Environmental Research and Technology
https://ert.yildiz.edu.tr - https://dergipark.org.tr/tr/pub/ert
DOI: https://10.35208/ert.1419063

Research Article

Determination of tree type selection in park and garden construction by the value engineering method: Sinanoba Beach Park Example

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ARTICLE INFO

Article history
Received: 13 January 2024
Revised: 27 April 2024
Accepted: 02 May 2024

Key words:
Value management; Value engineering; Value analysis; Material selection; Park and garden design; Ecology

ABSTRACT

City parks are of great importance to people living in cities, and the presence of trees in the parks increases the value of the parks. There are many types of trees that can be planted in parks. However, it is not possible for every tree to adapt to every natural environment. In addition, the initial investment costs of the trees, the characteristics that may affect the life cycle costs, and the expectations of managers and park users from the trees also affect this choice. All these criteria should be evaluated together, and the ideal selection should be made. Value Engineering is a method that can be applied to make the most appropriate choice by taking into account the wishes of all stakeholders. Value engineering (DM) can be defined as an organized effort to analyze product features, functions and material selections; is designed to solve problems and/or reduce costs while maintaining or improving performance and quality requirements; and performs essential functions at the required quality, reliability, and life-cycle cost. In this study firstly a value engineering team was formed. The value engineering team decided that the trees should be coniferous with the prerequisite that they can remain green without shedding their summer-winter leaves and determined which criteria the coniferous trees required to be located in the park should meet. The team members conducted value engineering after determining which trees met these criteria and were subsequently purchased. In this study, since an existing project and a new project are not compared, it does not include a result on how much the cost gain is. As a result, the team determined the most appropriate optimum cost solution with the value engineering method to meet all the criteria among the determined alternative tree species.

Cite this article as: Atabay Ş, Tekin H. Determination of tree type selection in park and garden construction by the value engineering method: Sinanoba Beach Park Example. Environ Res Tec 2024;7(4)489–501.

INTRODUCTION

Cities are settlements with an administrative organizational unit that contains a certain population where people live together and have the weight of industry and service sector in economic life [1]. The main purpose considered when establishing cities is to meet the basic vital needs of the people living in the city, and therefore, to create vital areas and tools that meet those needs [2]. A busy pace of work in cities often leads to life happening between home and work and in closed environments. Many problems, such as heavy traffic, poor air quality, trying to cope with many problems throughout the day, and stress, also affect the quality of life in cities. With the intensification of urbanization over time, it has become very important to create sports, entertainment, and recreation areas in cities for the psycho-

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logical rest and sociocultural development of people under the pressure of city life [3]. In such cases, people need to integrate with nature by moving away from densely structured environments and vehicle traffic. However, it may not always be possible to leave the city and access natural environments. For this reason, it is very important to build natural environments in cities, at distances that people can reach in a short time, in order to sustain life normally. City administrators build parks and gardens of different sizes in various parts of a city to meet the needs of people.

Green spaces are very important not only for the needs of living things but also for the livability of the world and the sustainability of natural life [4, 5]. Green areas reduce carbon emissions and provide benefits for the protection of the ozone layer [6–8]. Gardens contribute to green mitigation and energy transition and adaptive reuse of gardens can ecologically optimize user comfort and health in terms of microclimate and spatial quality [9].

Tourism is an important service sector for countries. Similar to other developing countries, national parks are not marketed much in Türkiye, but groves and national parks play an active role in foreign tourism [10]. If sufficient attention and care are given, parks and national parks will benefit domestic and foreign tourism. Central Park, located in the United States, which first comes to mind in regard to parks worldwide, has approximately 40 million visitors annually [11]. It is not possible to achieve this goal if parks such as Central Park are targeted. This can only be possible if the parks are designed to meet their unique needs.

There are many studies on city parks, trees in parks, and the benefits of these trees for the ecological environment [12–17]. Green spaces have positive effects on human well-being, climate, biodiversity, and air quality. These impacts enable cities to become more ideal and sustainable places to live and work [18]. In recent years, the importance of greening cities in adapting to urban climate change has been increasing. Climate change will lead to extreme temperatures and droughts, followed by extreme rainfall and flooding. This will place high demands on the urban environment [19]. Green trees and plants can prevent atmospheric CO_2 concentration on both a global and local scale. Trees and plants in a city can provide a significant cooling effect during heat waves. Considering the ecosystem services provided by green infrastructure to combat climate change, the quantity and health of trees that are part of green infrastructure is quite important as they provide fresh and clean air [20]. Covering the surfaces in cities with materials with high sealing rates prevents the natural flow of water, the infiltration of water into the soil and the growth of plants. In summary, this situation leads to an increase in surface flow rates [21]. Green spaces help keep these flows. Green cities, green roofs, facades, tree-lined streets, parks and forests compensate for heat through evaporative cooling. Therefore, greening and bluing the city is a complementary counter-strategy for cities under climate change, which consistently provides co-benefit to ecosystem services [22].

In a study by Stephen F., a total of 3,335 trees containing 79 species on the Austin State University (Nacogdoches, Texas, USA) campus and 1,572 trees containing 44 species in Nacogdoches city parks were investigated, and the health and regeneration values and differences between the two groups were statistically compared [23]. Kazemi et al. [24] proposed a low-input landscape design concept based on the efficient use of inputs, natural resources, and labor. Low-input landscape design is an approach that can accommodate many sustainable landscape design techniques and methods, including xeriscaping and water-sensitive urban design, which help to use resources effectively. Value engineering was used as the method for landscape design, and a cost reduction of 62.7% was achieved over the 20-year life cycle of a park. In another study, Kazemi et al. [25] measured people's preferences and perceptions about approaches to low-input design of traditional parks through three-dimensional designs of parks and interview-based questionnaires. In their study, Tochaiwat et al. [26] aimed to determine the eco-efficiency of trees on outdoor thermal comfort by examining the change in the ratio of the physiologically equivalent temperature in cities to the cost of trees planted in cities. In the study prepared by Guo and Mell [27], a number of thematic features that shape the planning and design of quality urban parks in China were identified through interviews with technical professionals consulting local governments on urban planning and landscape projects throughout China.

There are various studies on how to construct city parks from different perspectives. In their study, Yazıcı and Kiper [28] aimed to determine the spatial preferences of the urban landscape with a method developed based on visual perception specific to Topkapı city park. In his master's thesis, Demir [29] proposed the use of smart parking applications in Maltepe Fill Area Orhangazi City Park and examined the effects of the use of smart urban furniture in public spaces where smart urbanization is aimed at change and development in cities in Türkiye and İstanbul. Yücel and Yıldızcı [30], on the other hand, conducted a study on the establishment of quality criteria for urban parks.

The use of materials and methods that can meet the needs of the public, while creating parks enables parks to be more efficient [31]. One of the important issues to be determined here is what is needed. The term "need" refers to the product's expectations and the requirements that must be met. However, these expectations and criteria may have different meanings for the users or technical staff who produce that product. It must satisfy the needs of the users, technical staff members expect that all safety regulations and laws will be followed, architects desire an aesthetically pleasing design, and manufacturers hope to turn a profit on their creation. Then, whose criteria and expectations will be taken as the basis? What needs to be done here is to meet the expectations of all parties at an optimum level when producing any product. In addition, there are many alternative materials/methods that can meet all the criteria of stakeholders in solving these problems. Which of these is the right one to apply?

In this paper, a study was carried out to determine the tree species that should be planted in a park to be built in the city in a way that meets the criteria determined by the value engineering team through value engineering, which is a value-based method. In the study, a proportional amount of savings related to cost and other gains cannot be given, since an existing project and a proposed project are not compared. A choice of trees is needed for a new park. It was desired that the trees should be green in summer and winter, and for this reason, four types of coniferous tree species were determined as the most suitable for the location of the park, with the prerequisite that they should be coniferous. A sufficient number of value engineering teams were formed among stakeholders who are experts in trees and parks and can have a say. This team first determined their expectations from the trees, that is, the criteria that the solution of the problem should meet. They then put these criteria in order of importance and calculated the percentages of importance. They quantified the values of the trees to meet these criteria and thus found the satisfaction levels of each tree in terms of meeting the criteria. They also ascertained the purchase costs of each tree sapling. Using all this data, they calculated the value of each tree and decided to plant the tree species with the highest value in the park.

MATERIALS AND METHODS

Value Engineering Method

The selection of trees to be planted in the area designed as a city park will be made with the help of the value engineering method. Value engineering is a teamwork-oriented, organized effort to analyze building features, systems, functions, equipment, and material selections; is designed to solve problems and/or reduce costs while maintaining or improving performance and quality requirements; and performs essential functions at the required performance, quality, reliability, and life-cycle cost. The concept of value is confused with price by many people. However, value is not a concept that can be measured only by the cost or price of that product. Value is meeting people's expectations of a product or service at minimum cost. Since expectations about each product or service cannot be the same for everyone, the concept of value varies from person to person. The highest value is the value that can safely perform the desired functions at the desired time and place and meet the basic quality requirement with the minimum possible total cost. The true value of a product is revealed only by comparing its quality and costs or other characteristics with those of another product that performs the same functions [32].

Value engineering comprises all of the studies carried out by the value engineering team. These studies involve people and technical staff who have a say in the solution of the problem; are in line with customer requests; remove unnecessary functions determined by detailed analyses of products, business processes, or services; and select and implement the least costly alternatives among the alternatives that can solve the problem with various idea generation techniques in line with the criteria determined by the customers as well as the value engineering team by focusing on functions with a high degree of importance. Value engineering is carried out within the framework of a systematic business plan [33]. After the value engineering team members are determined, they start to implement the stages of the business plan; as a result, they choose the most valuable product/service/method.

The sooner the value engineering work is started on a project, the more impact the work will have on the project. In particular, the concept and design stages of the project are the best times to start working. After the design team outlines a project, a multidisciplinary/stakeholder team is formed, the majority of which are not included in the design team, and the project is reviewed and analyzed by this team. The objectives of value engineering are listed below [34].

- Achieve project functions efficiently and at the lowest total cost
- Producing more valuable projects
- Methods that will enable the project to be completed in a shorter time
- Helping to improve building life
- Preventing unnecessary functions and therefore unnecessary costs
- Use the budget and all other resources effectively and efficiently
- Improving project quality
- Producing safer structures
- To eliminate the errors in the project drawing, to draw completely
- All business processes of the project are reviewed, and functions that do not contain value for the customer are removed or new functions are added [35]
- Personnel skills can be revealed by using methods such as creativity, harmony, teamwork, and psychological techniques
- In addition, to produce value-based solutions to any problem encountered during the implementation process of the project, various creativity techniques can be used

The concept of "value" expressed in value engineering can be expressed with the following formulas [36]:

$$\text{Value} = \text{Merit}/\text{Cost} \quad (1)$$

$$\text{Value} = \text{Customer Satisfaction}/\text{Cost} \quad (2)$$

$$\text{Value} = (\text{Initial Impact to User} + \text{Benefit from Goods})/(\text{Initial Cost} + \text{Lifetime Cost}) \quad (3)$$

$$\text{Value} = \text{Benefit (Function)}/\text{Cost} \quad (4)$$

$$\text{Benefit (Function)} = \text{Importance} \times \text{Satisfaction Level} \quad (5)$$

Value engineering is an ideal method for selecting the most suitable materials needed to produce a product from the determined alternatives. There are various studies on material

Figure 1. Location of Sinanoba beach park [42].

selection with the help of value engineering. In one study, partition material was selected for use in wall construction in a reinforced concrete structure with the help of value engineering [37]. In another study, the authors attempted to determine which material/method should be chosen to fill the gap between the shoring wall and the structure using the value engineering method [38]. While in another study, the value engineering method was used to select the exterior cladding material in a building from among sustainable materials according to LEED criteria [39]. Hosseinpour et al. [40] conducted a cost-benefit analysis of the application of urban agriculture in a sustainable park design in their study and benefited from value engineering in this study.

Determination of Tree Type Selection in Park and Garden Construction by the Value Engineering Method: Sinanoba Beach Park Example

Sinanoba, a neighborhood in the Büyükçekmece district of Istanbul Province, is close to the Marmara Sea on the southern side of the district and has following characteristics [41]: a) The southern parts of Büyükçekmece are under the influence of the Mediterranean macroclimate due to the Marmara Sea, b) Covering Terkos Lake in the northern parts are coastal to the Black Sea, they are under the influence of the Black Sea climate. In general, a climate called the "Marmara transition regime" is observed. c) Rainfall can occur in all seasons due to hot and dry summers, warm and humid Black Sea climates in winter, warm summers, and very cold winters. d) Büyükçekmece has its common features from both climate types. An area that does not fall below the soil temperature cutoff is ideal for plants. e) Naturally, oak, beech, and hornbeam can grow in humid places in the region. There are larch and scotch pines among conifers.

Park construction was planned only for the Sinanoba coastal corridor, which is afforested by a concrete road and a single row (Fig. 1). The total area of the park is 3670.86 m², the green area is 3011.564 m², the walking path is 572.096 m², the area where the game groups live is 87.2 m², and the total circumference of the park is 298.21 m [42].

When designing the park, it was decided to plant trees in certain areas. The region is suitable for the survival of many tree varieties; therefore, there are many alternatives. Which of the alternative tree types should be selected can be determined from various perspectives. In this study, trees were planted at an optimal cost so that the trees could meet the projected costs; in other words, the trees could meet the aforementioned requirements, and the value engineering method was applied to achieve this goal.

The problem to be solved in this study is the choice of trees to be planted in a park. The value engineering method was used to solve the problem. For this purpose, first, a value engineering team was formed with representatives from parties and professional groups who could solve this problem or who might be needed to solve the problem. This team consists of five people. These include a landscape architect, a forest engineer, an environmental engineer, a civil engineer, and an owner who wants to build parks and gardens. This team was created to determine the alternatives for all the needs of a park, such as walking paths, perimeter fences, grass to be planted on the ground, and flowers, and to choose the most ideal among these alternatives. However, in this paper, only studies on tree selection are explained as examples to explain the method in detail. First, the team determined the main criterion: Trees should remain green in summer and winter and should not shed their leaves. The team decided that the trees that should be planted be selected among the coniferous species based on the preliminary finding that coniferous trees can meet these criteria and then determine other expectations from the trees, that is, other criteria. After determining which tree species are coniferous and can live in this geographical area, all the criteria determined by the team can be met, and a value analysis study can begin.

For value analysis, first, all the determined criteria were voted upon by the value engineering team and placed in order of importance. After determining where to buy the trees and their prices, the extent to which these tree species met the criteria, that is, the numerical values of their technical and biological characteristics, was determined.

Table 1. Limit values of attributes

Product attributes	Cedrus libani	Cupressus macrocarpa	Picea pungens	Pinus nigra
Average life (year)	1600	1000	400	1000
Reachable height (m)	30	22,5	35	35
The amount it can extend in a year (cm)	100	125	110	100
Leaf shedding rate (%)	0.1	0.1	0.1	0.1
Light liking rate (%)	1	0.5	1	0.5
Min. temperature it can withstand (°C)	-20	-25	-30	-30
Planting range (m)	3.5	5.5	5.5	5
Irrigation request (%)	0.1	0.1	0.5	0.1
Cost (TL/m^2)	261	107	573	132

The trees were selected on the basis of their values, and formula (4) was used for this purpose. To calculate the value, it is necessary to determine the "benefit". The benefit was found with a formula (5). The importance included in the formula was achieved by distributing 100 full points to the attributes normally specified in the product specification or perceived relatively by the customer. The satisfaction level is a value that indicates how satisfied the customer is with the specified qualities of each product. It was found by digitizing between 1 and 10.

As a result of all these calculations, the utility values obtained for each alternative tree species were divided by the costs of the trees, and their values were determined. It was decided to select the tree species with the highest value for the solution of the problem.

Attributes of Trees to Compare

The Value Engineering Team determined the characteristics that can be compared for the selection of trees that need to be planted in the park by the brainstorming method. The specified attributes and limit values of the attributes are given in Table 1.

- Average life (years)
- Reachable height (m)
- The amount it can extend in a year (cm)
- Leaf shedding rate (%)
- Light liking rate (%)
- Min. temperature it can withstand (°C)
- Planting range (m)
- Irrigation request (%)
- Cost (TL/m^2)

Determination of Alternative Tree Types

The Value Engineering Team identified coniferous and purchasable alternative tree species suitable for the geography of the area to be parked, complying with all the determined criteria. The names and characteristics of these trees are described below.

Figure 2. Cedrus libani [45].

Cedrus Libani

Cedru libani, which is a full-bodied, thick-branched, majestic forest tree (Fig. 2) has the following properties [43, 44]: a) Even if a young individual has a pyramidal hill, the hill shape deteriorates over time, becomes flat, and takes the form of an umbrella, b) It is a long-lasting tree genus and live for 1200–2000 years. It is a tree genus that can reach 25–35 meters in length and has a trunk diameter of 2 m. c) As may be inferred from typical instances, it grows in the Mediterranean environment. Nonetheless, it grows better in cool locations because it is a species that can get mite illness. It can dry otherwise. This tree is fond of light.

Cupressus Macrocarpa

Although it is a tree species that is grown on Monterey Island in North America, it is also found in Türkiye and has

Figure 3. Cupressus macrocarpa [45].

following properties [46]: a) It is long-lasting because it can live for 1000 years. It can reach up to 20–25 meters, and the crown width can reach up to 5 meters. b) It is a species that thrives in warm Mediterranean climates. Like light, it can also grow in semi-sunny areas. It is used as a decorative tree, and the curtain is one of the tree species, c) Cupressus macrocarpa leaves, which can form pyramids, are also known as Lemoni Servi because they are yellowish and have the smell of lemon (Fig. 3).

Picea Pungens - Blue Spruce

This tree grows in the high parts of North America and has following features [44]: a) The Blue Spruce species, which can reach 30–40 meters, can live for approximately 400 years. Compared to other spruce species, it is more resistant to drought, b) They become well-developed in cool and temperate climates. These plants are not easily affected by cold, and they are resistant to frost events. It is used in urban green areas because it strongly affects air pollution, c) Since the visual field is aesthetic, these trees are also preferred as Christmas trees (Fig. 4).

Pinus Nigra - European Black Pine

Black pine, which is widely distributed in Türkiye and also grown in Europe has characteristics as follows [46].

Figure 4. Picea pungens [47].

Figure 5. Pinus nigra [48].

a) Larch plants, which can live for an average of 1000 years, can reach heights of up to 20–30 meters, b) They can live in hot and dry places and adapt to all types of climates. These plants can withstand frost events and temperature, c) The leaves are always green. It is tolerant to air pollution, such as blue spruce, and is suitable for urban use (Fig. 5).

Limitations of the Qualifications

The limit values of the qualities of the trees to be compared, determined by the value engineering team, are given in Table 1.

Table 2. Determination of the order of importance of the qualifications with the nominal group technique

VE team attributes	Landscape architect	Forest engineer	Environmental engineer	Civil engineer	Owner	Total	Seq. no
Average life (year)	2	8	7	5	3	25	2
Reachable height (m)	6	7	3	3	4	23	4
The amount it can extend in a year (cm)	5	6	2	2	6	21	6
Leaf shedding rate (%)	7	1	6	1	7	22	5
Light liking rate (%)	4	5	4	4	1	18	8
Min. temperature it can withstand (°C)	3	4	5	6	2	20	7
Planting range (m)	8	2	1	8	5	24	3
Irrigation request (%)	1	3	8	7	8	27	1

Table 3. Determination of importance percentages with the priority matrix method

Attr. seq. No	Attributes	1	2	3	4	5	6	7	8	Total	%	Seq. no
1	Average life (year)		1	1	1	1	1	1	0	6+1	19.4	2
2	Reachable height (m)	0		1	1	1	1	0	0	4+1	13.9	4
3	The amount it can extend in a year (cm)	0	0		0	1	1	0	0	2+1	8.3	6
4	Leaf shedding rate (%)	0	0	1		1	1	0	0	3+1	11.1	5
5	Light liking rate (%)	0	0	0	0		0	0	0	0+1	2.8	8
6	Min. temperature it can withstand (°C)	0	0	0	0	1		0	0	1+1	5.6	7
7	Planting range (m)	0	1	1	1	1	1		0	5+1	16.7	3
8	Irrigation request (%)	1	1	1	1	1	1	1		7+1	22.2	1

Cost values were not directly involved in the problem in the benefit calculation as qualitative properties but were used in the value calculation. Since the planting intervals of the trees are different, the lowest market sales price that can be purchased for each tree was determined, and the tree prices per m^2 of land were calculated and used to solve the problem of calculating a common denominator. When purchasing seedlings, the prices were taken into account, each of which was approximately 200 cm in height.

Rankings and Percentages of Importance of Attributes

The order of importance and percentages of the attributes were determined by the nominal group technique (Table 2) and the priority matrix method (Table 3).

In the nominal group technique, each member of the value engineering team assigned a higher score to the qualifications as required by his/her profession and a lower score to the qualifications he/she found important and insignificant; these scores were subsequently collected, and a general order of importance was created for the whole team. In the priority matrix method, as a result of comparing the qualities by taking into account the order of importance previously determined by the team members, 1 point was given to the more important and 0 to the insignificant; these scores were subsequently summed, and the importance percentages were determined. +1 point has been added to the total score for the comparison of the qualifications with itself.

Satisfaction Levels of the Qualifications

Figure 6a shows the benefit curve plotted for the mean life attribute. On the vertical axis, satisfaction levels are between 1 and 10. On the horizontal axis, the average life quality values were calculated for all the alternative tree species discussed. The performance level with the lowest quality value was matched with 1, the performance value with the highest quality value was matched with 10, and these two coordinates were combined with a linear line. Then, through this line, the satisfaction levels corresponding to the intermediate performance levels of the tree species were determined.

In this example, blue spruce has the lowest satisfaction level, with an average life of 400 years, and cedrus libani has the highest satisfaction level, with a life of 1600 years. In this case, the patients were satisfied with the cupressus macrocarpa shuttle and larch at a level of 5.5 on average. Similarly, the satisfaction levels of all the other qualifications were determined (Fig. 6b–h).

Attribute/Function Matrix

The quality/function matrix was used to calculate the benefits of each tree alternative and its attributes (functions) (Table 4).

The importance of wood alternatives was determined by distributing the previously determined importance percentages of each quality to the ratio of the materials to meet the performance requirements of that quality.

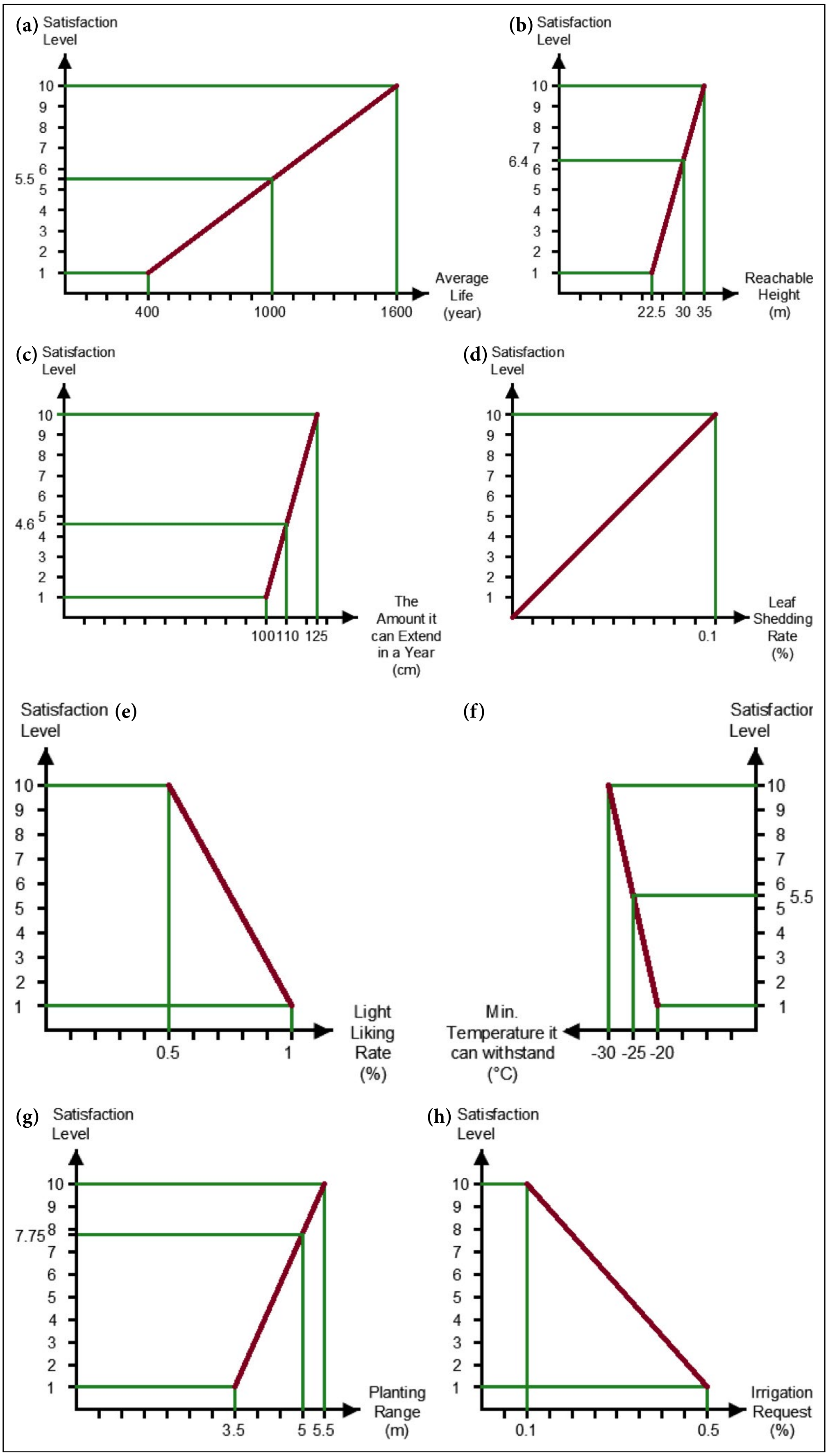

Figure 6. **(a)** Satisfaction level for average life. **(b)** Satisfaction level for reachable height. **(c)** Satisfaction level for the amount it can extend in a year. **(d)** Satisfaction level for leaf shedding rate. **(e)** Satisfaction level for light liking rate. **(f)** Satisfaction level for min. temperature it can withstand. **(g)** Satisfaction level for planting range. **(h)** Satisfaction level for irrigation request.

Table 4. Attribute/function matrix

	Average life	Reachable height	The amount it can extend in a year	Leaf shedding rate	Light liking rate	Min. temperature it can withstand	Planting range	Irrigation request	Total
Cedrus libani									
Importance	7.76	3.40	1.91	2.78	0.47	1.07	3.00	6.47	
Satisfaction level	10	6.40	1	10	1	1	1	10	
Benefit	**77.60**	**21.76**	**1.91**	**27.80**	**0.47**	**1.07**	**3.00**	**64.70**	**198.31**
Cupressus macrocarpa									
Importance	4.85	2.55	2.39	2.78	0.93	1.33	4.71	6.47	
Satisfaction level	5.5	1	10	10	10	5.5	10	10	
Benefit	**26.68**	**2.55**	**23.90**	**27.80**	**9.30**	**7.32**	**47.10**	**64.70**	**209.35**
Picea pungens									
Importance	1.94	3.97	2.10	2.78	0.47	1.60	4.71	2.78	
Satisfaction level	1	10	4.6	10	1	10	10	1	
Benefit	**1.94**	**39.70**	**9.66**	**27.80**	**0.47**	**16.00**	**47.10**	**2.78**	**145.45**
Pinus nigra									
Importance	4.85	3.97	1.91	2.78	0.93	1.60	4.28	6.47	
Satisfaction level	5.5	10	1	10	10	10	7.75	10	
Benefit	26.68	39.70	1.91	27.80	9.30	16.00	33.17	64.70	219.26
Function benefit	**132.90**	**103.71**	**37.78**	**111.2**	**19.54**	**40.39**	**130.37**	**196.88**	

For example, when the importance of cedrus libani for average quality of life is calculated, the importance percentage of the average quality of life determined by the value engineering team is 19.4%. The average life span of the cedrus libani is 1600 years. The sum of the average life spans of all the trees was calculated as follows: (1600+1000+400+1000) =4000 years. In this case, the percentage of importance corresponding to the ratio of cedrus libani to total average life was 19.4 × (1600/4000) = 7.76. Similarly, importance was calculated for all the other tree species. A benefit calculation was performed with the formula (5).

For each tree type, the benefits were calculated by multiplying the importance and satisfaction levels of the quality values corresponding to that tree. These benefits were subsequently collected, and the total benefit was determined for each tree species. In addition, the benefits of each quality value were summed, and the total benefits were found.

RESULTS AND DISCUSSION

Value Calculation

The values were calculated with equation (4). The total benefit of each tree species was divided by its unit cost, and the tree species with the highest value was selected for planting in the park (Table 5).

Considering the tree species deemed suitable for planting in the park and their qualities, it is most appropriate in terms of value engineering to choose cupressus macrocarpa, which has the highest value of 1.96.

Table 5. Value calculation

	Cedrus libani	Cupressus macrocarpa	Picea pungens	Pinus nigra
Benefit	198.31	209.35	145.45	219.26
Cost (TL/m^2)	261	107	573	132
Value	0.76	**1.96**	0.25	1.66

It should be noted here that the tree type with the highest value was determined in line with the preferences and needs of the stakeholders participating in this study, such as their professions, their expectations about the solution, the importance they attach to these expectations, and the tree types they choose. In addition, if these change, the value calculation will also change, so the selected alternative product may also be different.

The concept of value is perceived by most people as the monetary equivalent of the product. However, value is not a concept that can be measured only by cost or price. Value is a personal concept and has a different meaning for everyone. The highest value is achieved by reaching the safest and most cost-effective solution that meets all the expectations of people for the problems they face. The value of a product is revealed only by comparing its quality, cost, or other characteristics with those of one or more products that perform the same functions. The value that one person attaches to one product or to the characteristics of that product may not be the same as another. Therefore, "relative importance" can be mentioned in the concept of value.

Value-based solutions should also be sought for problems encountered in project development or projects. Value engineering is a method developed for this purpose and carried out within the framework of teamwork and a certain business plan. Value engineering is a method that can be applied in all areas of life and tries to increase value without ignoring costs. The value of a project is directly proportional to the owner's or customer's expectations. One of the important issues to be determined here is what the expectation or need is. A project can have many parties/stakeholders. However, these expectations and criteria may have different meanings for the users or technical staff who produce that product. For example, in a construction project, while the user wants all their needs to be met, technical staff expects safety conditions and all legislative requirements to be met, architects want the product to look aesthetic, and manufacturers or owners want to make a profit from the product they produce. These requests often require conflicting decisions. Then, whose criteria and expectations will be taken as the basis? What needs to be done here is to meet the expectations of all parties at an optimum level when producing any product. In addition, there are many alternative materials/methods that can meet all the criteria of stakeholders for solving this problem. Which of these should be chosen? Value engineering can be used to solve problems by overcoming all these problems.

Team selection is very important in value engineering because it will be this team that analyzes the problem, determines the solution alternatives, generates ideas and determines the most valuable solution. When determining team members, the problem to be solved should be addressed in all aspects. There is no exact number recommended for team members. The type of expertise required by the study, the type of project, current conditions, what the needs are, the quality, the time, and the knowledge and experience of the team members are determined by who the team members will be composed of and how many people there will be [49]. Chung et al. [50] in their study, conducted a five-stage value engineering with seven team members in the exterior walls and awning works of a hospital project. Uğural [51] conducted a value engineering study on which wall material would be more appropriate to use in a building and carried out that study with four team members. In addition, different teams or sub-teams can be created to solve different problems. If the number of members in the team is less than needed or if there are no team members at the level of knowledge required by the problem, the solution obtained may be insufficient, incorrect or inapplicable. Conversely, overcrowding of team members can sometimes lead to complexity, conflicts of opinion, and therefore a failure to reach a conclusion instead of a quick solution. For this reason, if it is concluded that a solution can be reached with the knowledge, skills and experience levels of the selected team members after analyzing the problem, the team members are "sufficient". In addition, support from a consultant can be obtained when a problem that requires special knowledge is encountered during the study process. It should not be forgotten that creating a value engineering team and getting services from them for a certain period of time also requires a certain budget. Having more team members than needed also means an unnecessary budget increase. In this study, the problem was analyzed, and five team members were selected from the fields of science and knowledge levels required by the solution of the problem. There was no need for support from a consultant during the study process.

While applying the value engineering method for the selection of trees discussed in this study, the criterion proposed by any stakeholders in the value engineering team was not prioritized, and the request of each stakeholder was included in the problem in proportion to the importance of that criterion. Since the value engineering method is not cost-based, but a value-based method, the alternative with the highest value, including the cost, has been chosen as the solution to the problem, not the alternative with the lowest cost.

In the criteria considered, the purchase costs of the seedlings were taken into account as the initial investment cost. However, criteria such as irrigation needs and defoliation rates were added to the problem, and the irrigation and maintenance costs that trees may need throughout their life cycle were indirectly included in the importance calculations.

There are studies available on the selection of trees to be planted in city parks and on the sides of the streets using various methods. In one study, trees that should be planted in various streets and parks in Hefei were selected from alternative tree species in the inventory using the Analytical Hierarchy Process (AHP) method and expert knowledge approach [52]. In a study, Sjöman et al. [53] examined the tree species growing in certain regions of various countries with similar climatic and field conditions by conducting the field research, and concluded that the 27 species of trees they identified in this research could live in other similar climatic and field conditions, and that the planted tree species could be diversified. In a study of trees planted in the city of Toronto, Canada, surveys were conducted with landscape architects, non-profit organizations, retail nurseries and garden centers, and municipal forestry staff in Toronto, and it was observed that each group chose the tree to be planted with different criteria and determined the type of tree to be planted with their own experience [54].

CONCLUSION

In this study, it was desirable to build a city park. Many needs, such as roads, perimeter fences, grass, flowers, and trees, have been identified for this park. For these reasons, there are many accessible alternatives on the market with different features and prices. Which of these should be selected? A value engineering study was conducted on this subject. Value engineering studies conducted only for the selection of tree species are explained in detail in this study as an example. First, a value engineering team consisting of professional groups and owners who can have a say in the construction of the park was formed. A list of criteria, including expectations about the tree species, was determined, taking into account the conditions required by the geographical region where the park will be built, customer requests, and technical requirements. Considering these criteria and costs, a value calculation was performed, and it was decided that the "cupressus macrocarpa", which has the highest value, would be planted in the park.

In this study, a solution was sought through value engineering, as an objective selection method, in a way that will meet all the criteria determined by the team members selected considering that they can contribute to the solution of the problem for the tree species to be planted in city parks. This study addressed the benefits of value engineering by demonstrating a case study on selecting tree species in parks. Applying the value engineering norms in parks can yield several benefits to explore the most appropriate alternative in terms of average life, height, extension amount, leaf shedding rate, light, temperature, planting, irrigation and cost. The implications of this study is crucial for different stakeholders, such as policy-makers, municipalities, contactors and designers. For future studies, it may be suggested to try to solve the problem by increasing alternatives with more comprehensive criteria and much more tree species.

DATA AVAILABILITY STATEMENT

The author confirm that the data that supports the findings of this study are available within the article. Raw data that support the finding of this study are available from the corresponding author, upon reasonable request.

CONFLICT OF INTEREST

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

USE OF AI FOR WRITING ASSISTANCE

Not declared.

ETHICS

There are no ethical issues with the publication of this manuscript.

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