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Economic evaluation and comparison of the development of different residential space types in new towns (Case study: Residential investment packages in Eyvanekey new town)

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ABSTRACT

The attractiveness of cities, the concentration of industrial activities have resulted in rural-urban migrations or migrations from small cities to metropolitan areas, sometimes causing existing metropolises not to be unable to meet their citizens' needs. Therefore, it's necessary to develop some plans to satisfy Eyvanekey needs. One of the solutions is to develop new town development plans. Eyvanekey New Town, located in the eastern part of Tehran and near numerous industrial towns, has been planned and developed to accommodate the overspill of Tehran, and the workers of the industrial sector in this area, as well as a new settlement for the local people of Eyvanekey. Considering the high costs of construction and planning of urban projects including housing, it's required to conduct feasibility studies and related economic evaluations in different dimensions before any investment to ensure their efficiency and effectiveness. this study aims to economically evaluate and compare the development of different types of residential spaces in Eyvanekey NewTown. For this purpose, various economic indicator calculation methods are used in Excel software, and four types of residential space are considered, including 1-A moderate-density 50-unit residential complex project,2-A moderate-density 100-unit residential complex project with a mix of residential, commercial, and local services uses,3-A moderate-density particular residential project for special habitations in the form of a two-story 8-unit building, and finally,4-A low-density residential villa complex project. Examining Financial-economic indicators, including net present value, benefit-cost ratio, internal rate of return, payback period, and annual worth, indicate that these projects are financially feasible. Moreover, according to the variety of residential types, diversity of investment amounts, civil participation, and the employer's share of land worth, the land cost is also removed from the projects, resulting in the enhanced attractiveness of investments.

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1. Introduction

The rapid population growth in the world, on the one hand, and the Industrial Revolution and the increasing trend towards urbanization, on the other hand, have caused mass rural-to-urban migration and rapid urban population growth across the world, including in Iran. The concentration of industrial centers and job opportunities in cities, especially metropolises, have led to people's increased tendency to migrate to these places, resulting in their rapid population growth. In many cases, this occurred when the cities' sphere of influence could not meet newcomers' residential needs. On the other hand, such population growth in a short period has made cities and their residents experience many cultural, social, and economic problems (Eskandari, 2022).

The uncontrolled growth of big cities, the problems induced by future urbanization, and the increasing impact of the concentration of various activities have caused the Ministry of Housing and Urban Development of Iran to try to find solutions to solve these in recent years, making the ministry to consider three "Empowerment of fabrics within the cities to properly attract population and prevent the evacuation of old fabrics", "Preparation of the areas around cities while protecting agricultural lands and environmental resources," and "New town development" policies (Gharakhloo et al., 2009; Hosainzadeh Dalir et al., 2011) serious solutions to abovementioned problems. So, new towns were established with goals such as creating growth poles, spatial organization, attracting overspill, controlling the growth of metropolises, moving political-administrative centers, preventing the destruction of agricultural lands, developing underdeveloped areas, decentralization, and spatial distribution of industries and population. Accordingly, regarding new town development, the Ministry of Roads and Urban Development attempted to recognize capabilities and weaknesses, determine the needs, and ratify some laws based on local and national values to enact an approval, according to which the New Towns Development Company was established in 1989 (Hosainzadeh Dalir et al., 2011). In line with these policies, Eyvanekey New Town was located in the north of an old city with the same name, the east of the Eyvanekey-Absard Road, and the north of Eyvanekey-Garmsar Road, and it was approved to have a maximum population of 50,000 people. According to the Eyvanekey New Town Preparation Plan, it is located northeast of Eyvanekey City, next to the Tehran-Garmsar Road, with an area of approximately 800 hectares. Considering the location and characteristics of Eyvanekey New Town, tasks including meeting research, exhibition, and administrative needs of the industrial towns within the area with an approximate radius of 40 kilometers can be considered for Eyvanekey New Town. Also, the special policy considered for Eyvanekey New Town is to accommodate those working in the industrial axis east of Tehran (toward Garmsar) (Master Plan of Eyvanekey New Town, 2008). The abovementioned industrial axis includes Abbas Abad, Pishva, Kharazmi, Payetakht, Eyvanekey, Jannat Abad, Garmsar, Fajr, and Baharestan industrial towns, which are located at a maximum distance of 55 km from Eyvanekey New Town. According to the information on the s along the Tehran-Garmsar Road, more than 70 thousand people are working in these towns, and most of them commute to these towns from Tehran, Eyvanekey, Garmsar cities, and surrounding villages and towns. It should be noted that all these towns, except for the Eyvanekey industrial town with 280 households as tenants, are completely industrial and without housing cooperatives and residential uses, indicating a serious need for housing in them (Study Plan of 10 Investment Packages in Eyvanekey New Town, 2020). The important location of the area and the limitations of industrial development in Tehran City have caused Eyvanekey and Tehran cities to expand towards the axis in the east of Tehran City and the formation of special economic zones and industrial towns in the area. Also, the inability of the cities and residential areas near these industrial towns and Eyvanekey City to meet the housing needs of those working in these sectors and the lack of residential cooperatives inside these industrial towns have caused Eyvanekey New Town to be planned to meet the needs and remove the deficiencies of the region. In the Eyvanekey New Town Plan, several types of housing have been proposed for the residence of different people, employees, and managers, with different income levels and needs. In addition to the abovementioned, the old city of Eyvanekey cannot satisfy the needs of the youth and new settlements. So, considering the importance of housing planning, development, and construction for different groups active in the industrial sector as well as the different needs of the youth of Eyvanekey city for new housing, four housing types, including 50-unit residential complex, 100-unit residential complex, special residential complex (2-story 8-unit building), and residential villa complexes have been proposed. Considering the high costs of the plans, it is required to carry out feasibility studies and relevant economic evaluations in various dimensions to ensure the effectiveness and efficiency of projects before any investment or action. Therefore, the present study aims to economically analyze these residential projects to assess the resulting economies considering the profit and loss of their establishment to justify the public and private sectors to invest in them. There is no study exists on the economic evaluation of residential projects in new towns.

Some studies have addressed only the position of new towns in housing, and in general, there are few studies on the economic evaluation of residential projects. The following includes some of these studies. Gharakhloo et al. (2009), in their study entitled "New Towns Position in Housing Development", stated that new towns should be planned in such a way that they have an independent identity and an independent role and function should be defined for them to provide economies of scale, jobs, and productions to cover the expenses. Warasi and Ahmadi (2011), in their study, examined the performance of new towns in popularity with the case study of Majlesi New Town and stated that new towns, considering the goals of their establishment and their specific functions, have sometimes become a pole for attracting population and sometimes acted so poorly that they have failed in attracting people. The results of their research indicated that most of the residents of Majlesi New Town have settled in it for job opportunities, a calm environment, and affordable housing. Also, many feasibility studies have been carried out on residential development and construction for different groups in economic, social, etc. dimensions, among which one can refer to the feasibility study of social housing projects in Moldova in 2011, which evaluated different alternatives from an economic perspective and carried out a cost-benefit analysis. Claassens et al. (2019), in their study on the financial feasibility of residential development in existing cities, investigated the costs of densification and redevelopment of residential areas and its benefits and stated how the costs and benefits vary between locations, development options, and scenarios regarding future housing demand. Also, Diamond (2020), in his study entitled "The Costs and Benefits of Affordable Housing, A Partial Solution to the Conflict of Competing Goods, "states that in today's society, people bear many costs, due to the lack of adequate, affordable housing units. Public and private cost savings can bring many benefits by providing affordable housing, and if it is not provided, there will be a conflict of competing goods, meaning that this conflict occurs when there is a great variety of public goods to be obtained. However, there are not adequate resources to maximize them. Then, he assessed the high costs induced by the lack of such a housing model regarding its benefits and stated that the public costs of building such housing would be compensated over time by the housing itself, which is insignificant compared to the enormous costs spent to reduce the gap of the conflict in access to housing, and its construction is justified. Maske and Gaikward (2021), in their study entitled "Feasibility Study for a Residential Construction Project", financially examined a construction project to determine whether this project is feasible or not. For this purpose, they used the criteria of net present value, internal rate of return, and benefit-cost ratio, and the results indicated that the studied project would be feasible only in certain conditions. Also, Abastante et al. (2022), in their study on the economic evaluation of urban projects, addressed the conveying of the sustainability concept in the city and examined relevant techniques and methods. They stated that the economic evaluation of projects is influential in the structured organization of the decision processes, in addition to playing a critical role in defining the financial aspects of urban transformation. Moreover, it teaches future professionals how to direct the selection of urban projects. Generally, it should be mentioned that new towns should be developed for the overspill of metropolitan areas in such a way that they would be attractive to different classes in activity, economic, and social dimensions to reach their targeted performance. job and income attractions and low housing prices in them would encourage people to live and invest in them. Regarding people's housing needs, it should be tried to present cost-effective options, and the alternatives selected for residential projects must be confirmed to be rational through financial feasibility studies and cost-benefit analysis so that they can compensate for created expenses over time.

2. Material and Methods

2.1. Data analysis methods

The present study was conducted in the financial and market conditions in 2019. The revenues and costs, and sale and rental prices of the competitors by the uses in the project were discovered and predicted using the market research method and searching real estate websites. To carry out this research, various economic indicator calculation methods were used in Excel software. One of the essential aims of the feasibility study of projects is to

evaluate them economically, and every project, regardless of its type and size, must be cost-effective. Private and public projects are evaluated in somewhat different ways. For private projects, the maximization of the investor's profit is evaluated, and the social advantages and disadvantages of an investment may receive less attention. While, for public projects, since an investment aims to enhance the welfare of the public, the advantages and disadvantages of an investment to, that influence the public, are paid attention, and it is economically analyzed and assessed considering all its advantages and disadvantages (Tehran Urban Research and Planning Center, 2018). The following includes the definitions of the important indicators and methods used for the financial and economic evaluation of the projects studied in the present research.

2.1.1. Net Present Value (NPV)

The present value technique is one of the most important, albeit the simplest, engineering economy techniques. It is the basis of the application of other techniques. The present value of a financial process is calculated by converting the future value of all receipts and payments into the current value in the present or the project's origin (Oskoonejad, 2019). First, all costs and revenues, depending on when they will occur, are calculated with an appropriate interest rate according to Eq. 1:

$$\frac{R_t}{(1+i)^t} \quad (1)$$

Where *t* is the time when revenues are obtained, or costs are spent, *i* is the interest rate (product of the rate of profit by risk rate by the predictable inflation rate), and R_t denotes revenue or cost (net cash flow) at time t. Next, a net value, *NPV*, is obtained by subtracting the present value of costs (cash outflows) from the present value of revenues (cash inflows). If this value is positive, the project is profitable and acceptable. If it is negative, the project is unprofitable and economically unfeasible (Eslami, 2002), and if it is equal to zero, the project is not attractive itself, i.e., there is neither gain nor loss (Tahami Pour Zarandi and Safahan, 2021).

$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} - C_0 \quad (2)$$

Where $\sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$ denotes net cash inflows at time *t*, C_0 is total initial investment costs in the base year, *r* is the discount rate, and *t* is the number of periods.

2.1.2. Internal Rate of Return (IRR)

The Internal Rate of Return *(IRR)* refers to an interest rate that can balance revenue and cost and present the final efficiency of investment. This method is especially significant since it allows the use of the internal rate of return when there is no financial exchange market and a single rate of discount (Tahami Pour Zarandi and Safahan, 2021; derived from Lajvardi, 2010). The internal rate of return is a metric for indirectly evaluating the profitability of a project, because it determines the return on investment (*ROI*) (in percent) at the end of the investment, instead of the net benefit. The internal rate of return is a discount rate at which the *NPV* is zero. This metric is calculated by Eq 3:

$$NPV = \sum_{t=0}^{n} \frac{R_t - C_t}{(1+r)^t} - C_0 = 0 \quad (3)$$

Where C_t denotes the costs of the project in year *t*, R_t is the benefit of the project in year *t*, *r* is the discount rate, *n* is the service life of the project, and *t* is the time when the benefits are realized or costs are spent. If the net present value of a project is positive, it follows that the internal rate of return of that project is higher than the acceptable rate of return used for investment and vice versa. If the net present value of a project is negative, its internal rate of return is lower than its acceptable rate of return, and if the net present value of a project is zero, it follows that all the investments on the project, plus the accrued interest in each year, are returned, and the internal rate of return of that project is equivalent to its acceptable rate of return.

2.1.3. Payback Period (PBP)

The Payback Period *(PBP)* is one of the standard methods widely used for evaluating economic plans, due to its easy calculation, by many financial analysts. In this method, the project is evaluated based on the time it takes to recover the cost of an investment, that is, the length of time it takes for the initial investment (costs) on a project to equal its revenues. So, projects with shorter payback periods are more attractive than those with more extended ones. This method is mainly applied when two or more projects are compared. In the *PBP* method, the time value of money is not considered, and the cash flows are summed under the assumption of having the same value in different years. Since considering the time value of money enhances the accuracy and

precision of calculations, here, the discounted payback period (*DPBP*) index, instead of the *PBP* index, is defined, where the cash flows are summed after being discounted (Tehran Urban Research and Planning Center, 2018).

2.1.4. Benefit-Cost Analysis (B/C)

This metric is one of the important indices used in the economic evaluation of projects and is also known as the profitability ratio (Elahi et al., 2018). The benefit-cost analysis measures the costs and sources of a specific policy or executive project as much as possible. Since the cost sources of policies or executive projects are considered a financial issue, in the benefit-cost analysis, costs and benefits are measured in currency, and the data is quantitative (Peyravi, 2018).

$$\frac{B}{C}=\frac{\sum_{t=1}^{n}\frac{B_t}{(1+r)^t}+\frac{SV_n}{(1+r)^n}}{\sum_{t=0}^{n}\frac{C_t}{(1+r)^t}} \quad (4)$$

Where B_t is the benefits of the project in year t, C_t is the costs of the project in year t, SV_n is the salvage value of the project in year n, r is the discount rate, n is the service life of the project, and t is the time when benefits are realized. If this ratio is >1, the project is feasible, meaning that the *NPV* is >0, and if it is <1, the plan is unfeasible. If it is equal to one, there is no gain or loss. In addition to the economic evaluation of private investment projects, this method is a famous technique used to evaluate public investment projects (Oskoonejad, 2011).

2.2. Introduction of the case study

Eyvanekey New Town is located between Semnan and Tehran provinces. The important cities located in this area include Garmsar, Eyvanekey, Aradan, Firouzkoh, Kilan, Damavand, and Bomehen cities (Tohmak et al., 2022). Eyvanekey New Town was located in an area of about 2200 hectares in the north of an old city with the same name, east of the Eyvanekey-Absard Road, and north of Eyvanekey-Garmsar Road, and it was approved to have a maximum population of 50,000 people. According to the Eyvanekey New Town Preparation Plan developed by the Arseh Consulting Engineers, Eyvanekey New Town, with an area of about 800 hectares, was located northeast of Eyvanekey city, and its master plan was developed by the Part Consulting Engineers. This new town is next to the Tehran-Garmsar Road. Fig. 1 shows the distance from the industrial towns to the city of Ivanki (Study Plan of 10 Investment Packages in Eyvanekey New Town, 2020).

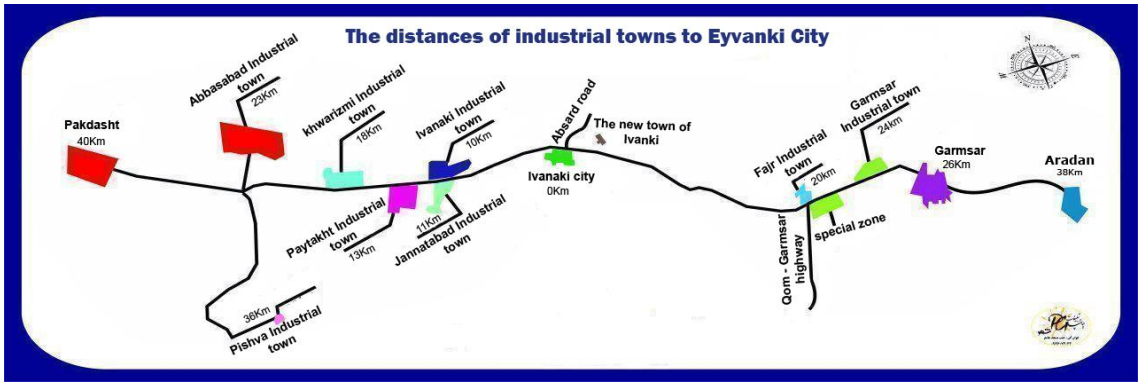

Fig. 1. The distances of industrial towns to Eyvanekey city

The residential spaces economically evaluated and compared in the present study are as follows:

1. A 50-unit residential complex project in a moderate-density residential area;
2. A moderate-density 100-unit residential complex project for mas building activities and meeting the conditions of housing cooperatives in an area with a mix of residential, commercial, and local services uses;
3. A moderate-density special residential project for special habitations in the form of a two-story, 8-unit building, and finally,
4. A low-density residential villa complex project.

It should be noted that the abovementioned projects are owned by the government, and investment can be performed in different forms, including public, private, or civil partnerships between the public and private sectors.

3. Results and discussion

As mentioned earlier, four different housing types were considered in the Eyvanky New Town Plan for workers, employees, and

managers working in industrial towns, and to meet the new residential needs of the youth, middle and upper classes of Eyvanekey City, and those who are working in nearby towns. In the following, the abovementioned economic indicators are evaluated to examine the feasibility of "50-unit residential complex", "100-unit residential complex", "special residential complex", and "residential villa complex" projects. Table 1 presents the specifications of the uses in these projects, including the built-up areas of the uses, parking, green, and open spaces.

Table 1. The physical plans and areas of the projects

	Use	Number of units	The floor area of each unit (m^2)	Gross floor area (m^2)	Net floor area/Gross floor area ratio	Net floor area (m^2)	Number of floors	Land area
50-unit residential complex	Residential-50	50	100	5,000	0.85	4,250	5	1,000
	Parking	50	25					1,250
	Green space and landscaping							250
	Total			5,000		4,250		2,500
100-unit residential complex	Residential-100	100	125	12,500	0.85	10,625	4	3,125
	Parking	116	25					2,900
	Commercial	20	40	800	0.65	520	1	800
	Greenspace and landscaping							3,175
	Total			13,300		111,45		10,000
Special residential complex	Special residential	8	100	800	0.85	680	2	400
	Parking	8	25					200
	Green space and landscaping							200
	Total			800	3	680		800
Residential villa complex	Residential villa	20	375	7,500	0.85	6,375	1.50	5000
	Parking	40	25					1,000
	Green space and landscaping							9,000
	Total			7,500		6,375		15,000

As seen in Table 1, the 50-unit residential complex, 100-unit residential complex, special residential complex, and residential villa complex projects have total floor area of 5000, 13300, 800, and 7500 m^2, respectively. Before estimating costs and revenues and performing relevant financial analyses, the most important computational assumptions in the financial evaluation of these investment packages, including study period (construction and sale), discount rate, inflation rate, unit land cost, unit construction cost, sale prices, and revenue generation strategies, which are based on the market conditions in 2019, are briefly presented for all four residential investment packages abovementioned.

3.1. Estimation of costs and revenues and benefit-cost analysis of the 50-unit residential complex investment package

According to the investigations on the 50-unit residential complex project, the construction period was considered to be two years, and the study period (construction and sale) was considered to be three years, which was proportional to the market. Also, the discount rate was considered equal to 25% by calculating the weighted average cost of capital, and the average inflation rate for the cost and revenue components was assumed to be equal to 15% according to the trends of adjustment indices and the consumer price index in recent years. The construction cost per m^2 for gross space, green space, and parking was estimated as 18, 2, and 2 million Rials, respectively. Also, the sale price per m^2 for residential space was considered to be 30 million Rials, and the land worth per m^2, considering the land size and the type of use, was considered to be 4 million Rials. Finally, it was assumed that the pre-sales

would be started in the first year. Table 2 presents the results of estimating the investment costs defined in the complex, and the assumptions considered.

Table 2. The results of estimating all investment costs defined in the 50-unit residential complex project (in million Rials).

Type of cost	Cost	Cost Share (%)
Land cost	10,000	9%
Building permit cost	750	1%
Construction costs	93,000	83%
Costs of design, engineering services, and supervision	4,650	4%
Costs of Service connections	1,860	2%
Transfer and sales costs	1,275	1%
Total	**111,535**	**100%**

As seen in the above table, the most important cost during the construction period is the construction costs, with a share of 83% of the total costs. The costs listed in this table indicate that the construction of this project in Eyvanekey New Town, considering the considered construction period, requires about 11 billion Tomans. Also, since this project was considered a cooperative and construction-sale one according to the employer's policy, it has no operational costs. In addition to various investment costs, the sales revenue of the 50-unit residential complex project should also be examined. For this purpose, Table 3 presents the project's sales revenues.

Table 3. Estimation of the sales revenue of the 50-unit residential complex project (million Rials).

Use	Net area/number	Sale price per m^2/unit	Revenue	Revenue Share (%)
50-unit Residential	4250	30	127,500	100%
Parking	1250	0	0	0.00%
Green space and landscaping	250	0	0	0.00%
Total	**5750**		**127,500**	**100%**

Table 3 shows that the services of the 50-unit residential complex project can generate a revenue of about 12.8 billion tomans. Considering the estimated costs, revenues, and their relevant periods, the cash flow of this project is estimated in the form of two charts of net cash flow in the normal mood and net cumulative in Figs 2 to 3.

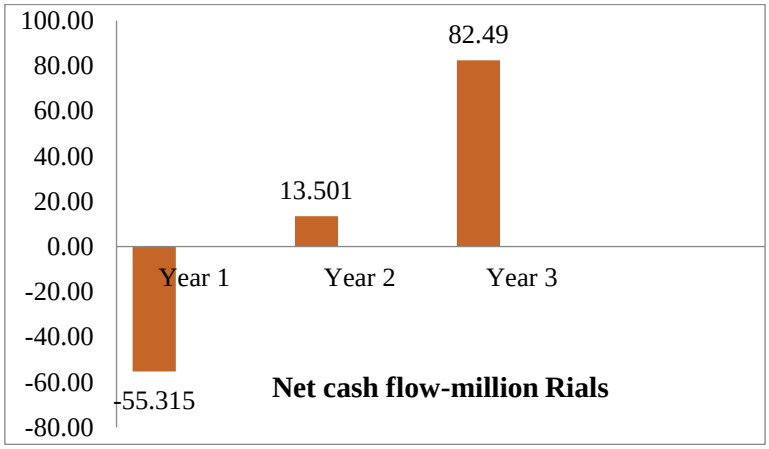

Fig. 2. Net cash flow of the 50-unit residential complex project

Fig. 2 shows that the cash flow will be negative in the first year, and it will be positive due to the pre-sold units since the second year. Also, Fig. 3 indicates that the cumulative revenues of the project in the third year will cover the total costs and be positive, indicating that the third year is the payback period of the project.

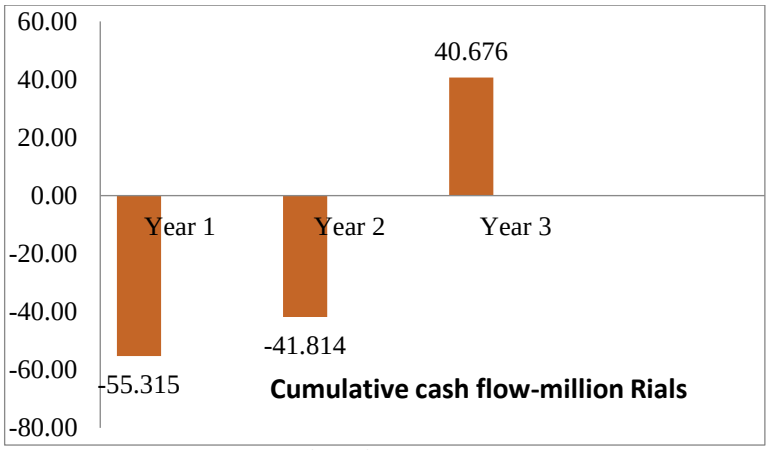

Fig. 3. Net cumulative cash flow of the 50-unit residential complex project

- Calculation of financial evaluation indices

According to the cash flow table of the project, various indices of the benefit-cost analysis were calculated, as listed in the table 4.

Considering the indices calculated for financial evaluation, this project, with an internal rate of return of about 34%, a net present value of about 628 million Tomans, and a payback period of about one year after the construction period, is considered feasible.

- Participation share and land value sensitivity analysis

Considering the importance of land price in participation investment, as equity capital of the employer or New Town Development Company, this section presents land value sensitivity analysis to show how changes in land price affect financial indices and the employer's participation share. Table 5 shows the Land price sensitivity analysis for the 50-unit residential complex project. Also, Fig.4 shows Changes in the adjusted internal rate of return versus land price changes in the 50-unit residential complex project.

Table 4. The financial indices evaluated for the 50-unit residential complex project

Index	Acronym	Unit	Result
Net Present Value (Total Profit)	NPV	Million Rials	6.289
Benefit/Cost ratio	B/C	Ratio	1.06
Internal Rate of Return	IRR	Percent	33.60%
Payback Period (since operation)	PBP	Number of years	1
Annual Worth (Annual Profit)	AW	Million Rials	3,222

Table 5. Land price sensitivity analysis for the 50-unit residential complex project

Option	Land price (million Rials)	NPV	MRR	The employer's participation share
Original option	4	6,289	33.60%	10.00%
Option 1	5	3,989	30.20%	12.10%
Option 2	6	1,689	27.10%	14.00%
Option 3	7	-611	24.30%	15.90%

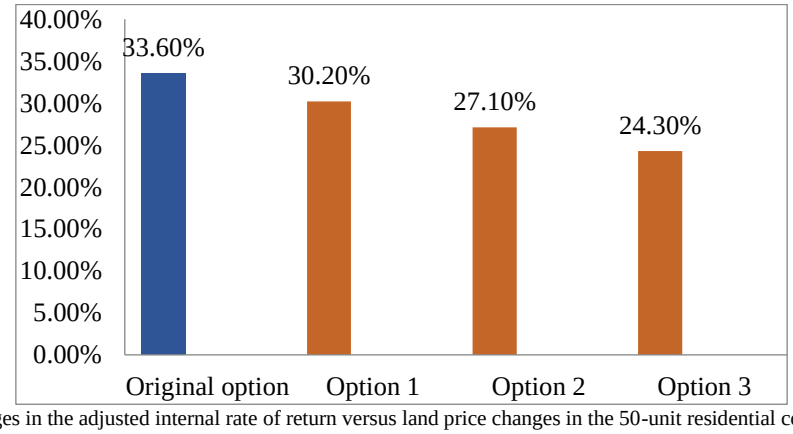

Fig. 4. Changes in the adjusted internal rate of return versus land price changes in the 50-unit residential complex project

3.2. Estimation of costs and revenues and benefit-cost analysis of the 100-unit residential complex investment package

According to the investigations on the 100-unit residential complex project, the construction period was considered to be three years, and the study period (construction and sale) was considered to be four years, which was proportional to the market. Also, the discount rate was considered equal to 25% by calculating the weighted average cost of capital, and the average inflation rate for the cost and revenue components was assumed to be equal to 15% according to the trends of adjustment indices and the consumer price index in recent years. The construction cost per m^2 for gross space, green space, and parking was estimated as 18, 2, and 2 million Rials, respectively. Also, the sale price per m^2 was considered 30 for residential space and 80 million Rials for commercial space. The land worth per m^2, considering the land size and the type of use, was considered 4 million Rials. Finally, it was assumed that the pre-sales would be started in the second year. Table 6 presents the results of estimating the investment costs according to the buildings required and defined in the complex, and the assumptions considered.

Table 6. The results of estimating all investment costs defined in the 100-unit residential complex project (in million Rials).

Type of cost	Cost	Cost Share (%)
Land cost	30,000	10%
Building permit cost	2,655	1%
Construction costs	248,375	82%
Costs of design, engineering services, and supervision	12,419	4%
Costs of Service connections	4,968	2%
Transfer and sales costs	3,604	1%
Total	**302,020**	**100%**

As seen in the above table, the most important cost during the construction period is the construction costs, with a share of 82% of the total costs. The costs listed in this table indicate that the construction of this project in Eyvanekey New Town, considering the considered construction period, requires about 30 billion Tomans. Also, since, like the 50-unit residential complex project, this project was considered a cooperative and construction-sale one, it does not have any operational costs.

Table 7. Estimating the sales revenue of the 100-unit residential complex project (million Rials).

Use	Net area/number	Sale price per m^2/unit	Revenue	Revenue Share (%)
100-unit residential	10625	30	318,750	88.5%
Parking	2500	0	0	0.0%
Commercial	520	80	41,600	11.5%
Green space and landscaping	3575	0	0	0.0%
Total	17220		360,350	100%

Table 7 shows that the services of the 100-unit residential complex project can generate a revenue of about 36 billion tomans, with residential and commercial uses with a share of 89% and 11% of this revenue, respectively. Considering the estimated costs, revenues, and their relevant periods, the cash flow of this project is estimated in the form of two charts of net cash flow in the normal mood and net cumulative flow in Fig 5 and 6. Fig. 5 shows that the cash flow will be negative in the first and second years, and it will be positive, due to the pre-sold units, since the third year. Also, fig.6 indicates that the cumulative revenues of the project in the fourth year will cover the total costs and be positive, indicating that the fourth year is the payback period of the project.

- Calculation of financial evaluation indicators

According to the cash flow table of the project, various indices of the benefit-cost analysis were calculated, as listed in the table 8.

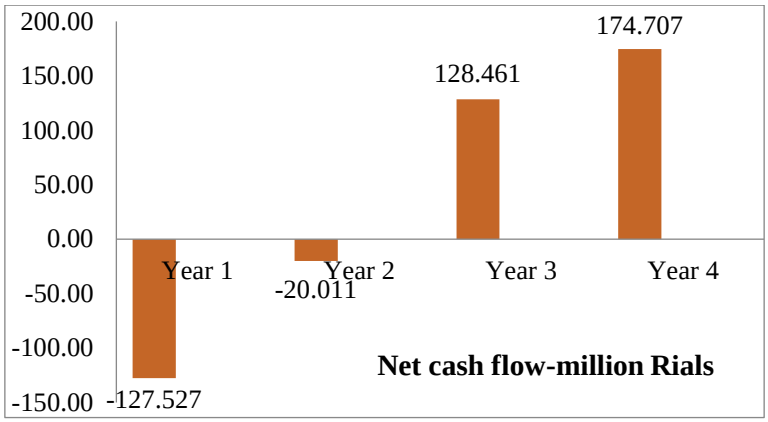

Fig. 5. Net cash flow of the 100-unit residential complex project

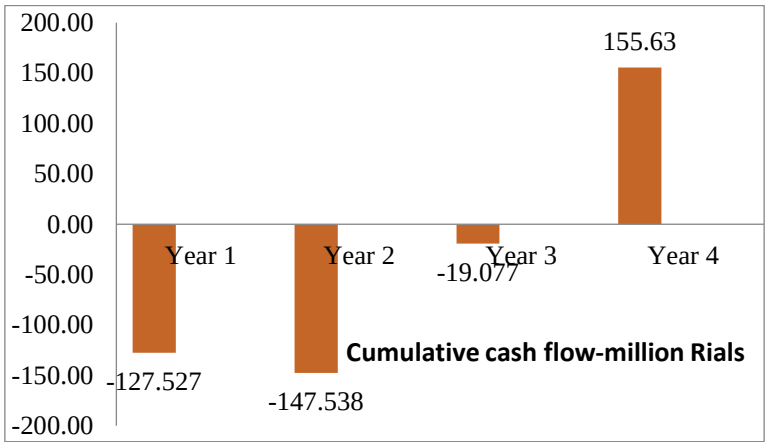

Fig. 6. Net cumulative cash flow of the 100-unit residential complex project

Table 8. The financial indices evaluated for the 100-unit residential complex project

Index	Acronym	Unit	Result
Net Present Value (Total Profit)	NPV	Million Rials	22,503
Benefit/Cost ratio	B/C	Ratio	1.09
Internal Rate of Return	IRR	Percent	32.7%
Payback Period (since operation)	PBP	Number of years	1
Annual Worth (Annual Profit)	AW	Million Rials	9,529

Considering the indices calculated for financial evaluation, this project, with an internal rate of return of about 33%, a net present value of about 2.2 billion Tomans, and a payback period of about one year after the construction period, is considered feasible.

- Participation share and land value sensitivity analysis

Considering the importance of land price in participation investment, as equity capital of the employer or New Town Development Company, this section presents land value sensitivity analysis to show how changes in land price affect financial indices and the employer's participation share. Table 9 shows the Land price sensitivity analysis for the 100-unit residential complex project. Also, Fig. 7 shows Changes in the adjusted internal rate of return versus land price changes in the 100-unit residential complex project.

Table 9. Land price sensitivity analysis for the 100-unit residential complex project

Option	Land price (million Rials)	NPV	MRR	The employer's participation share
Original option	3	22,503	32.7%	12%
Option 1	4	13,666	29.4%	15%
Option 2	5	4,466	26.4%	18%
Option 3	6	-4,734	23.6%	20%

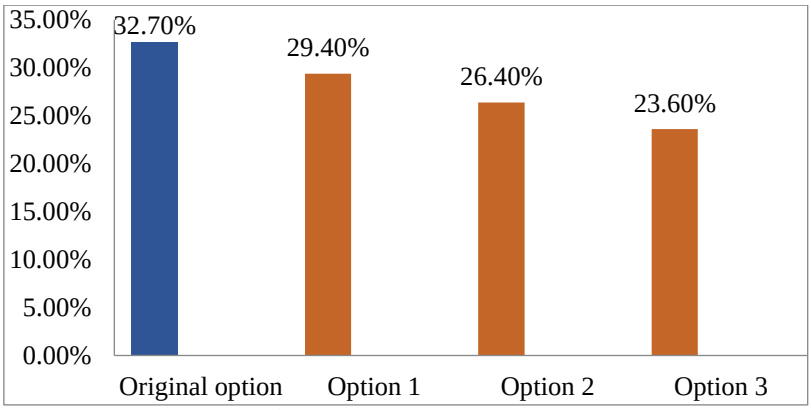

Fig. 7. Changes in the adjusted internal rate of return versus land price changes in the 100-unit residential complex project

3.3. Estimation of costs and revenues and benefit-cost analysis of the special residential complex investment package

Like two previous investment packages, according to the investigations on the special residential complex project, the construction period was considered to be two years, and the study period (construction and sale) was considered to be three years, which was proportional to the market. Also, the discount rate was considered equal to 25% by calculating the weighted average cost of capital, and the average inflation rate for the cost and revenue components was assumed to be equal to 15% according to the trends of adjustment indices and the consumer price index in recent years. Also, the construction cost per m^2 for gross space, green space, and parking was estimated at 18, 2, and 2 million Rials, respectively. The sale price per m^2 was considered to be 30 for residential space, and the land worth per m^2, considering the land size and the type of use, was considered to be 3 million Rials. In this project, it was assumed that the pre-sales would be started in the first year. Table 10 presents the results of estimating the investment costs according to the buildings required and defined in the complex, and the assumptions considered based on the market in 2019.

Table 10. The results of estimating all investment costs defined in the special residential complex project (in million Rials).

Type of cost	Cost	Cost Share (%)
Land cost	2,400	13%
Building permit cost	120	1%
Construction costs	15,200	80%
Costs of design, engineering services, and supervision	760	4%
Costs of Service connections	304	2%
Transfer and sales costs	204	1%
Total	18,988	100%

As seen in the above table, the most important cost during the construction period is the construction costs, with a share of 80% of the total costs. The costs listed in this table indicate that the construction of this project in Eyvanekey New Town, considering the considered construction period, requires about 1.8 billion Tomans. Also, since, according to the employer's policies, this project was considered a cooperative and construction-sale one, it does not have any operational costs.

Table 11. Estimation of the sales revenue of the special residential complex project (million Rials).

Use	Net area/number	Sale price per m^2/unit	Revenue	Revenue Share (%)
Special residential	680	30	20,400	100.0%
Parking	200	0	0	0.0%
Green space and landscaping	200	0	0	0.0%
Total	1080		20,400	100%

Table 11 shows that the services of the special residential complex project can generate a revenue of about 2 billion tomans. Considering the estimated costs, revenues, and their relevant periods, the cash flow of this project is estimated in the form of two charts of net cash flow in the normal mood and net cumulative flow as follows.

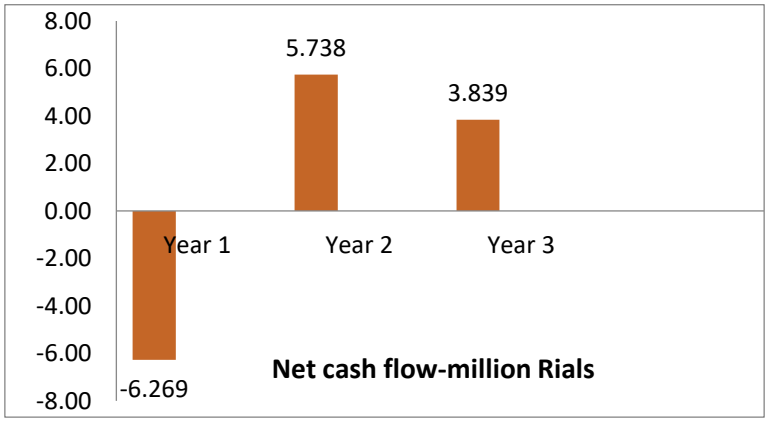

Fig. 8. Net cash flow of the special residential complex project

Fig. 8 shows that the cash flow will be negative in the first year, and it will be positive, due to the pre-sold units, since the second year. Also, Fig. 9 indicates that the cumulative revenues of the project in the second year will cover the total costs and be positive, indicating that the second year is the payback period of the project.

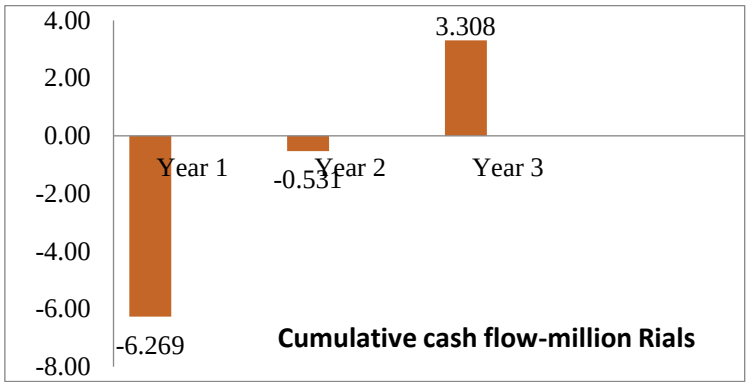

Fig. 9. Net cumulative cash flow of the special residential complex project

- **Calculation of financial evaluation indicators**

According to the cash flow table of the project, various indices of the benefit-cost analysis were calculated, as listed in Table 12. Considering the indices calculated for financial evaluation, this project, with an internal rate of return of about 32%, a net present value of about 62 million Tomans, and a payback period of about one year after the construction period, is considered feasible.

Table 12. The financial indices evaluated for the special residential complex project

Index	Acronym	Unit	Result
Net Present Value (Total Profit)	NPV	Million Rials	623
Benefit/Cost ratio	B/C	Ratio	1.04
Internal Rate of Return	IRR	Percent	32.5%
Payback Period (since operation)	PBP	Number of years	1
Annual Worth (Annual Profit)	AW	Million Rials	319

- **Participation share and land value sensitivity analysis**

Considering the importance of land price in participation investment, as equity capital of the employer or New Town Development Company, this section presents land value sensitivity analysis to show how changes in land price affect financial indices and the employer's

participation share. Table 13 shows the Land price sensitivity analysis for the special residential complex project. Also, Fig. 10 shows Changes in the adjusted internal rate of return versus land price changes in the special residential complex project.

Table 13. Land price sensitivity analysis for the special residential complex project

Option	Land price (million Rials)	NPV	MRR	The employer's participation share
Original option	3.0	623	32.5%	14%
Option 1	3.5	255	27.9%	16%
Option 2	4.0	-113	23.8%	17%
Option 3	4.5	-481	20.0%	19%

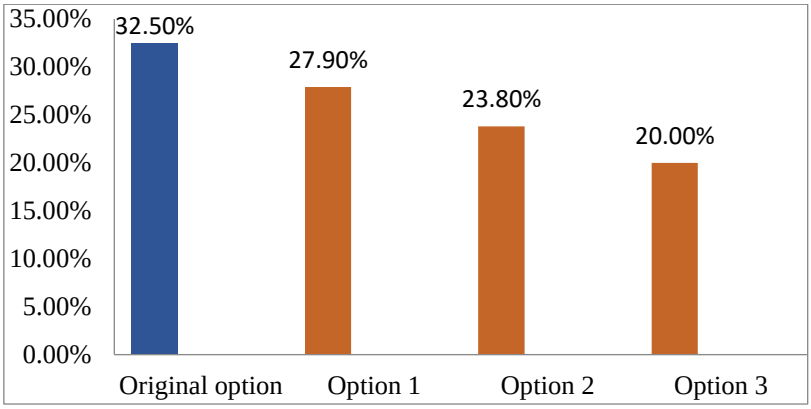

Fig. 10. Changes in the adjusted internal rate of return versus land price changes in the special residential complex project

3.4. Estimation of costs and revenues and benefit-cost analysis of the residential villa complex investment package

In the residential villa complex project, the construction period was considered to be two years, and the study period (construction and sale) was considered to be three years, which was proportional to the market. Also, the discount rate was considered equal to 25% by calculating the weighted average cost of capital, and the average inflation rate for the cost and revenue components was assumed to be equal to 15% according to the trends of adjustment indices and the consumer price index in recent years. The construction cost per m^2 for gross space, green space, and parking was estimated as 18, 2, and 2 million Rials, respectively. Also, the sale price per m^2 was considered to be 40 for residential space, and the land worth per m^2, considering the land size and the type of use, was considered to be 3 million Rials. Finally, it was assumed that the pre-sales would be started in the first year. Table 14 presents the results of estimating the investment costs defined in the residential villa complex project.

Table 14. The results of estimating all investment costs defined in the residential villa complex project (in million Rials).

Type of cost	Cost	Cost Share (%)
Land cost	45,000	20%
Building permit cost	1,125	0%
Construction costs	165,000	73%
Costs of design, engineering services, and supervision	8,250	4%
Costs of Service connections	3,300	1%
Transfer and sales cost	2,550	1%
Total	**225,225**	**100%**

As seen in the above table, the most important cost during the construction period is the construction costs, with a share of 72% of the total costs. The costs listed in this table indicate that the construction of this project in Eyvanekey New Town, considering the

considered construction period, requires about 22.5 billion Tomans. Also, since, like the three projects abovementioned, this project was considered a cooperative and construction-sale project, it does not have any operational costs.

Table 15. Estimation of the sales revenue of the residential villa complex project (million Rials).

Use	Net area/number	Sale price per m^2/unit	Revenue	Revenue Share (%)
Residential villa	6375	40	255,000	100.0%
Parking	1000	0	0	0.0%
Green space and landscaping	14000	0	0	0.0%
Total	**21375**		**255,000**	**100%**

Table 15 shows that the services of the residential villa complex project can generate a revenue of about 25.5 billion tomans. Considering the estimated costs, revenues, and their relevant periods, the cash flow of this project is estimated in the form of two charts of net cash flow in the normal mood (Fig. 11) and net cumulative flow (Fig. 12) as follows.

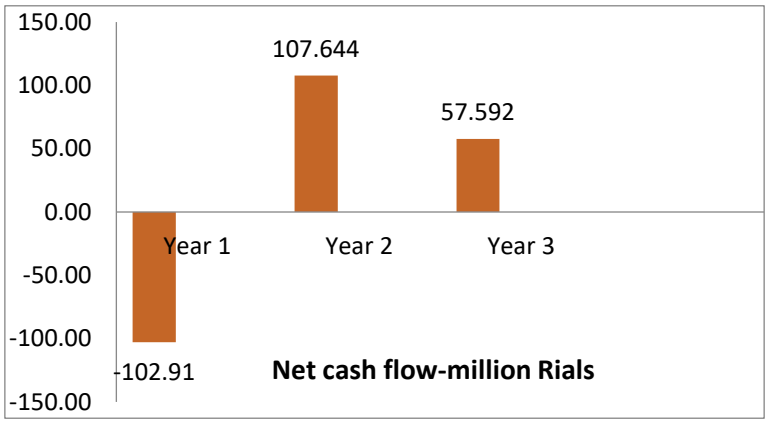

Fig. 11. Net cash flow of the residential villa complex project

Fig. 11 shows that the cash flow will be negative in the first year, and it will be positive, due to the pre-sold units, since the second year. Also, Fig. 12 indicates that the cumulative revenues of the project in the second year will cover the total costs and be positive, indicating that the second year is the payback period of the project.

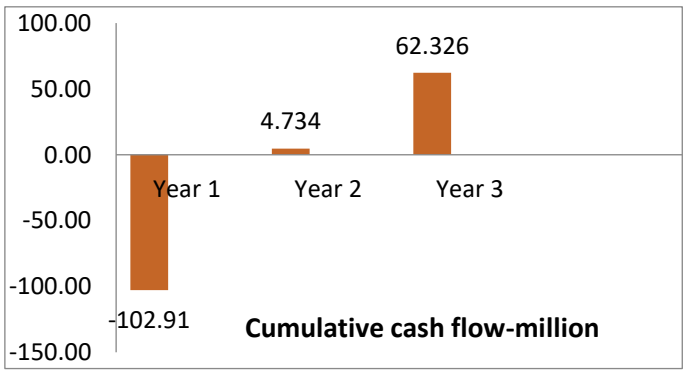

Fig. 12. Net cumulative cash flow of the residential villa complex project

Table 16. The financial indices evaluated for the residential villa complex project

Index	Acronym	Unit	Result
Net Present Value (Total Profit)	NPV	Million Rials	16,051
Benefit/Cost ratio	B/C	Ratio	1.08
Internal Rate of Return	IRR	Percent	36.6%
Payback Period (since operation)	PBP	Number of years	0
Annual Worth (Annual Profit)	AW	Million Rials	8,223

- Calculation of financial evaluation indicators

According to the cash flow table of the project, various indices of the benefit-cost analysis were calculated, as listed in the table 16.

Considering the indices calculated for financial evaluation, this project, with an internal rate of return of about 37%, a net present value of about 1.6 billion Tomans, and a payback period of less than one year after the construction period, is considered feasible.

- Participation share and land value sensitivity analysis

Table 17. Land price sensitivity analysis for the residential villa complex project

Option	Land price (million Rials)	NPV	MRR	The employer's participation share
Original option	3	16,051	36.6%	21.0%
Option 1	4	2,251	26.5%	26.1%
Option 2	5	-11,549	18.3%	30.5%
Option 3	6	-25,349	11.5%	34.5%

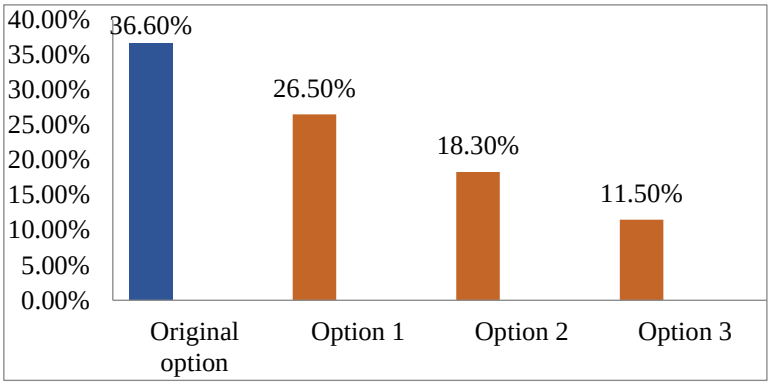

Fig. 13. Changes in the adjusted internal rate of return versus land price changes in the residential villa complex project

4. Conclusion

This present study economically and financially evaluated four residential investment packages in Eyvanekey New Town, which were planned to accommodate those working in the surrounding industrial areas, as well as the overspill of the eastern area of Tehran. So, four types of residential complexes, including 100-unit, 50-unit, special residential, and villa complexes proposed for this new town, were analyzed. As mentioned at the beginning of the research, since this new town was established to meet the housing needs of workers, employees, and managers working in industrial areas for housing, as well as those living in the old city of Eyvanekey, the four housing types abovementioned have been proposed with different conditions, facilities, services, and budgets. So, considering the high construction costs, it is required to economically evaluate these projects before their implementation to know whether they are economically feasible or not. According to the financial and economic evaluation of these four investment packages in the market conditions in 2019 and the estimation of financial and economic indices, including net present value (total profit), benefit-cost ratio, internal rate of return, payback period, and annual worth (annual profit), carried out in the present study, all the four projects were found to be feasible: the 50-unit residential complex (IRR ≈ 34%, NPV≈ 628 million Tomans, and PBP≈ 1 year after the construction period), the 100-unit residential complex (IRR ≈ 33%, NPV≈ 2.2 billion Tomans, and PBP≈ 1 year after the construction period), the special residential complex (IRR ≈ 32%, NPV≈ 62 million Tomans, and PBP≈ 1 year after the construction period), and the residential villa complex (IRR ≈ 37%, NPV≈ 1.6 billion Tomans, and PBP< 1 year after the construction period). Therefore, considering the feasibility of all the residential projects mentioned, it is possible to invest in housing projects with small and large amounts. Also, considering the civic participation approach and the employer's share of land worth, the land cost was removed from projects, resulting in the enhanced attractiveness of investments.

Acknowledgement

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