African Journal of Business Management Vol. 4(8), pp. 1586-1604,18 July, 2010
Available online at http://www.academicjournals.org/AJBM
ISSN 1993-8233 ©2010 Academic Journals

Full Length Research Paper

Decision-support analysis for risk management

Hülya Demir[1]* and Bülent Bostanci[2]

[1]Yildiz Technical University, Department of Surveying Engineering, Istanbul, Turkey.
[2]Kayseri Erciyes University, Department of Surveying Engineering, Kayseri, Turkey.

Accepted 1 June, 2010

Generally, a project is an investment suggestion, which requires making a series of investment expenditures (cash outflow) in a planned manner to obtain more cash inflow in the future. Therefore, the basic objective of project appraisal should be to make prior decisions on the feasibility of investment advice. The results of project feasibility can be classified into two categories: uncertainty and risk. Risks related to investment and financial markets are also closely related with the audit and supervision authorities. One of the main objectives of regulatory and control authorities is to achieve economic stability in the market and to minimize systematic risks. This requires that all institutions define the risks they will encounter, measure these risks via risk analysis techniques and assess the potential impacts of these risks on the institution. Today, projects within the housing sector -which has been heavily hit by the recent economic crisis- are one of the areas subject to risk analysis. This article aims to determine and discuss risks factors within the housing project development process by applying discounted cash flow analysis (DCF), Monte Carlo Simulation (MCS) and sensitivity analysis to a housing sector with an integrated approach. Two different discounted cash flow models were developed as part of a scenario analyzing a housing development project. These models were subjected to risk analysis based on MCS, one of the many methods analyzing risk distribution. Thus, data from the probability distributions are envisaged to strengthen the trust of the manager in the value and acceptance of the project, and to concretize the attitude to risk of the decision making group. In conclusion, the study defined important variables for efficient risk management of housing development projects and developed a risk-decision support model, which incorporates scenario analysis and MCS.

Key words: Risk analysis, decision-support analysis, risk management, Monte Carlo simulation, discounted cash flow analysis (DCF).

INTRODUCTION

Appraisal of development projects is based on measuring expected return and cash flows. The yield (return) of a development project cannot be calculated without knowing when expenditures and cash inflows will be realized. Comparison of investment options is a complex issue, as it depends on the size of investment and timing of cash inflows and outflows. Therefore, approaches such as repayment period, internal rate of return and net current value have been developed to make useful comparisons. These approaches produce mathematically precise results; however, the underlying data for these calculations are often imprecise. For instance, it is impossible to know the exact discount rate of the investment, as this may change at any time during the project. A tiny change in discount rate may lead to drastic changes in the return of the investment. This is also valid for variables such as sales, expenditure and economic lifespan. Therefore, the projected rate of return does not reveal all possible results; rather, it represents a single point on a continuous curve. Some techniques have been developed to reduce such uncertainty (probabilistic analysis, sensitivity analysis and scenario analysis). However, when used alone, any of these techniques can only provide the decision maker with limited data.

Sensitivity analysis is the process of recalculating the rate of return by assigning different values to important variables. Sensitivity analysis shows the possible impacts of the basic variables on appraisal indicators such as net present value (NPV) or internal rate of return (IRR). This analysis provides the following information:

In project development, when discount rate changes by y %, NPV changes by x %.

*Corresponding author. E-mail: hudemir@yildiz.edu.tr.

This information is useful, but insufficient in terms of risk analysis. Decision-makers rightly require further information on the probability of various scenarios. This demand can be met by developing a probability profile of the appraisal indicators such as net current value or internal rate of return. In order to produce a risk profile, it is necessary to carry out a risk simulation.

The attitude of the manager towards the value and acceptance of the project reflects their attitude and that of the decision-making group towards risk. The risk attitude of the decision maker is based on the intuitive balance between the arithmetic deviation and standard deviation of return.

In a world where global competition and economic crises are frequently experienced, it is necessary to establish intercompany risk management. Risk management is a discipline that ensures efficient and effective utilization of project resources, which supports decision-making based on information, and which aims to reduce uncertainties and their negative effects to a more manageable level. Fikirkoca (2003) suggests that risk management brings about two benefits. Firstly, performance, cost and profitability targets of the company can be achieved by anticipating problems before they arise or by minimizing the negative impacts of such problems; Secondly, considerable gains can be made by preventing serious risks by defining their basic causes. De Marko (2001), on the other hand, adopts a different perspective and defines risk management as the discipline of failure planning [URL 1].

In practice, many decisions are made without having all the necessary data and at a certain level of uncertainty. In cases with no data at hand, there is complete uncertainty. Project risk management stands somewhere between full certainty and full uncertainty. In project management, the main objective of risk management is "to define project risks and to develop strategies to reduce probability of these risks or to ensure avoidance from these risks" (Fikirkoca, 2003). On the other hand, some steps should be taken within project risk management to capitalize on potential project-related opportunities. Project risk management and process includes planning and implementation to minimize the risk of worsening of the works and to minimize the net impact of potential risks (Figure 1). The main objective of project risk management is to direct uncertainty from risks to opportunities (Project Management Institute, 2000).

Risk management decision-support analysis consists of realization of the risk analysis; risk assessments based on analysis of results; decisions taken to mitigate and manage risks; and risk treatment processes (Figure 2).

Risk management techniques are used in a wide range of fields and applications. For more detailed information on risk management in general and risk management within a business environment, see the works of Chapman and Ward (1997) and Flanagan and Norman (1993). In addition, risk management has been applied to examples such as the development of new products in pharmacy industry (Kleczyk, 2008), Risk attitudes and management strategies of small-scale crop producer in Kwara State, Nigeria: A ranking approach (Ayinde et al., 2008), Risk Management in Corporate Governance: A Review and Proposal (Brown, 2009).

The purpose of the present study is to present mathematical expressions of the potential risks within the project development process and, thus, to contribute to effective project management. The study focuses on the housing development sector, which is at increased risk due to changes in the economic conjuncture. The present study has been designed as follows:

Part – 2 Introduction to study method: Risk and risk analysis
Part– 3 Risk analysis in housing development projects and Monte Carlo Simulation (MCS)
Part– 4 Risk analysis via MCS in a housing development project
Part– 5 Main conclusions and suggestions for future studies

Risk and risk analysis

Risk, which is mathematically related to concepts of probability and impact, is a potential event or situation that has negative or positive impacts on the project targets (PMI, 2000). Risk is an objective measure of uncertainty. Risk, which has to be defined to achieve efficient risk management, has two basic components (Rezaie et al., 2007; Bostanci, 2008).

Risk = f (probability, impact)

Probability of uncertainty: Probability of failure to produce a specific result or of occurrence of an undesired event.
Uncertainty impact: The impact on the expected result in case of a failure to produce a specific result or of occurrence of an undesired event

While each risk is an uncertainty, each uncertainty is not a risk. Here the distinction is the level of interaction between the uncertainty and the process required to meet the objective (Figure 3).

Since future-oriented plans are made within the project, this process incorporates many unknowns. The terms "risk" and "uncertainty" are often used interchangeably to define these unknowns, but it is of great importance to define these terms in a more meaningful way (French and Gabrielli, 2005). There is "risk" when experts can produce a probability distribution about the results, and there is "uncertainty" when experts cannot reach an agreement. Project risk can be defined as the difference between the expected value and realized value. Therefore, future returns of a risky project can only be estimated through probability distribution, because a probability distribution reflects the variability of the possible future returns (Sarıaslan, 1997). When

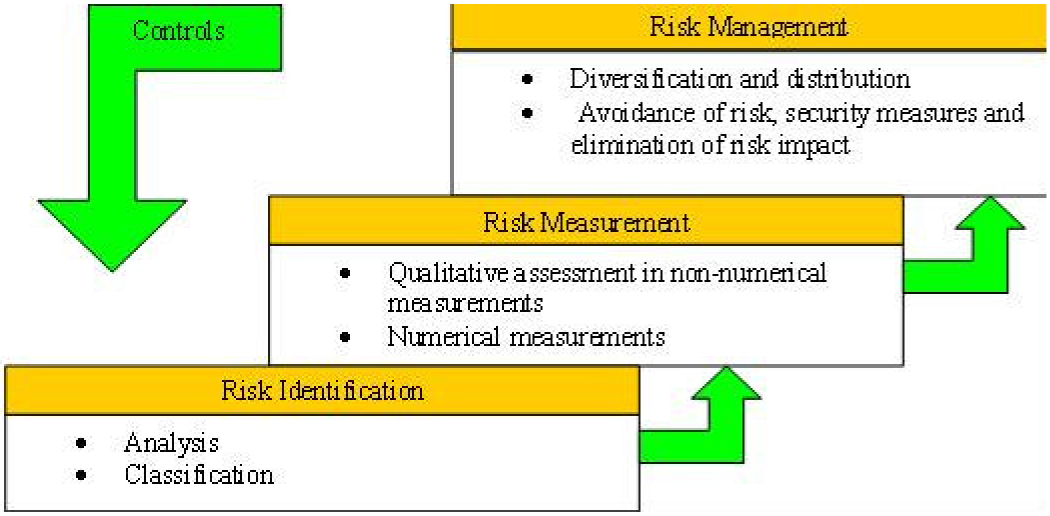


Figure 1. Risk management process (Wellner, 2003).

Figure 2. Relations in risk management process [URL 2].

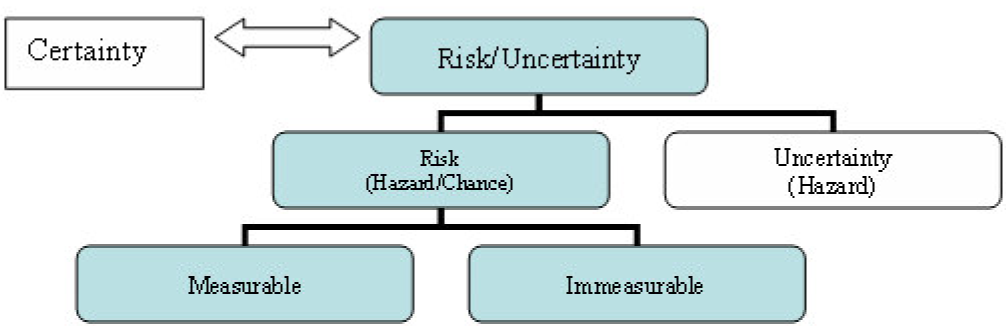


Figure 3. Limits of risk and certainty (Wellner, 2003).

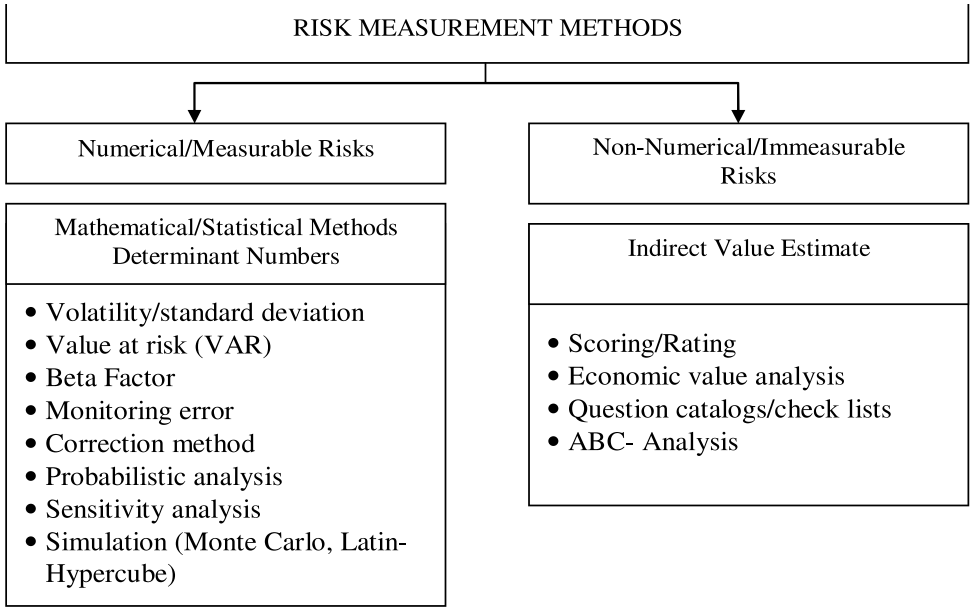


Figure 4. Risk measurement methods (Welner, 2003).

considered from another perspective, there is risk for statistical events and uncertainty for non-statistical events (Weston and Brigham, 1977; Lindley, 1985; Tevfik, 1997). Project risk can be defined as the level of occurrence of negative events and their possible impacts on the scope, quality, time and cost of project targets (Project Management Institute, 2000).

Risk analysis is a methodology that assumes that the factors determining the profitability of a project are dependent on future events, which cannot be foreseen precisely. The basic objective of identification of the risk (variability) related to an investment project is to develop a judicial decision tree or decision method which will shape possible project results by taking into consideration the possible variability range of future returns and the probability of each value in this range (Clifton and Fyffe, 1977; Sariaslan, 1997). Risk assessment and risk analysis are closely related (Wellner, 2003). Therefore, most of the techniques used to measure risk are also used for risk analysis (Figure 4).

Various studies have been conducted on risk analysis in the construction sector and other areas, including: Corrosion in cast iron water supplies (Sadiq et al., 2004) fixed price construction projects (Öztaş and Ökmen, 2004); identification of a tunnel support template (You et al., 2005); critical asset protection (McGill et al., 2007) and shipping traffic in Istanbul Strait (Ulusçu et al., 2009).

Risk analysis and MCS in housing development projects

The analysis of risk within the housing development sector has three components: These are: "how much of the risk will be borne by the organization", "how does profit and loss change per investment" and "the degree of the expected shock". Following this three-column assessment, the institution generally determines the potential variation in profit and loss. In other words, risk level is assessed based on potential exposure to risk, particularly price sensitivity of the market, market variability and the relationship between them.

One of the objectives of risk measurement in housing projects is to define which risk group the project can be classified into. At this phase, subjective probability distributions related to project variables are defined. These distributions form the inputs to a risk simulation, which is the method used to define project risk. Solution of the developed model gives the probability distributions of the resulting variables.

The outputs of the risk simulation provide detailed information on project risk, which informs project managers on the quality of the project, problems related to cash flow estimates and important uncertain variables. Managers can classify the project into low, mid or high-risk group by evaluating the probability distributions of "Net Present Value" and "Internal Rate of Return" scenarios. These classifications can assist in the selection of an appropriate discount rate. Output of the project risk cannot determine the relationship between a single project and the wider activities of the organization. The impact of a single project on the overall company revenue can be assessed through a separate simulation.

The risk simulation process is illustrated in Figure 5 (French and Gabrielli, 2005).

Typically, MCS incorporates thousands of repetitions using different inputs. By using random inputs, the simulation actually turns a deterministic model into a

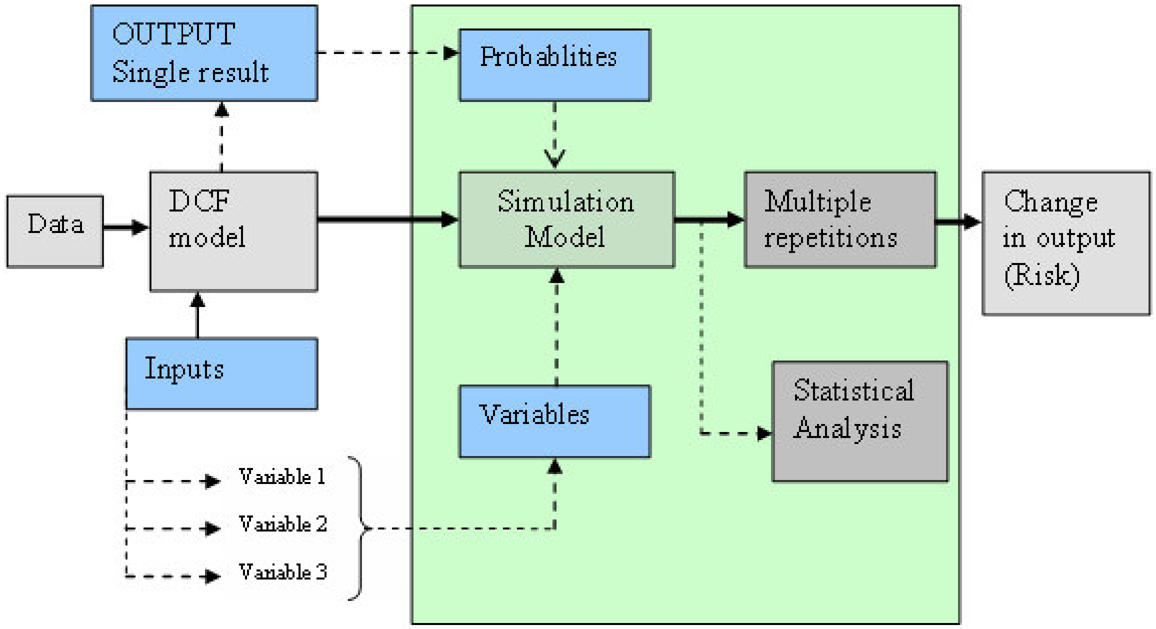


Figure 5. Risk simulation process (French and Gabrielli, 2005).

scholastic model. MCS, which is used as a simulation model in the present study, is only one of many models available to analyze the distribution of uncertainty when it is aimed to determine the impact of random variables on the sensitivity, performance and reliability of the modeled system. MCS is classified as a “sampling method”. Inputs are obtained randomly from probability distributions so as to simulate a sampling process in a real population. It is necessary to choose a probability distribution which represents the information in the best way and which is closest to the current information. Data obtained at the end of a simulation can be represented as a probability (or histogram) distribution, or can be represented as error lines, reliability estimates, tolerance zones and reliability ranges [URL 3].

MCS has been an important element of numerical risk measurement since the 1960s (Hetrz, 1964). MCS is used when it is impossible or too difficult to make calculations by using analytical solutions in finance, in deciding on production management and price, and in appraisal of real estate (Baroni et al., 2005). Rather than making one estimate for one variable, the user assigns a probability distribution to the variable. The Monte Carlo technique selects random numbers for each variable and produces a result based on this model before selecting another random input. This process is repeated, as necessary, thereby producing a range of varying outputs. This model can be used to produce multiple results probability, which can be analyzed statistically. Each result will serve as the distribution of possible results and as the variable of possible appraisal figures. Simulation results are given in the form of a different distribution (histogram) or continuous and uninterrupted distribution (normal distribution). These distributions enable the ones who make evaluations to know the result figures and probability of the values at each point within the distribution (Evans, 1992). Risk analysis studies using Monte Carlo Simulation include: Fires (Au et al., 2007), engineering project costs (Chou et al., 2009), construction projects (Öztaş and Ökmen, 2005) and real estate development (Atherton et al., 2008).

Decision-Support Analysis for risk management through MCS in a housing development project

Project overview

The project is located in Mimar Sinan Region of Büyükçekmece District of Istanbul Province, Turkey. It is 1.5 km (on the sea side) from European highway no 80 (Figure 6).

The Mimar Sinan Kent Plus (MSKP) project consists of 660 flats in 19 blocks, built on an area of 42600 m^2, 32000 m2 of which will be allocated for social facilities and landscape. MSKP offers apartments of differing sizes, with a sea-view. The project will include 120 1+1 (one room + one saloon), 60 2+1 (two rooms + a saloon), 160 4+1 (four rooms + a saloon) and 320 3+1 (three rooms + a saloon) apartments. Following a study by Emlak Real Estate Investment Trust (EREIT), a table of cost estimates was drawn up, based on area and building information. Using this information, costs were calculated using a Discount Cash Flow (DCF) model. Costs were

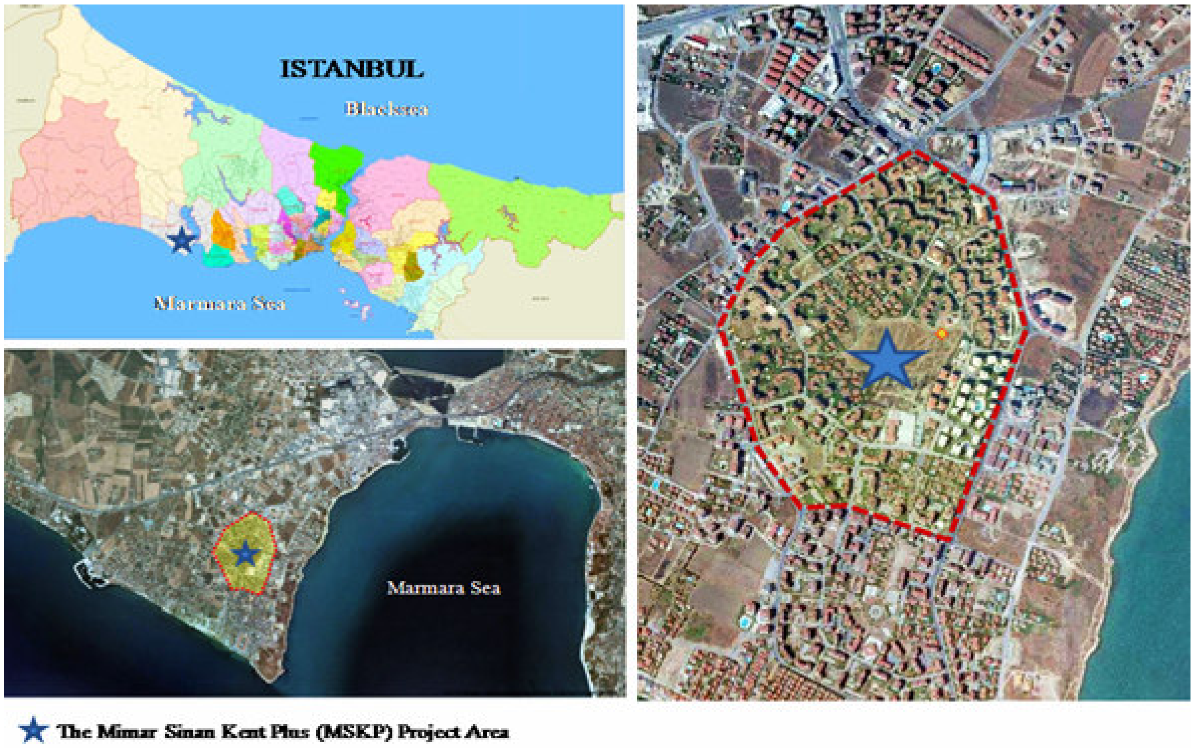


Figure 6. Location of Mimar Sinan Kent Plus Project.

calculated on the basis of the *Communiqué Nr 2717 on "2009 Approximate Construction Unit Costs To Be Used In Calculation of Architectural and Engineering Service Charges"* issued by the Ministry of Public Works and Settlement on 19.03.2009. A summary cost table and area-building information for the Mimar Sinan Kent Plus project is given in Annex 1. Two DCF models have been developed on the basis of a comprehensive market survey and by considering cost and construction information: one model for the basic case (normal economy) and one model for the worst case (crises) (See Annex-2a, 2b and Annex-3, respectively).

Information gathering

It is necessary to gather as much information as possible to make analysis on a housing project. This includes any kind of information related to the purpose, position, characteristics and costs of the project. Each housing project has unique technical characteristics resulting from its construction type, operation period and environmental conditions. Therefore, each project creates a specific risk atmosphere (Flanagan and Norman, 1993; Öztaş and Ökmen, 2004). The accuracy of the risk analysis simulation depends on the quality of the data used in the models (French, 2007). In developing countries such as Turkey, the quality of available data based on market research remains relatively low. To minimize this problem in the present study, information used in the discounted cash flow and MCS was collected from Real Estate Investment Partnership. Future estimates about variable values were produced in cooperation with experts from the construction, architecture, mapping, industry, finance, and real estate evaluation sectors. Housing and office prices and occupancy rates in the study area were decided at the end of the research, based on information from real estate firms and on-line research.

Variables and selection criteria

In the discounted cash flow model developed for a housing project, important variables which will have impact on the cost and return of the project are taken as independent variables. In the MSKP DCF model, gross revenues and expenditures were calculated on the basis of a fixed inflation rate. Then, inflation has been deflated in the net revenue to obtain NPV and IRR. In such cases, the real discount ratio has to be taken as an independent variable. The real discount ratio was determined as 3% periodically (quarterly). Probability distributions were decided following comprehensive market research conducted in Turkey. However, a triangular distribution was preferred, as it is impossible to obtain complete statistical information in developing countries. The DCF model of the MSKP housing development project was developed on a periodical (quarterly) basis. Project construction was

Annex 1. Mimar Sinan Kent Plus cost data.

Mimar sinan kent plus housıng constructıon project estimated cost chart			
General informatıon			
Gross land area (m^2)		-	
Net land area (m^2)		42648.00	
Used precedent construction area (m^2)		117196.00	
Housing (m^2)		93325.00	
Commercial (m^2)		377.00	
Garage (m^2)		10170.00	
Social facility (m^2)		604.00	
Swimming pool (m^2)		1148.00	
School (m^2)		5661.00	
Total construction area (m^2)		111285.00	
Total marketable area (m^2)		93702.00	
Total rentable area (m^2)		-	
Marketable area-rentable area/total construction area		0.842000269	
Starting date of construction		January 2009	
Ending date of construction		December 2009	
Construction cost	**Amount**	**Unit price (TL)**	**Total (TL)**
Housings	93225	498	46,426,240.00
Social facilities	604	437	264,000.00
School	5661	561	3,176,380.00
Swimming pool	1148	622	714,220.00
İn-complex car park	10170	437	4,444,500.00
Market	377	498	187,980.00
Total construction cost			55,213,320.00
Other-than-construction costs			
Roads to complex			40,000.00
Complex walls, security house and doors			600,000.00
Landscape and clearance			2,950,000.00
In-complex roads, car parks			400,000.00
Walkways			200,000.00
Total other-than-construction costs			4,190,000.00
Total construction costs			59,403,320.00
Project, management and marketing costs			
Architecture, engineering services -			500,000.00
Permits+Title Deed+Insurance+Construction supervision costs			350,000.00
Installation and consultancy services			450,000.00
Marketing and sample house costs -			2,756,000.00
Management+construction site overheads			2,474,000.00
Opening costs			100,000.00
Other costs			300,000.00
Total development and marketing costs			6,930,000.00
Land cost			42,120,000.00
Total ınvestment cost _			108,453,320.00

envisaged to be completed in one year and sales procedures in two years. Independent variables and probability distributions of DCF model are given in Figure 7.

Annex 2a. DCF Model MSKP basic case (2009-2010).

	Years		**2009**				**2010**			
	Periodical inflation rate		**2.00%**							
Mimar Sinan Kent Plus										
Cash flow table	**Periods**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Project revenues		**Total**	**2009 1st Period**	**2009 2nd Period**	**2009 3rd Period**	**2009 4th Period**	**2010 1st Period**	**2010 2nd Period**	**2010 3rd Period**	**2010 4th Period**
Sales revenues										
Area marketable for housing	96320									
Area marketable for offices	390									
Mean unit size (m^2)	120									
No on units	660 houses+ 6 offices									
Unit sales value for housing (TL/m^2)	1500									
Unit sales value for offices (TL/m^2)	2500									
Periodical sales areas for housing (m^2)						19264	19264	9632	9632	19264
Occupancy rate of housing		100%				20%	20%	10%	10%	20%
Periodical sales areas for offices (m^2)						70.2	70.2	35.1	35.1	70.2
Occupant rate for offices		90%				18%	18%	9%	9%	18%
Total housing revenue (TL)						31277959.7	31903518.89	16270794.63	16596210.53	33856269.47
Total office revenue (TL)						189966.8441	193766.181	98820.75229	100797.1673	205626.2214
Total real estate gyo revenue (TL)						31467926.54	32097285.07	16369615.39	16697007.69	34061895.69
Project costs										
Land costs (TL)		42120000	42962400							
Distribution of costs (%)		100%	100%							
Development marketing (TL)		6930000	1413720	1441994.4	1470834.288	3000501.948				
Distribution of expenditures (%)		100%	20%	20%	20%	40%				
Construction (TL)		59403320	18177415.92	30901607.06	6303927.841	6430006.398				
Distribution of costs (%)		100%	30%	50%	10%	10%				
Total project costs (TL)		108453320	62553535.92	32343601.46	7774762.129	9430508.345				
Real estate cash flow										
Real estate cash flow (TL)		2087530	-62553535.92	-32343601.46	-7774762.129	22037418.19	32097285.07	16369615.39	16697007.69	34061895.69
Real estate cumulative balance (TL)			-62553535.92	-94897137.38	-102671899.5	-80634481.32	-48537196.25	-32167580.86	-15470573.17	18591322.53

Annex 2a. Cont'd

VAT										
Revenue VAT(TL)	1%	1659079				314679	320973	163696	166970	340619
Expenditure VAT(TL)	18%	-20178433	-11259636	-5821848	-1399457	-1697492				
VAT reimbursement (TL)								17000000		
VAT Balance			-11259636.47	-5821848.264	-1399457.183	-1382812	320972.8507	17163696	166970	340618.9569
Total Balance VAT Inc. (TL)			-72365855.28	-36683438.8	-8645071.76	19081663.24	29362215	29776621	14681107.5	29362215
Cumulative VAT balance (TL)			-72365855.28	-109049294.1	-117694365.8	-98612702.6	-69250487.6	-39473866.6	-24792759.1	4569455.897
Real discount rate (Periodical-quarterly)	3.0%									
Net current value	12,188,046.72 TL									
İnternal rate of return	5%									

Annex 2b. DCF Model MSKP basic case (2011).

		Years	**2011**			
		Periodical ınflation rate				
Mimar Sinan Kent Plus						
Cash flow table	**Periods**		**9**	**10**	**11**	**12**
Project revenues		**Total**	**2011 1st Period**	**2011 2nd Period**	**2011 3rd Period**	**2011 4th Period**
Sales revenues						
Area marketable for housing	96320					
Area marketable for offices	390					
Mean unit size (m^2)	120					
No on units	660 houses+ 6 offices					
Unit sales value for housing (TL/m^2)	1500					
Unit sales value for offices (TL/m^2)	2500					
Periodical sales areas for housing (m^2)			9632	9632		
Occupancy rate of housing		100%	10%	10%		
Periodical sales areas for offices (m^2)			35.1	35.1		39
Occupant rate for offices		90%	9%	9%		
Total housing revenue (TL)			17266697.43	17612031.38	0	0
Total office revenue (TL)			104869.3729	106966.7604	0	123653.575
Total real estate GYO revenue (TL)			17371566.8	17718998.14	0	123653.575
Project costs						
Land costs (TL)		42120000				

Annex 2b. Cont'd.

Distribution of costs (%)		100%				
Development marketing (TL)		6930000				
Distribution of expenditures (%)		100%				
Construction (TL)		59403320				
Distribution of costs (%)		100%				
Total project costs (TL)		108453320				
Real estate cash flow						
Real estate cash flow (TL)		2087530	17371566.8	17718998.14	0	123653.575
Real estate cumulative balance (TL)			35962889.33	53681887	53681887.47	53805541.05
VAT						
Revenue VAT(TL)	1%	1659079	173716	177190	0	1237
Expenditure VAT(TL)	18%	-20178433				
VAT reimbursement (TL)						
VAT balance			173716	177190	0	1237
Total balance VAT Inc. (TL)			14681107.5	14681107.5	0	98475
Cumulative VAT balance (TL)			19250563.4	33931670.9	33931670.9	34030145.9
Real discount rate (Periodical-quarterly)	3.0%					
Net current value	12,188,046.72 TL					
İnternal rate of return	5%					

Annex 3a. DCF Model for MSKP worst case (2009-2010).

	Years		2009				2010			
	Periodical inflation rate		5.00%							
Mimar Sinan Kent Plus										
Cash flow table	**Periods**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Project revenues		**Total**	**2009 1st Period**	**2009 2nd Period**	**2009 I3rd Period**	**2009 4th Period**	**2010 I1st Period**	**2010 2nd Period**	**2010 3rd Period**	**2010 4th Period**
Sales revenues										
Area marketable for housing	96320									
Area marketable for offices	390									
Mean unit size (m^2)	120									
No on units	660 Housing + 6 Offices									
Unit sales value for housing (TL/m^2)	1250									
Unit sales value for offices (TL/m^2)	2500									

Annex 3a. Cont'd

Periodical sales areas for housing (m^2)						17337.6	17337.6	8668.8	8668.8	17337.6
Occupancy rate of housing		90%				18%	18%	9%	9%	18%
Periodical sales areas for offices (m^2)						70.2	70.2	35.1	35.1	70.2
Occupant rate for offices		90%				18%	18%	9%	9%	18%
Total housing revenue (TL)						26342451.45	27659574.02	14521276.36	15247340.18	32019414.38
Total office revenue (TL)						189966.8441	193766.181	98820.75229	100797.1673	205626.2214
Total real estate gyo revenue (TL)						26532418.29	27853340.2	14620097.11	15348137.35	32225040.6
Project costs										
Land costs (TL)		42120000	44226000							
Distribution of costs (%)		100%	100%							
Development marketing (TL)		6930000	1455300	1528065	1604468.25	3369383.325				
Distribution of expenditures (%)		100%	20%	20%	20%	40%				
Construction (TL)		59403320	18712045.8	32746080.15	6876676.832	7220510.673				
Distribution of costs (%)		100%	30%	50%	10%	10%				
Total project costs (TL)		108453320	64393345.8	34274145.15	8481145.082	10589894				
Real estate cash flow										
Real estate cash flow (TL)		2087530	-64393345.8	-34274145.15	-8481145.082	15942524.3	27853340.2	14620097.11	15348137.35	32225040.6
Real estate cumulative balance (TL)			-64393345.8	-98667490.95	-107148636	-91206111.74	-63352771.53	-48732674.42	-33384537.07	-1159496.472
VAT										
Revenue VAT(TL)	1%	1513754				265324	278533	146201	153481	322250
Expenditure VAT(TL)	18%	-21192935	-11590802	-6169346	-1526606	-1906181				
VAT reimbursement (TL)								17000000		
VAT balance			-11590802.24	-6169346.127	-1526606.115	-1640857	278533.402	17146201	153481	322250.406
Total balance VAT Inc. (TL)			-72365855.28	-36683438.8	-8645071.76	11766017.29	22042059.08	23704500.73	11016711.01	22029287.68
Cumulative VAT balance (TL)			-72365855.28	-109049294.1	-117694365.8	-105928348.5	-83886289.46	-60181788.74	-49165077.73	-27135790.05
Real discount rate (Periodical-quarterly)	3.5%									
Net current value	-23,333,290.78 TL									
Internal rate of return	-1%									

Annex 3b. DCF Model for MSKP worst case (2011).

	Years		2011			
	Periodical inflation rate					
Mimar Sinan Kent Plus						
Cash flow table	**Periods**		**9**	**10**	**11**	**12**
Project revenues		**Total**	**2011 1st Period**	**2011 2nd Period**	**2011 3rd Period**	**2011 4th Period**
Sales revenues						
Area marketable for housing	96320					
Area marketable for offices	390					
Mean unit size (m^2)	120					
No on units	660 Housing+ 6 Offices					
Unit sales value for housing (TL/m^2)	1250					
Unit sales value for offices (TL/m^2)	2500					
Periodical sales areas for housing (m^2)			8668.8	8668.8		
Occupancy rate of housing		90%	9%	9%		
Periodical sales areas for offices (m^2)			35.1	35.1		39
Occupant rate for offices		90%	9%	9%		
Total housing revenue (TL)			16810192.55	17650702.18	0	0
Total office revenue (TL)			104869.3729	106966.7604	0	123653.575
Total real estate gyo revenue (TL)			16915061.92	17757668.94	0	123653.575
Project costs						
Land costs (TL)		42120000				
Distribution of costs (%)		100%				
Development marketing (TL)		6930000				
Distribution of expenditures (%)		100%				
Construction (TL)		59403320				
Distribution of costs (%)		100%				
Total project costs (TL)		108453320				
Real estate cash flow						
Real estate cash flow (TL)		2087530	16915061.92	17757668.94	0	123653.575
Real estate cumulative balance (TL)			15755565.45	33513234	33513234.39	33636887.96
VAT						
Revenue VAT(TL)	1%	1513754	169151	177577	0	1237
Expenditure VAT(TL)	18%	-21192935				

Annex 3b. Cont'd.

VAT reimbursement (TL)					
VAT balance		169151	177577	0	1237
Total balance VAT Inc. (TL)		11012635.73	11010684.99	0	69543.48681
Cumulative VAT balance (TL)		-16123154.32	-5112469.322	-5112469.322	-5042925.835
Real discount rate (Periodical-quarterly)	3.5%				
Net current value	-23,333,290.78 TL				
Internal rate of return	-1%				

Implementation

Crystal Ball software was used for of the simulation process in the present study. The program can be run when the cost and discounted cash flow account model of the housing development investment is developed (Annex-1, Annex-2 and Annex-3). In a real estate development project, NPV and IRR depend on annual cash inflows and cash outflows of the project. In this case, the variables that constitute and impact cash inflows and outflows of the project are independent variables, which determine the dependent variables, NPV and IRR. Therefore, NPV and IRR are taken as dependent variables in the DCF model. When MCS is applied to the DCF model of the MSKP housing development project according to the probability distribution of the selected dependent variables (Figure 7), the following NPV graph is produced (Figure 8).

At the end of the simulation, NPV was found to be within the range -7.407.246 TL (-4.844.504$) 18.385.504 TL (12.024.528 $) with a 95.4% probability. The wide range of NPV values and the variability coefficient of 1.17 show that the predicted distribution represents a high level of risk to the project. The possibility of a positive NPV was calculated as 79.39% (Figure 8).

IRR will be in 3-5% range with 68% probability. The probability of an IRR above 3% is 80.08% (Figure 9). Sensitivity analysis shows that NPV and IRR are most sensitive to the following variables.

Sensitivity analysis shows that, NPV is sensitive to unit sales value with 61.4% probability, construction cost with 17.2% probability, discount rate with 0.8% probability and apartment occupancy rate with 7.6% probability; IRR is sensitive to unit sales value with 64.6% probability, construction cost with 20.4% probability, housing occupancy with 8.3% probability and land cost with 6.4% probability (Figure 10).

The level of risk calculated within the basic case analysis indicates that there is also a need to determine the potential risks under a worst-case scenario. In the worst case, it is assumed that periodical inflation will rise to 5%, that this rise will suppress housing demand, and that unit sales value will decrease to 1250 TL (817 $) for apartments and to 2500 TL (1635 $) for office space. In this case, the real discount rate has been taken as 3.5% with 0.5 point increase. Occupancy rate has been taken as 90% for housing and offices. The discounted cash flow model was revised, based on this information (Annex-3). MCS was applied for the variables of the MSKP housing development project on the basis of a worst-case scenario.

Following the worst-case simulation, NPV was found to be within the range -17.851.759 TL (-11.675.447 $) to -34.218.471 TL (-22.379.641 $) with 95.4% probability. The model indicated zero probability of a positive NPV. In the worst-case scenario of an investment of approximately 110 billion TL, the project is likely to make a loss of 34.2 billion TL (Figure 11).

As indicated in Figure 12, the worst-case model suggests a 68% probability that IRR will be in the range of 2-0%. The model predicts that there is zero probability of an IRR value larger than the real discount rate.

Sensitivity analysis showed that NPV is sensitive to unit sales value by 29.1%, to construction cost by 26.4%, to housing occupancy rate by 24.8% and to land cost by 12.1%; IRR is sensitive to unit sales value by 36.6%, to housing occupancy rate by 30.6%, to construction cost by 21.0% and to land cost by 8.6% (Figure 13).

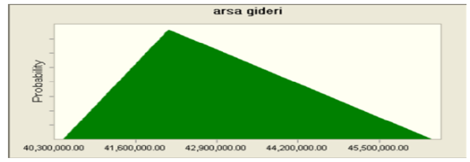
CONCLUSIONS AND DISCUSSION

According to project scenario analysis and MCS results, the variable to which NPV is most sensitive is sales value. When inflation is taken as a fixed figure, it has scarcely any impact on the investment. In development projects with a high number of housing units, unit sales value of housing has huge impacts on the project risk. Therefore, it can be concluded that close monitoring of changes in the unit sales price is of great importance for the investment, particularly in development projects with a high number of

Basic case (normal economic condition) variables and probability distributions

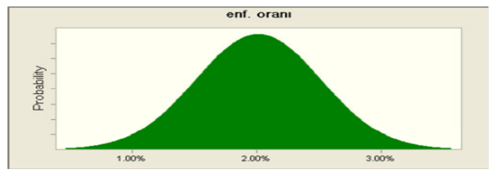
1 Land cost (TL) [1]

Min : 40.435.200,00
Opt.: 42.120.000,00
Max: 46.332.000,00



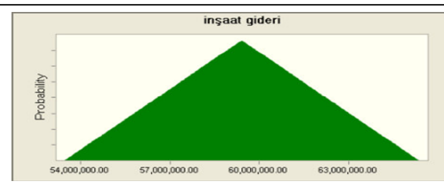
2 Periodical inflation rate

Mean: 2.0%
S.D: 0.5%



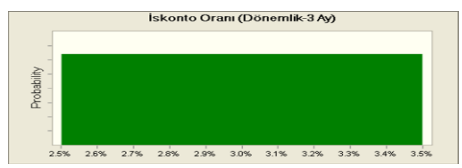
3 Construction cost (TL)

Min : 53.462.988,00
Opt.: 59.403.320,00
Max: 65.343.652,00



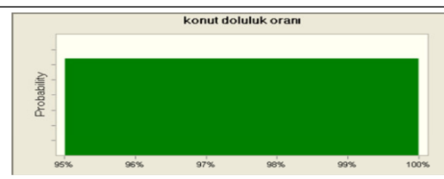
4 Discount rate (periodical-quarterly)

Min: 2.5%
Max: 3.5%



5 Housing occupancy rate

Min : 95%
Max: 100%



6 Unit sales price of housing (TL)

Min : 1.300,00
Opt.: 1.500,00
Max: 1.600,00

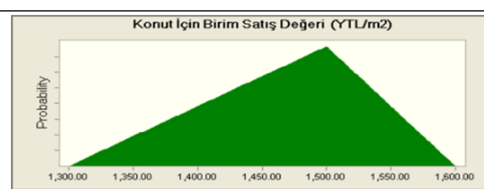
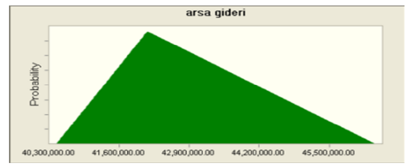


Figure 7. Probability distribution of variables used in the model.

Worst case (crises) distribution and probability distributions

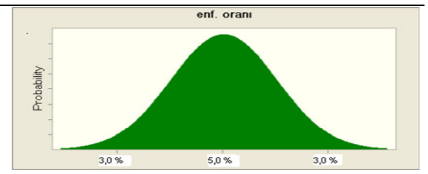
1 Land cost (TL)

Min : 40.435.200,00
Opt.: 42.120.000,00
Max: 46.332.000,00



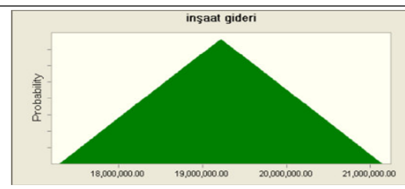
2 Periodical inflation rate

Mean: 5.0%
S.D: 1.0%



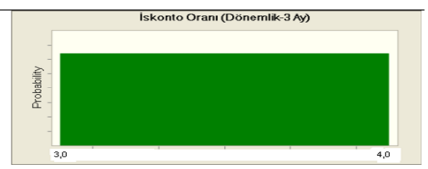
3 Construction cost (TL)

Min : 56.433.154,00
Opt.: 59.403.320,00
Max: 65.343.652,00



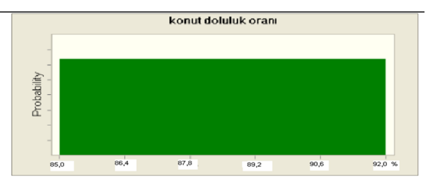
4 Discount rate (periodical-quarterly)

Min: 3.0%
Max: 4.0%



5 Housing occupancy rate

Min : 85%
Max: 92%



6 Unit sales price of housing (TL)

Min : 1.900,00
Opt.: 2.000,00
Max: 2.200,00

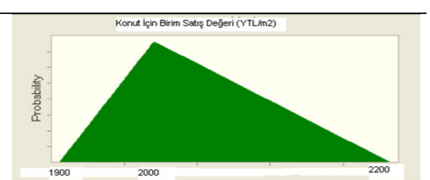


Figure 7. Cont'd.

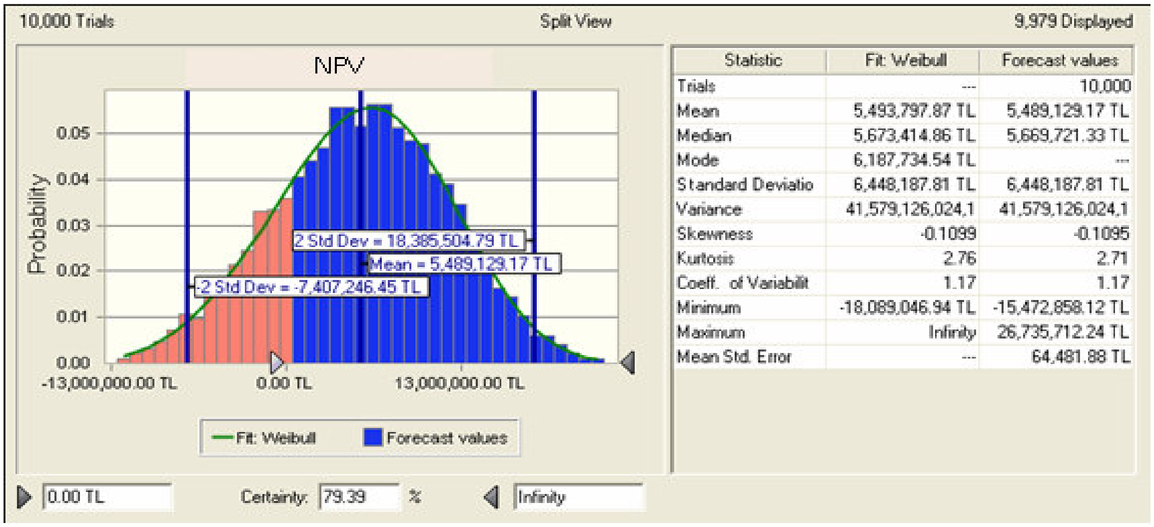


Figure 8. NPV Distribution of MSKP basic case.

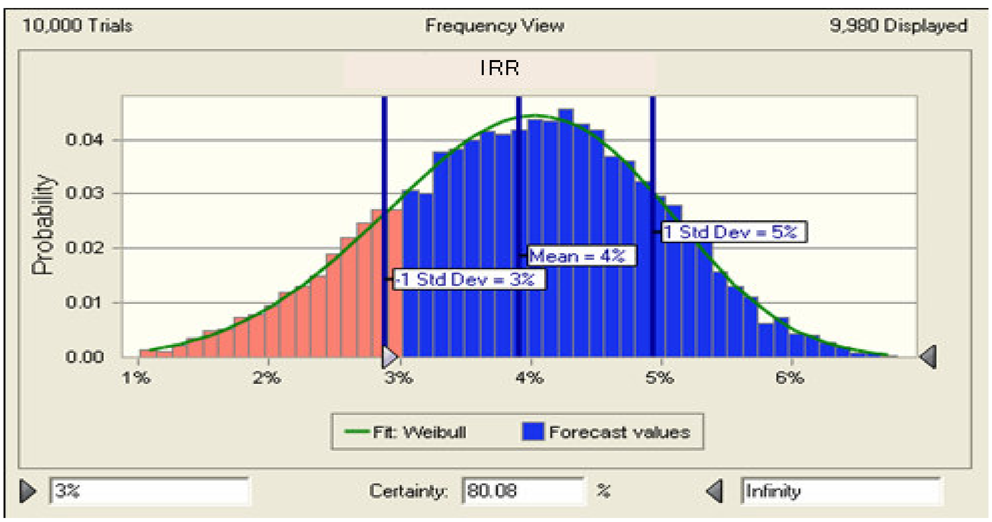


Figure 9. IRR Distribution of MSKP basic case.

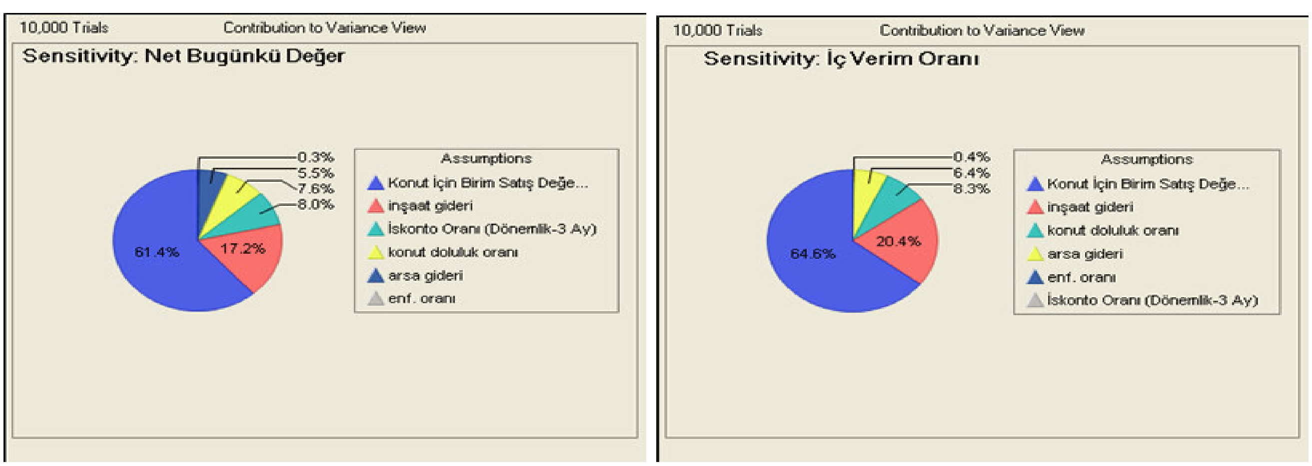


Figure 10. NPV and IVO sensitivity analysis of MSKP basic case.

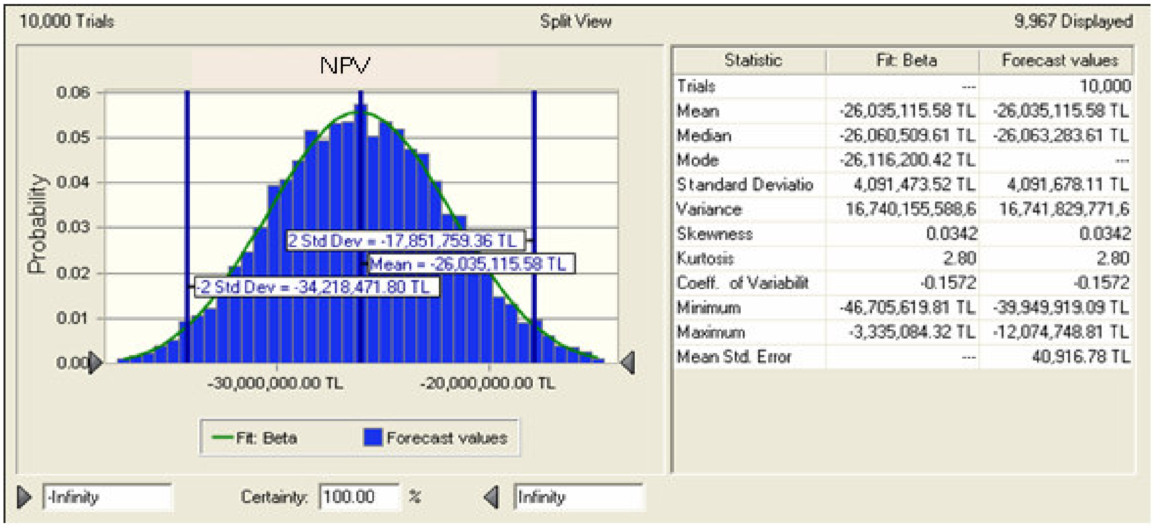


Figure 11. NPV distribution of MSKP worst case.

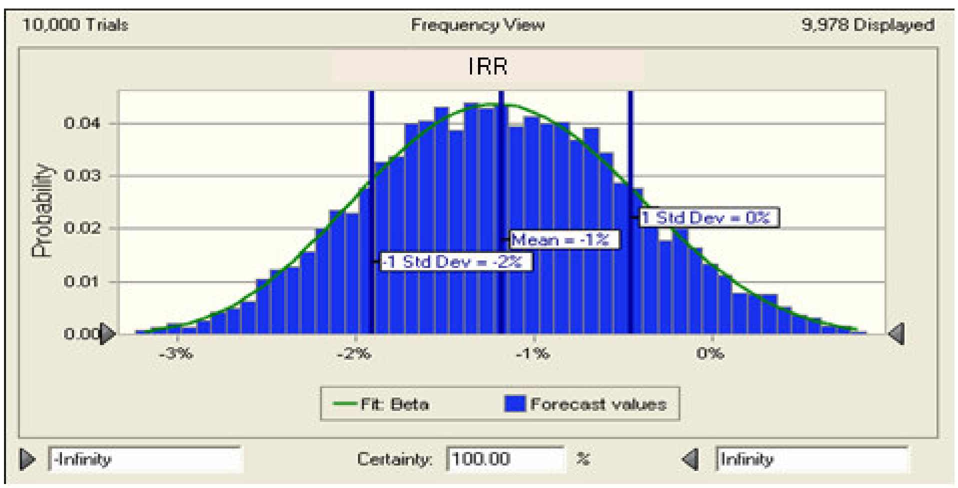


Figure 12. IRR Distribution of MSKP worst case.

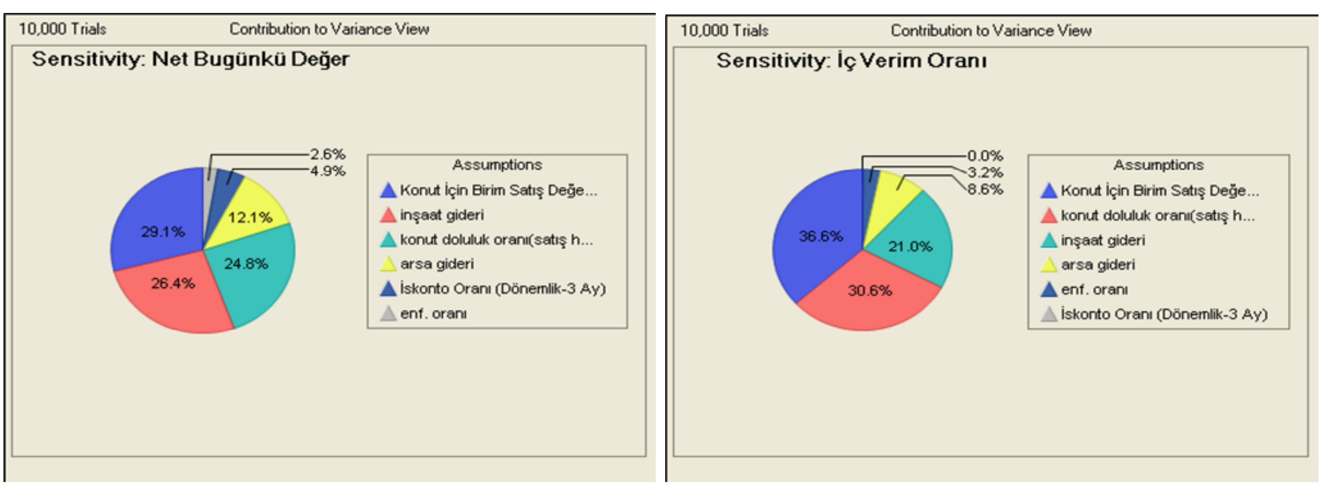


Figure 13. NPV and IRR sensitivity analysis of MSKP worst case.

Table 1. Risk analysis results in the framework of MSKP scenario analysis.

Risk analysis: Mimar Sinan kent plus project	Probability of positive NPV (%)	Probability of an IRR higher than discount rate (%)	Four variables to which NPV is most sensitive	Four variables to which IRR is most sensitive
Worst case	---	---	- Unit sales value - Construction cost - Occupancy rate - Land cost	- Unit sales value - Occupancy rate - Construction cost - Land cost
Basic case	79.39	80.08	-Unit sales value - Construction cost - Discount rate - Occupancy rate	- Unit sales value - Construction cost - Occupancy rate - Construction cost
Best case	Not needed since profit probability is high in the basic case.			

housing units, such as MSKP. In addition, changes in construction cost, occupancy rate and land costs should be monitored. Firms and organizations involved in housing development projects should closely monitor the unit sales values applicable in the locations in which they invest. This turns out to be the key factor for success in housing development, because the changes in the unit sales price of the project are effective on NPV and IRR at 61-65% level under normal economic conditions (basic case) and at 29-36% level in times of crises. In times of crises, unit sales value is less effective as it gets closer to cost price.

Developers and companies investing within an environment that experiences heavy global competition are exposed to various risks. In this scope, risk analysis (which is the process of defining the profit and loss range of an investment in the framework of a statistical analysis (Table 1)) gains increased importance for the logical and efficient utilization of resources in project development and appraisal. One of the prerequisites of accurate risk analysis and mitigating risks in project development process is to establish an effective intercompany risk management system. In such risk management systems, the risk analysis method presented in this study should be adopted, using data obtained from proper and large-scale market research. A risk management system should be structured such that it enables quick access to the required data and to make fast and correct decisions on the basis of data analysis.

Housing credits and mortgage-based housing financing systems are regarded as a driving force of developed economies. However, economic crises which have affected the real estate market show that developed countries have some problems in directing and managing their real estate markets. Developers play a significant role in directing the real estate market, efficient utilization of resources and the introduction of a reliable and effective structure for the market. With the commencement of risk analysis and risk management at the housing development phase, potential changes in the housing sector and economy can be monitored via simulation and necessary responses can quickly be implemented. The use of risk management to allocate funding to efficient projects will guide development of the real estate market and contribute to mitigation of risks that may otherwise affect the national economy

REFERENCES

Atherton E, French N, Gabrielli L (2008), Decision Theory and Real Estate Development: A Note On Uncertainty, J. Eur. Real Estate Res., 1(2): 162-182.

Au SK, Wang ZH, Lo SM (2007). Compartment fire risk analysis by advanced Monte Carlo simulation, Eng. Structures. September, 29(9): 2381-2390.

Ayinde OE, Omotesho OA, Adewumi MO (2008). Risk attitudes and management strategies of small - scale crop producer in Kwara State, Nigeria: A ranking, J. Bus. Manage., 2 (12): 217-221

Baroni M, Barthélémy F, Mokrane M (2005). Monte Carlo Simulations versus DCF in Real Estate Portfolio Valuation, ERES Conference, in Dublin (Ireland), June.

Bostanci B (2008). Taşınmaz Geliştirmede Değer Kestirim Analizleri ve İstanbul Konut Alanı Örneğinde Bir Uygulama, Doktora Tezi, İstanbul

Brown I, Steen A, Foreman J (2009). Risk Management in Corporate Governance: A Review and Proposal, Corporate Governance-An Int. Rev., 17(5): 546-558

Chapman C, Ward S (1997). Project Risk Management, John Wiley and Sons, West Sussex, England.

Chou JS, Yang T, Chong WK (2009). Probabilistic simulation for developing likelihood distribution of engineering project cost, Automation Construction, 18(5): 570-577

Clifton DS, Fyffe DE (1977). Project Feasibility Analysis, John Wiley and Sons Inc., New York.

Evans MD (1992). Expected returns, time-varying risk and risk premia, working paper, Stern School of Business, New York University.

Fikirkoca M (2003). Bütünsel Risk Yönetimi, Kalder - Pozitif Yayıncılık, Ankara.

Flanagan R, Norman G (1993). Risk management and construction, Backwell Scientific, Cambridge.

French N (2007). Valuation uncertainty: common professional standarts and methods, 13 th Pasific-Rim Real Estate Society Conference, 21 to 24 January, Fremantle, Western Australia,

French N, Gabrielli L (2005). Discounted cash flow: accounting for uncertainty, J. Property Investment Fin., 23(1): 75-89.

Kleczyk E (2008). Risk management in the development of new products in the pharmaceutical industry, Afr. J. Bus. Manage., 2(10): 186-194.

Lindley DV (1985). Making Decision, John Wiley and Sons, New York.
McGill WL, Ayyub BM, Kaminskiy M (2007). Risk analysis for critical asset protection, Risk Anal., 27(5): 1265-1281.
Öztaş A, Ökmen Ö (2004). Risk analysis in fixed-price design–build construction projects Building Environ., 39(2): 229-237.
Öztaş A, Ökmen Ö (2005). Judgmental risk analysis process development in construction projects", J. Building Environ., 40(9): 1244-1254.
Rezaie K, Amalnik MS, Gereie A, Ostadi B, Shakhseniaee M (2007). Using extended Monte Carlo simulation method for the improvement of risk management: Consideration of relationships between uncertainties, Appl. Math. Computation, 190: 1492-1501
Sadiq R, Rajani B, Kleiner Y (2004). Probabilistic risk analysis of corrosion associated failures in cast iron water mains, Reliability Eng. Syst. Safety, 86(1): 1-10
Sarıaslan H (1997). Yatırım Projelerinin Hazırlanması ve Değerlendirilmesi, Turhan Kitabevi, Ankara.
Tevfik AT (1997). Risk Analizine Giriş, Alfa Basım Yayım Dağıtım Ltd.Şti, İstanbul.
Wellner K (2003). Entwicklung eines Immobilien-Portfolio-Management-Systems, Herstellung Books on Demand GmbH, Norderstedt.
Weston FJ, Brigham FE (1977). Essentials of Managerial Finance, Third Edition, The Dryden Press, Hindshale.
You K, Park Y, Lee JS (2005). Risk analysis for determination of a tunnel support pattern Tunnelling and Underground Space Technology. 20(5): 479-486 [URL 1]: http://www.uptofuture.at/files/03_risikomanagement.pdf, 04/2009 [URL 2]: http://www.unece.org/trans/doc/2006/wp15/06OCTOINF8E.pdf, 02/2010[URL 3]: http://www.vertex42.com/ExcelArticles/mc/MonteCarloSimulation.html , 8/2006