard Error	3382,204
Observations	6

ANOVA

	df	SS	MS	F	Significance F
Regression	1	8367737214	8367737214	731,4902243	1,11119E-05
Residual	5	57196507,46	11439301,49		
Total	6	8424933721			

After those analyses above, we can say that number of working people for a wage can be estimated by using GNP in the City. Because all the regression results of different cities for 6 year period indicate high correlation between the two values. If the GNP is fluctuating than the number of working people is also fluctuating. If GNP is likely to grow, there will be employment in the city. After we find out the key relationship, we decided to use GNP instead of working with huge amount of data since all the fields are correlated with each other. That is, if a city has high population number of employed people will be higher. If there are more companies in a city, the GNP will be higher.

In Portfolio theory of Markowitz, he indicates that Portfolio expected portfolio return is the weighted average of investment fractions to shares times expected return of the share. The expected return of the share is found by taking average of the Return rate of the share. The Portfolio variability can be minimized by investing different Shares.

Taking the Markowitz's model as a base, we firstly chose 30 cities which have highest GNP.

İLLER	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ADANA	3.016.540	2.867.159	3.040.507	3.191.528	3.002.390	3.279.427	3.572.017	3.443.934	3.572.192	3.391.787	3.565.131	3.190.488
ANKARA	6.579.837	6.608.432	6.964.055	7.666.776	7.248.458	7.738.543	7.907.343	8.379.276	8.870.607	8.448.358	9.545.749	8.471.367
ANTALYA	1.902.320	1.911.547	2.091.110	2.213.629	2.359.660	2.552.512	2.725.519	2.945.645	3.016.640	2.814.530	2.938.699	2.956.989
AYDIN	1.311.294	1.217.221	1.293.453	1.471.545	1.547.185	1.645.318	1.737.358	1.725.075	1.848.872	1.624.667	1.807.663	1.565.776
BALIKESİR	1.452.161	1.449.597	1.489.052	1.543.496	1.564.822	1.613.807	1.680.324	1.657.210	1.785.099	1.642.249	1.789.308	1.594.430
BOLU	767.034	825.029	907.674	889.226	902.025	928.224	923.194	938.432	989.431	972.869	859.666	698.021
BURSA	3.322.877	3.400.361	3.778.433	4.149.800	3.680.919	3.968.347	4.142.540	4.384.248	4.719.616	4.603.113	5.015.684	4.601.273
ÇANAKKALE	798.999	826.846	888.125	892.899	879.830	959.018	984.204	1.001.849	948.482	909.895	1.017.588	843.815
DENİZLİ	1.159.241	1.154.963	1.229.668	1.288.282	1.284.144	1.407.303	1.527.469	1.667.413	1.724.022	1.704.105	1.817.721	1.780.652
DİYARBAKIR	1.118.803	1.156.405	1.210.141	1.272.529	1.133.422	1.154.709	1.178.321	1.220.163	1.295.328	1.177.896	1.196.370	1.223.428
ELAZIĞ	653.023	565.939	614.389	637.554	607.437	601.501	616.817	644.227	683.897	637.388	630.710	584.740
ESKİŞEHİR	991.376	1.012.336	998.110	1.066.366	1.108.909	1.138.784	1.202.465	1.267.785	1.449.453	1.331.760	1.424.621	1.512.380
GAZİANTEP	1.504.936	1.479.299	1.449.119	1.639.026	1.446.521	1.602.370	1.567.466	1.664.717	1.645.996	1.559.240	1.741.987	1.685.811
HATAY	1.429.209	1.356.504	1.455.708	1.682.794	1.554.540	1.667.383	1.727.368	1.861.498	1.865.064	1.808.121	1.888.771	1.731.119
İSTANBUL	17.333.961	17.572.946	18.761.393	20.706.501	18.518.939	20.768.956	22.843.261	25.330.310	25.650.461	24.483.238	26.278.326	23.607.618
İZMİR	6.338.207	6.334.960	6.781.070	7.586.864	7.442.700	7.949.598	8.360.002	8.744.832	8.934.496	8.393.554	9.016.134	8.381.585
KAYSERİ	926.315	958.126	1.025.911	1.097.118	1.025.782	1.100.243	1.175.002	1.259.497	1.286.103	1.261.778	1.373.965	1.332.039
KIRKLARELİ	790.880	747.197	782.821	724.253	719.959	805.027	839.483	910.314	895.822	845.109	921.207	868.539
KOCAELİ	3.643.984	3.771.598	3.917.987	4.635.378	4.230.165	4.548.222	4.594.037	5.225.073	5.226.091	4.727.588	5.223.778	5.035.541
KONYA	1.957.269	2.051.462	2.184.539	2.107.015	1.990.412	2.068.768	2.218.031	2.385.771	2.591.925	2.411.102	2.639.553	2.272.249
KÜTAHYA	671.259	706.902	730.916	781.313	843.184	850.815	952.483	887.217	879.653	852.098	863.686	831.895
MALATYA	707.042	737.218	791.653	815.910	851.607	865.903	867.584	906.886	904.429	837.706	942.046	907.019
MANİSA	2.247.267	2.200.410	2.407.508	2.621.978	2.345.066	2.505.396	2.677.591	3.036.718	3.127.602	3.008.825	3.273.149	3.007.258
MERSİN	2.348.656	2.340.501	2.451.698	2.917.526	2.616.950	2.718.618	2.642.593	2.924.423	3.001.226	2.950.785	3.079.797	2.948.871
MUĞLA	1.114.967	1.083.224	1.208.923	1.218.779	1.295.523	1.393.069	1.567.583	1.639.165	1.715.446	1.556.970	1.896.362	1.658.266
SAKARYA	856.483	862.164	924.336	952.086	943.518	1.099.101	1.197.979	1.253.782	1.314.815	1.218.022	1.343.891	1.173.629
SAMSUN	1.426.481	1.304.679	1.436.217	1.449.724	1.307.943	1.435.408	1.563.424	1.602.003	1.759.983	1.680.797	1.726.504	1.595.304
TEKİRDAĞ	893.035	931.513	1.020.666	1.063.537	987.485	1.094.894	1.193.418	1.367.245	1.412.077	1.473.271	1.574.939	1.455.139
TRABZON	781.090	758.632	846.782	830.093	781.327	822.165	818.767	886.380	897.271	941.272	927.767	970.276
ZONGULDAK	1.220.487	1.205.917	1.192.767	1.224.222	1.162.471	1.169.930	944.285	1.008.476	976.729	920.057	989.486	947.027

Then we found the increase rate of GNP in all cities by subtracting the next year from the previous year and dividing the product with the previous year. Adana's Economic growth for the year 1991 is calculated as (2.867.159 - 3.016.540)/ 3.016.540.

Growth	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ADANA	-0,04952	0,06046	0,04967	-0,05926	0,092272	0,08922	-0,03586	0,037242	-0,0505	0,051107	-0,10509
ANKARA	0,004346	0,053814	0,100907	-0,05456	0,067612	0,021813	0,059683	0,058636	-0,0476	0,129894	-0,11255
ANTALYA	0,00485	0,093936	0,05859	0,065969	0,081729	0,067779	0,080765	0,024102	-0,067	0,044117	0,006224
AYDIN	-0,07174	0,062628	0,137687	0,051402	0,063427	0,055941	-0,00707	0,071763	-0,12127	0,112636	-0,13381
BALIKESİR	-0,00177	0,027218	0,036563	0,013817	0,031304	0,041217	-0,01376	0,077171	-0,08002	0,089547	-0,10891
BOLU	0,075609	0,100172	-0,02032	0,014393	0,029045	-0,00542	0,016506	0,054345	-0,01674	-0,11636	-0,18803
BURSA	0,023318	0,111186	0,098286	-0,11299	0,078086	0,043896	0,058348	0,076494	-0,02468	0,089629	-0,08262
ÇANAKKALE	0,034852	0,074112	0,005375	-0,01464	0,090004	0,026262	0,017928	-0,05327	-0,04068	0,118358	-0,17077
DENİZLİ	-0,00369	0,064682	0,047667	-0,00321	0,095907	0,085387	0,091618	0,03395	-0,01155	0,066672	-0,02039
DİYARBAKIR	0,033609	0,046468	0,051554	-0,10932	0,018781	0,020448	0,03551	0,061602	-0,09066	0,015684	0,022617
ELAZIĞ	-0,13336	0,08561	0,037704	-0,04724	-0,00977	0,025463	0,044438	0,061578	-0,06801	-0,01048	-0,07289
ESKİŞEHİR	0,021142	-0,01405	0,068385	0,039895	0,026941	0,05592	0,054322	0,143296	-0,0812	0,069728	0,061602
GAZİANTEP	-0,01704	-0,0204	0,13105	-0,11745	0,107741	-0,02178	0,062043	-0,01125	-0,05271	0,117203	-0,03225
HATAY	-0,05087	0,073132	0,155997	-0,07621	0,072589	0,035976	0,07765	0,001916	-0,03053	0,044604	-0,08347
İSTANBUL	0,013787	0,067629	0,103676	-0,10565	0,121498	0,099875	0,108875	0,012639	-0,0455	0,073319	-0,10163
İZMİR	-0,00051	0,07042	0,11883	-0,019	0,068107	0,051626	0,046032	0,021689	-0,06055	0,074174	-0,07038
KAYSERİ	0,034341	0,070747	0,069409	-0,06502	0,072589	0,067948	0,071911	0,021124	-0,01891	0,088912	-0,03051
KIRKLARELİ	-0,05523	0,047677	-0,07482	-0,00593	0,118157	0,042801	0,084375	-0,01592	-0,05661	0,090045	-0,05717
KOCAELİ	0,03502	0,038814	0,183102	-0,08742	0,075188	0,010073	0,13736	0,000195	-0,09539	0,104956	-0,03603
KONYA	0,048125	0,064869	-0,03549	-0,05534	0,039367	0,072151	0,075626	0,08641	-0,06976	0,09475	-0,13915
KÜTAHYA	0,053099	0,033971	0,06895	0,079188	0,00905	0,119495	-0,06852	-0,00853	-0,03132	0,013599	-0,03681
MALATYA	0,042679	0,073838	0,030641	0,043751	0,016787	0,001941	0,045301	-0,00271	-0,07377	0,124554	-0,03718
MANİSA	-0,02085	0,094118	0,089084	-0,10561	0,068369	0,06873	0,134123	0,029928	-0,03798	0,08785	-0,08123
MERSİN	-0,00347	0,04751	0,190002	-0,10302	0,03885	-0,02796	0,106649	0,026263	-0,01681	0,043721	-0,04251
MUĞLA	-0,02847	0,116042	0,008153	0,062968	0,075295	0,125273	0,045664	0,046536	-0,09238	0,217982	-0,12555
SAKARYA	0,006633	0,072112	0,030022	-0,009	0,164897	0,089963	0,046581	0,048679	-0,07362	0,103339	-0,12669
SAMSUN	-0,08539	0,10082	0,009405	-0,0978	0,097455	0,089184	0,024676	0,098614	-0,04499	0,027194	-0,07599
TEKİRDAĞ	0,043087	0,095708	0,042003	-0,07151	0,10877	0,089985	0,145655	0,03279	0,043336	0,069008	-0,07607
TRABZON	-0,02875	0,116196	-0,01971	-0,05875	0,052267	-0,00413	0,082579	0,012287	0,049039	-0,01435	0,045819
ZONGULDAK	-0,01194	-0,0109	0,026371	-0,05044	0,006417	-0,19287	0,067978	-0,03148	-0,05802	0,075462	-0,04291

Then we take the average of the growth rate of the cities.

City	Average
ADANA	0,007249
ANKARA	0,025636
ANTALYA	0,041915
AYDIN	0,020145
BALIKESİR	0,010216
BOLU	-0,00516
BURSA	0,032631
ÇANAKKALE	0,007958
DENİZLİ	0,04064
DİYARBAKIR	0,009664
ELAZIĞ	-0,0079
ESKİŞEHİR	0,040544
GAZİANTEP	0,013197
HATAY	0,020071
İSTANBUL	0,031683
İZMİR	0,027313
KAYSERİ	0,034776
KIRKLARELİ	0,01067
KOCAELİ	0,033261
KONYA	0,016505
KÜTAHYA	0,021107
MALATYA	0,024166
MANİSA	0,029684
MERSİN	0,023565
MUĞLA	0,041046
SAKARYA	0,032083
SAMSUN	0,013016
TEKİRDAĞ	0,047524
TRABZON	0,021136
ZONGULDAK	-0,02021

Then the difference between the growth rate and the mean growth for 5 years are calculated for the selected 30 cities.

City	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ADANA	-0,05677	0,053211	0,04242	-0,06651	0,085023	0,081971	-0,04311	0,029992	-0,05775	0,043858	-0,11233
ANKARA	-0,02129	0,028178	0,075271	-0,0802	0,041977	-0,00382	0,034047	0,033001	-0,07324	0,104258	-0,13819
ANTALYA	-0,03706	0,052021	0,016676	0,024054	0,039814	0,025864	0,03885	-0,01781	-0,10891	0,002202	-0,03569
AYDIN	-0,09189	0,042483	0,117542	0,031257	0,043282	0,035796	-0,02721	0,051618	-0,14141	0,092491	-0,15396
BALIKESİR	-0,01198	0,017002	0,026346	0,0036	0,021088	0,031001	-0,02397	0,066955	-0,09024	0,079331	-0,11913
BOLU	0,080773	0,105336	-0,01516	0,019557	0,034209	-0,00025	0,02167	0,059509	-0,01157	-0,1112	-0,18287
BURSA	-0,00931	0,078554	0,065655	-0,14562	0,045455	0,011264	0,025716	0,043862	-0,05732	0,056997	-0,11525
ÇANAKKALE	0,026895	0,066154	-0,00258	-0,02259	0,082046	0,018305	0,009971	-0,06123	-0,04864	0,1104	-0,17873
DENİZLİ	-0,04433	0,024042	0,007027	-0,04385	0,055268	0,044748	0,050979	-0,00669	-0,05219	0,026032	-0,06103
DİYARBAKIR	0,023945	0,036804	0,041891	-0,11898	0,009117	0,010785	0,025846	0,051939	-0,10032	0,00602	0,012953
ELAZIĞ	-0,12545	0,093514	0,045608	-0,03933	-0,00187	0,033367	0,052342	0,069482	-0,0601	-0,00257	-0,06498
ESKİŞEHİR	-0,0194	-0,0546	0,027842	-0,00065	-0,0136	0,015377	0,013778	0,102752	-0,12174	0,029184	0,021058
GAZİANTEP	-0,03023	-0,0336	0,117853	-0,13065	0,094544	-0,03498	0,048847	-0,02444	-0,0659	0,104006	-0,04545
HATAY	-0,07094	0,053061	0,135926	-0,09629	0,052519	0,015905	0,057579	-0,01816	-0,0506	0,024534	-0,10354
İSTANBUL	-0,0179	0,035946	0,071993	-0,13733	0,089815	0,068192	0,077191	-0,01904	-0,07719	0,041636	-0,13331
İZMİR	-0,02782	0,043108	0,091517	-0,04631	0,040794	0,024313	0,01872	-0,00562	-0,08786	0,046861	-0,09769
KAYSERİ	-0,00043	0,035972	0,034633	-0,0998	0,037814	0,033172	0,037135	-0,01365	-0,05369	0,054136	-0,06529
KIRKLARELİ	-0,0659	0,037007	-0,08549	-0,0166	0,107487	0,032131	0,073704	-0,02659	-0,06728	0,079375	-0,06784
KOCAELİ	0,00176	0,005553	0,149841	-0,12068	0,041927	-0,02319	0,104099	-0,03307	-0,12865	0,071696	-0,0693
KONYA	0,03162	0,048365	-0,05199	-0,07184	0,022862	0,055646	0,059121	0,069905	-0,08627	0,078245	-0,15566
KÜTAHYA	0,031992	0,012864	0,047844	0,058082	-0,01206	0,098388	-0,08963	-0,02963	-0,05243	-0,00751	-0,05792
MALATYA	0,018513	0,049672	0,006475	0,019585	-0,00738	-0,02222	0,021134	-0,02688	-0,09794	0,100388	-0,06135
MANİSA	-0,05054	0,064434	0,059399	-0,1353	0,038685	0,039045	0,104439	0,000244	-0,06766	0,058165	-0,11092
MERSİN	-0,02704	0,023945	0,166437	-0,12659	0,015285	-0,05153	0,083084	0,002698	-0,04037	0,020156	-0,06608
MUĞLA	-0,06952	0,074995	-0,03289	0,021922	0,034249	0,084227	0,004618	0,00549	-0,13343	0,176936	-0,1666
SAKARYA	-0,02545	0,040028	-0,00206	-0,04108	0,132814	0,057879	0,014498	0,016596	-0,1057	0,071256	-0,15878
SAMSUN	-0,0984	0,087804	-0,00361	-0,11081	0,084438	0,076168	0,01166	0,085598	-0,05801	0,014177	-0,08901
TEKİRDAĞ	-0,00444	0,048183	-0,00552	-0,11903	0,061246	0,042461	0,09813	-0,01473	-0,00419	0,021484	-0,12359
TRABZON	-0,04989	0,09506	-0,04084	-0,07988	0,031131	-0,02527	0,061443	-0,00885	0,027903	-0,03548	0,024682
ZONGULDAK	0,008275	0,009308	0,046584	-0,03023	0,026629	-0,17266	0,088191	-0,01127	-0,03781	0,095674	-0,0227

By multiplying the matrix with its transpose, We get the variance matrix for the Cities. How city growths are correlated with other cities. If a city grows, for example, another city might be worse of or another city might grow with the city. All this cases shapes the correlation Matrix. (Since the table is very large, the size of the page is not enough for displaying all cities, we just select e few of them.)

	ADANA	ANKARA	ANTALYA	AYDIN	BALIKESİR	BOLU	BURSA	ÇANAKKALE	DENİZLİ
ADANA	0,046861134	0,038338	0,017672	0,049237	0,031912	0,019148	0,040931	0,037325	0,023992
ANKARA	0,038338079	0,052699	0,017026	0,053225	0,03593	0,017202	0,049287	0,044372	0,024301
ANTALYA	0,017671831	0,017026	0,022158	0,0301	0,015627	0,011383	0,014824	0,018996	0,015334
AYDIN	0,049237435	0,053225	0,0301	0,083855	0,049603	0,019342	0,042414	0,04471	0,025996
BALIKESİR	0,031911731	0,03593	0,015627	0,049603	0,036231	0,018681	0,029705	0,033051	0,015896
BOLU	0,019148032	0,017202	0,011383	0,019342	0,018681	0,069353	0,023801	0,029083	0,009444
BURSA	0,040931143	0,049287	0,014824	0,042414	0,029705	0,023801	0,056369	0,039253	0,024692
ÇANAKKALE	0,037324867	0,044372	0,018996	0,04471	0,033051	0,029083	0,039253	0,063029	0,023963
DENİZLİ	0,023991537	0,024301	0,015334	0,025996	0,015896	0,009444	0,024692	0,023963	0,019343

The table above is symmetric with when look ad the city names from columns and rows. For example, the values are the same when we look at Bolu in row or column.

After generating this matrix, which has a key role, the next step is calculating the minimum variance for a given expected rate of return. The Real Profit rate is determined by the Manager of the company in the firs step. He enters the expected interest rate, expected inflation and desired nominal rate of return. Then the system calculates the real rate of return and calculation steps begin.

	ADANA	ANKARA	ANTALYA	AYDIN	BALIKESİR	BOLU	BURSA	ÇANAKKALE	DENİZLİ
Mean	0,007249254	0,025635508	0,041914794	0,020145	0,010216	-0,00516	0,032631	0,007958	0,04064
Fractions to invest	0,3035475989	0,030029547	0,113185831	0,259372	0,07717	0,38588	0,014029	0,03505	0,032792

	Actual	=	Required
Var Covar Matris Solution	2,0934	4,57537	0,400001 = 0,4

Solver tries to minimize over all portfolio variance. Firstly transpose of the investment fractions multiplied with the variance covariance matrix. Then the product of the multiplication is multiplicities with the investment fraction matrix. Thus, the variance of the over all portfolio is calculated in a single cell. In the simple table above solver tried to minimize the Var Covar Matris Solution by changing Fractions to Invest subjected to constraint that Actual Return is equal to the required return.

Min (Matrix Multiplication (Investment fractions; Matrix Multiplication (Variance Matrix; Transpose of Investment fractions))

Solver tries to minimize the portfolio variance by changing investment percents to the cities. Subjected to constraints that total of the investment percent is 1 and the expected return of the investment is equal to the given rate of return.

The Manager enters Expected Nominal Rate of return, interest rate and the inflation for calculation. All the other values are stored in the excel file. Economic growth of the

cities, average, standard deviation, variance covariance matrix is calculated in Excel file and ready for calculations.

In the other Menu, The user only makes a query by selecting criteria. The System Search for the related fields and displays the result on the screen. If the user want to see the cities which have more than 10.000 University Graduate, the system search the University Graduate Field and check the number than displays the result.

IV.3. User Interface and Reports

The Main Screen

Investment Analyzer

Report

City Finder

IV.4. Data Structure

We begin data analysis from regression and firstly we found high correlation between GNP in cities and number of working people in the city. Thus the huge amounts of data which are correlated with each other are eliminated. Then we used the increase rate in GNP to estimate future employment in the city. In our algorithm, mean or expected economic growth, variance covariance matrix which indicate the correlation of growth rate of cities and investment fractions. Finally we reach to desired rate of return by changing investment fractions at the same time minimizing the variance of the portfolio.

IV.4 Technical Issues

Our row data is gathered from Turkish Statistics Institute. Many of the data is in PDF and html format. They are converted Excel format carefully and merged.

We used Excel as a Regression analyzer to generate regression results for GNP in Cities and number of working People.

Excel and VBA for Excel used for running solver and finding result.

V. ASSESSMENT

We can not find the statistics of cities after the year 2001. If the data of near years are found and added to data base the estimation will be more applicable.

Excel cannot find results of Matrix multiplication of 81 cities. We have to limit the number of cities for enabling Excel make calculations.

VI. CONCLUSION

We optimized the investment portfolio of the Heidrick& Struggles Company by using GNP of cities as an estimator. We summarize all the data in terms of GNP making regression analysis of data to see how variables are related and we used GNP as a base because all other findings correlated with GNP. For example, if a city is taking migration from other cities, the GNP is likely to grow and therefore there will be employment in the city. We try to point out possible sources of sample dependencies in our data with regression analysis, because even if we use all variables to reach true consequences, this is not change the result and wastes time.

The Portfolio Theory of Markowitz is suitable for making investment decisions to different cities. So we take base this theory to optimize the investment portfolio of the Heidrick& Struggles Company. A Portfolio is distributed to different cities to generate

an expected rate of return and it is found by taking average of the Return rate of the share but the Portfolio variability should be minimized.

Someone can think that investing a city which has the highest average GNP growth can be suitable. However having highest GNP growth doesn't mean that, if a city has a GNP growth with high average it will grow highest in the coming year, in other words the GNP may decrease in next year we cannot guarantee continuous growth according to past data . Also the variability of growth of any city in terms of past years can be higher and the investment can be very risky one. Therefore distribution among the cities is necessary to minimize variance.

This research can be expanded to make a thesis by approaching the situation with detailed data. However there is not such an applied model or theory. The researchers must try data analysis with all the fields of data one by one to derive a model or formula because country growth estimations are not applicable to the cities.

REFERENCES

[1] Abdel-Aziz, Ahmed Mohamed (2000) Generalized economic model, risk analysis framework and decision support system for the analysis and evaluation of capital investment projects. The University of British Columbia (Canada) pp 4

[2] Nancy Y. C. Kong* and Jose Tongzon (2006) Estimating total factor productivity growth in Singapore at sectoral level using data envelopment analysis. Applied Economics. p

[3] Interview with Burak Yalçın. Heidrick & Struggles Company's Research & System Associate (October 2006)

[4] Eric Dash (October 18, 2006) New York Times. (Late Edition (East Coast)). New York, N.Y

[5] Arnott, D. (2005). *Cognitive biases and decision support systems development: A design science approach* (Working Paper. No. 2005/01). Melbourne, Australia: Decision Support Systems Laboratory, Monash University.

[6] Rustam Vahidov and Gregory E. Kertsen Decision Station: Situating Decision Support Systems, Decision Support Systems 2004, Vol. 38 No. 2, (pp. 283-303)

[7] The Greater Capital Region State of the Workforce Report, Diversity of Need/ Unity of Vision, Draft- November 22nd, 2004

[8] David Arnott Decision support systems evolution: framework, case study and research agenda, European Journal of Information Systems (2004) 13, 247–259

[9] Füsun Akkök and A.G. Watts Country Report On Turkey, World Bank March 2003

[10] Matthias Kipping and Thomas Armbrüster The Consultancy Field in Western Europe, The University of Reading

[11] Daiva Beržinskienė Model of Population Employment Estimation, ISSN 1392-2785 Engıneerıng Economıcs. 2005. No 4 (44) Work Humanısm

[12] Jim Kitay and Christopher Wrıght Take the Money and Run? Organisational Boundaries and Consultants' Roles, The Service Industries Journal, Vol.24, No.3, May 2004, pp.1–18

[13] http://www.qualityinfo.org/olmisj/ArticleReader?itemid=00003016&segmentid= 0007&tour=0&p_date=1

[14] http://www.geog.ubc.ca/courses/klink/gis.notes/ncgia/toc.html

[15] D Duffy, Hugh (2006) "Outsourcing: Thread or Opportunity?" Accounting Today, Nov 2006, Accounting & Tax Periodicals, pg.10.

[16] Adler, Paul.S.(2003) "Making The HR Decision Outsourcing" MIT Sloan Management Review,Vol 45, No:1, pp. 53.

[17] http://www.mis.boun.edu.tr/erdem/mis517/projects-04/ozgur_barut.ppt

[18]http://web.worldbank.org/WBSITE/EXTERNAL/WBI/WBIPROGRAMS/ICLP/0,, contentMDK:20270804~menuPK:461190~pagePK:64156158~piPK:64152884~theSite PK:461150,00.html

[19]Mary Hallward-Driemeier, Scott Wallsten, Lixin Colin Xu (2006) "Ownership, investment climate and firm performance" Economics of Transition, Volume 14(4) 2006, 629–647
[20] Littlefield,J.E."On the art of locating new banks," The Bankers Magazine, Autumn 1968,151,94-102

[21] Olsen, L.M and J.D. Lord. "Market area characteristics and branch bank performance," Journal of Bank Research,1979, 10, 102-110

[22] Lunsten, L.L. Market share forecasting for banking offices.UMI Research Press, 1978.

[23] Davidson, F. "Locating bank branches with managament science help," Bankers Magazine, Summer 1969, 84-89

[24] Sloan, J.V. "How one bank tried to make its branch site selection scientific." ABA Banking Journal, May 1981.

[25] Bell, R.R and N.B.Zabriskie. "Assisting marketing decisions by computer mapping: A branch bank application," Journal of Marketing Research, Volume 15,February 1978, pp. 122-128

[26] Alexanderson, K.W. Bank branch location feasibility analysis, Burroughs Clearing House, February 1969, 54, 26-27.

[27] Bauhoffer, R.J. "The census data gold, how to mine it new branches," Saving Bank Journal, Volume 53,February 1973,pp.68-77

[28] Lord, J.D. and D.B.Wright."Competition and Location Strategy in Branch Banking:Spatial Avoidance or Clustering," Urban Geography, 1981, pp.189-200

[29] Soenen, L.A. "Locating bank branches,"Industrial Marketing Managament, Volume 3, 1974,pp.211-228

[30] Carroll, Peter(1992) "Rationalizing Branch Location" Journal of Retail Banking, Summer,p.p 5-6

[31] Littlefield,J.E."On the art of locating new banks," The Bankers Magazine, Autumn 1968,151,94-102

[32] Olsen, L.M and J.D. Lord. "Market area characteristics and branch bank performance," Journal of Bank Research,1979, 10, 102-110
[33] Lunsten, L.L. Market share forecasting for banking offices.UMI Research Press, 1978.
1 Davidson, F. "Locating bank branches with managament science help," Bankers Magazine, Summer 1969, 84-89

[34] Sloan, J.V. "How one bank tried to make its branch site selection scientific." ABA Banking Journal, May 1981.

[35] Bell, R.R and N.B.Zabriskie. "Assisting marketing decisions by computer mapping: A branch bank application," Journal of Marketing Research, Volume 15,February 1978, pp. 122-128

[36] Alexanderson, K.W. Bank branch location feasibility analysis, Burroughs Clearing House, February 1969, 54, 26-27.

[37] Bauhoffer, R.J. "The census data gold, how to mine it new branches," Saving Bank Journal, Volume 53,February 1973,pp.68-77

[38] Lord, J.D. and D.B.Wright."Competition and Location Strategy in Branch Banking:Spatial Avoidance or Clustering," Urban Geography, 1981, pp.189-200

[39] Soenen, L.A. "Locating bank branches,"Industrial Marketing Managament, Volume 3, 1974,pp.211-228

[40] Bank Investment Consultant, Modern Portfolio Theory. New York: June 1,2006. Vol 14, Iss. 6; pg.36

[41] Bluford Putnam- Global Investor, Visualizing risk and correlation London: Jul/Aug 1999. Iss. 124; pg. 42

[42] Zvi Bodie, Alex Kane, Alan J. Marcus, Investments, 2005, 6. Edition

[43] http://www.investopedia.com/terms/p/portfolio.asp

[44] http://en.wikipedia.org/wiki/Portfolio

[45] http://www-128.ibm.com/developerworks/rational/library/aug05/mckenna/#notes

[46] M.Markowitz, Harry,"Portfolio Selection:Efficient Diversification of Investment",1959, pp 2-3-5-7

Other Read Resources:

- Pietro Gennari THE ESTIMATION OF EMPLOYMENT AND VALUE ADDED OF INFORMAL SECTOR IN PAKISTAN 7th Meeting of the Expert Group on Informal Sector Statistics (Delhi Group) New Delhi, 2-4 February 2004

- Lawrence R. Klein and Süleyman Özmucur The Estimation of China's Economic Growth Rate Journal of Economic and Social Measurement Volume 28, Number 42002 / 2003, pp. 187-202

-
  Alain Kabundi Estimation of Economic Growth in France Using Business Survey Data
- IMF Working Paper