JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Comprehensive Approach to Value Engineering in Government Construction Projects

Hussein Abdulkader Khalil
Value Engineering Expert
Architecture
Value Engineering & More, Riyadh, Saudi Arabia

Abstract: this research has significant implications for policymakers, project managers, and practitioners in the construction industry. It offers a valuable framework specifically tailored for Government building projects, providing guidance to enhance the value engineering process in passport and civil affairs projects in Saudi Arabia. Adopting these recommendations can lead to better project outcomes, cost savings, and sustainable infrastructure development.

Value Engineering (VE) process; Improve Value in government; SAVE International; Six-job plan; Resource utilization; Project performance.

1- ABSTRACT:

This study explores the management and control of the Value Engineering (VE) process in Saudi Arabian Government building projects, with a specific emphasis on passport and civil affairs projects. The objective is to identify areas of improvement that can optimize the utilization of limited financial resources, benefiting a larger number of beneficiaries.

To achieve this, an enhanced application of the Value Engineering process, tailored for Government projects, was developed and implemented. The study includes a comprehensive analysis of real-life case studies, specifically focusing on passport and civil affairs projects, to demonstrate the impact of the improved methodology on project performance and cost.

The findings reveal that the enhanced Value Engineering process resulted in significant cost savings of over 20% compared to the initial project cost in passport and civil affairs projects. These cost savings demonstrate the effectiveness of the improved methodology in optimizing the utilization of limited financial resources allocated by the Government.

Furthermore, the study identified specific investment areas to enhance the environmental aspects of passport and civil affairs projects. These examples showcase how the enhanced Value Engineering process can contribute to sustainable and environmentally friendly infrastructure development, aligning with the Government's broader goals.

This research makes a valuable contribution to the field of value engineering by addressing the specific needs and challenges associated with Government building projects in Saudi Arabia, particularly in the context of passport and civil affairs. The study provides practical recommendations and insights for professionals involved in planning and executing Government projects, enabling them to improve project outcomes and efficiently utilize public funds.

The findings of this study serve as a foundation for further research and development in the field of value engineering for Government projects in Saudi Arabia. By implementing the proposed enhancements, Government entities can optimize resources, improve project performance, and effectively serve a larger population of beneficiaries in passport and civil affairs projects.

The implications of this research are significant for policymakers, project managers, and practitioners in the construction industry. The study offers a valuable framework specifically tailored for Government building projects, providing guidance to enhance the value engineering process in passport and civil affairs projects in Saudi Arabia. By adopting these recommendations, Government entities can achieve better project outcomes, cost savings, and sustainable infrastructure development.

Keywords:
Value Engineering (VE) process; Improve Value in government; SAVE International; Six-job plan; Resource utilization; Project performance

2- INTRODUCTION

Government building projects in Saudi Arabia play a vital role in meeting community needs while efficiently using public funds. To optimize cost-effectiveness and performance in these projects, Value Engineering (VE) offers a systematic approach by identifying opportunities for cost reduction and performance improvement. This article focuses on enhancing VE in Government building projects in Saudi Arabia.

The research develops practical models and methodologies, specifically targeting the six-job plan of the VE process. The plan includes

phases such as information gathering, function analysis, creative brainstorming, evaluation, development, and presentation. By applying these methodologies, the study analyzes case studies from civil affairs sectors, such as Civil Affairs, passport, and traffic administration. The research emphasizes engineering functions from an architectural standpoint to identify areas for improvement.

The case study evaluation demonstrates the impact of the enhanced VE process on project performance and cost. The findings highlight substantial cost savings and identify investment opportunities for environmental enhancement. By optimizing the VE process, significant benefits can be achieved, including cost reduction and improved environmental outcomes.

The implications of this study extend to the construction and project management industry. By addressing the specific challenges of Government building projects in Saudi Arabia, the research contributes to the broader field of value engineering. The insights and recommendations provided are valuable for practitioners and policymakers involved in construction management and government project execution.

In summary, this article presents a comprehensive investigation into enhancing value engineering in Government building projects in Saudi Arabia. By focusing on the six-job plan and employing practical methodologies, the study identifies areas for improvement and showcases the potential for cost savings and environmental enhancement. The findings have implications for the construction industry and provide valuable guidance to practitioners and policymakers.

3- SCOPE OF THE VE STUDY

The VE study had a specific scope of verifying and improving upon the concepts proposed for the project. To accomplish this, the VE Team undertook a series of activities and applied the principles and practices of the VE Job Plan. The following description provides a detailed account of these activities:

- Thorough Project Review and Analysis: The VE Team conducted a comprehensive review and analysis of the project,
- Brainstorming Sessions: The team engaged in brainstorming sessions to foster creative thinking and generate innovative ideas. They explored different aspects of the project, considering factors such as design, construction methods, material selection, and resource allocation.
- Evaluation of Improvement Opportunities: The VE Team critically evaluated the ideas generated during the brainstorming sessions.
- Fresh Perspective and Constructability Analysis: To bring a "fresh set of eyes" to the project, the VE Team examined constructability issues from a new perspective. They sought to identify potential challenges or inefficiencies in the construction process and proposed alternative approaches to enhance constructability. This analysis aimed to optimize project execution, streamline construction activities, and minimize potential issues or delays.
- Identification of Value Added and Cost Saving Opportunities: The primary objective of the VE study was to identify opportunities for value addition and cost savings. The team scrutinized various project elements, including design features, materials, systems, and processes, with the goal of proposing enhancements that would maximize project value while minimizing costs.

When can Value Engineering Really Make a Difference?

Value engineering is most effective when performed early in the design process, as the potential for impactful changes is greater, and the consequences and costs associated with implementing those changes are minimized. As the project progresses and the design becomes more finalized, the design team may be resistant to embracing changes that could incur additional expenses that cannot be recovered. Moreover, the cost implications of proposed changes in later stages of the project extend beyond the simple capital cost and may involve factors such as abortive work and consequential impacts.

The "value zone" refers to the early stage of a project where value engineering can have the most significant impact while minimizing adverse consequences. During this phase, the design is still flexible, and modifications can be made without significant disruptions or cost implications. By identifying value engineering opportunities in the value zone, project stakeholders can optimize project outcomes, reduce costs, and enhance overall value.

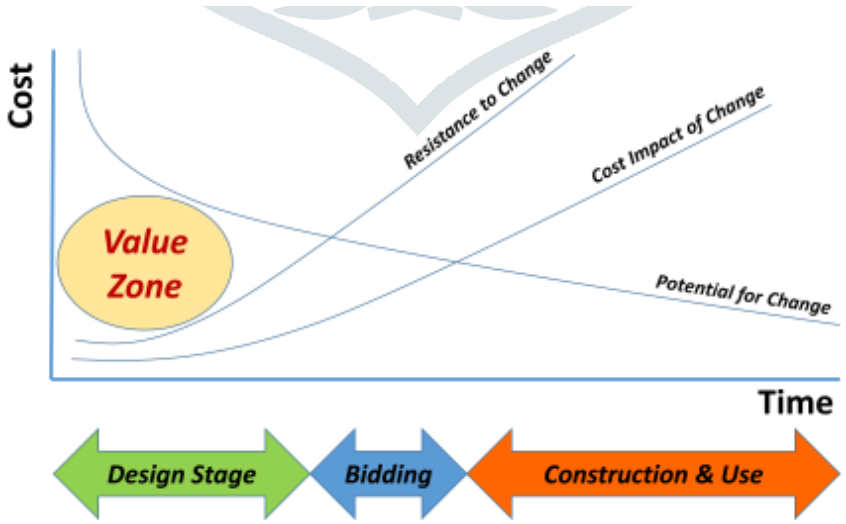


Figure 1.potential saving from VE applications "GARRY NESS (2023)."

4- VALUE ENGINEERING PROCESS

A sequential approach for conducting a value study, consisting of steps or phases used to manage the focus of a team's thinking so that they innovate collectively rather than as uncoordinated individuals. It provides the structure for the Value Study which is part of a 3-stage process

1- Pre-Study preparation
2- Value Workshop which applies the 6-Phase Job Plan
3- post-study documentation and implementation

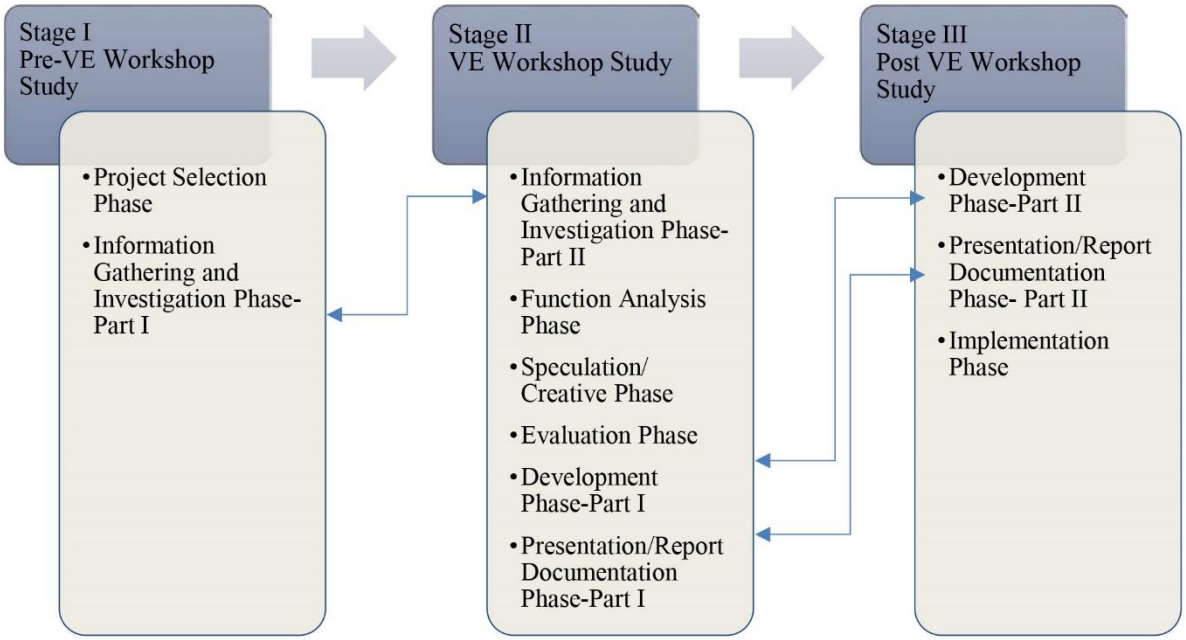


Figure 2. value engineering process ("NJDOT," 2017)."

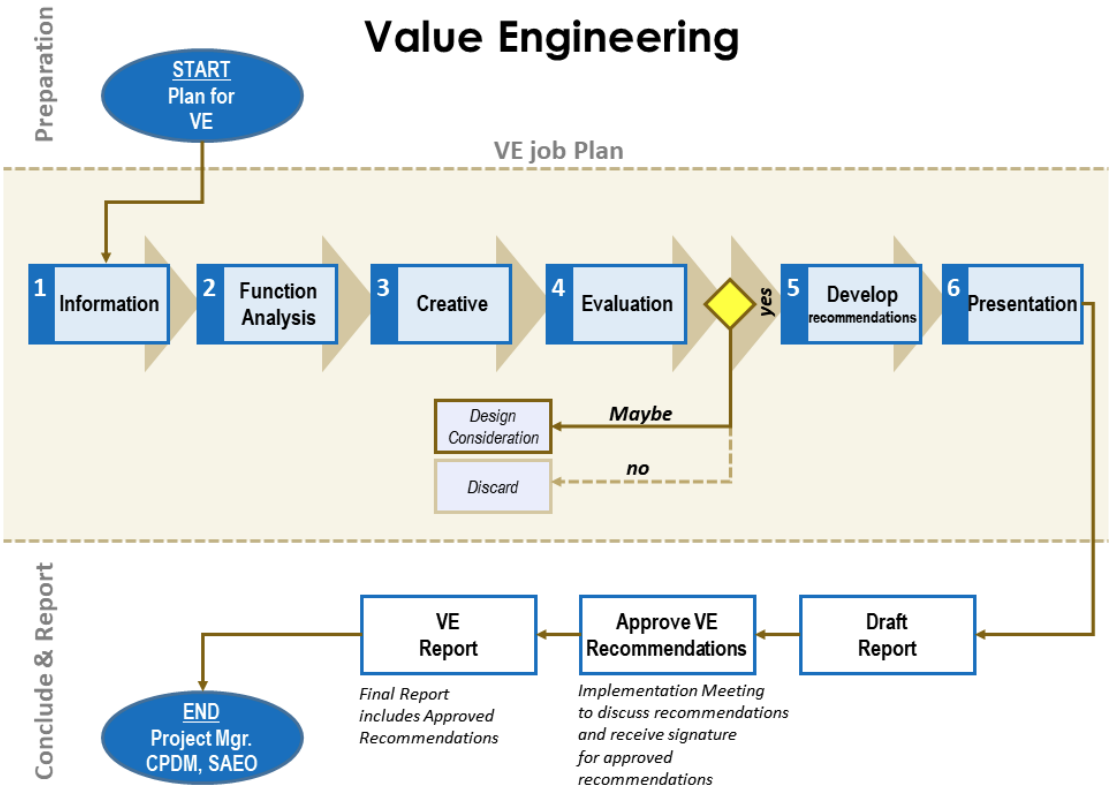


Figure 3. Value Engineering Job Plan "(Value Engineering-Workshop Guide

5- THE SIX-STEP VALUE ENGINEERING JOB PLAN

The value methodology is a systematic process that follows the Job Plan. A value methodology is applied by a multidisciplinary team to improve the value of a project through the analysis of functions. The Job Plan consists of the following sequential phases:

5.1 INFORMATION PHASE -

The Value Engineering process starts by examining every part of your product's lifecycle to identify its cost elements. That is, everything you currently spend in manufacturing, maintaining and distributing the product.

To do this, start by breaking down costs into cost buckets including Bills of Material and Process costs. Process costs include everything from production build and test, to delivery logistics. In Value Engineering nothing is off the table for consideration - from the way you source materials to the way you dispatch your products. In this way, opportunities for intelligent cost reductions can be identified and exploited wherever they may lie.

Use the Pareto analysis to identify the different elements that make up your entire product cost or COG's (Cost of Goods).

5.2 FUNCTION ANALYSIS PHASE –

The Value Study Team defines the project functions using a two-word active verb/ measurable noun context. The team reviews and analyzes these functions to determine which need improvement, elimination, or creation to meet the project's goals.

5.3 CREATIVE PHASE -

This is the fun part. VE teams conduct a series of workshops to brainstorm creative ideas and new approaches to building and delivering the product. It may be so long since a product was last analyzed that much of your current process and materials are outmoded, inefficient and becoming obsolete. Leave no stone unturned in your search for an optimal way of doing things.

With a cross-discipline team, you should explore the 'functions' of each of the identified cost elements of the product. 'Function analyses should be used to think clearly about what each of these elements or components actually does for a customer (the value it brings to them) rather than 'how it works' right now.

From this starting point the team are free to completely re-imagine how the product is manufactured or even the entire way it works - if its value to your customers can be maintained or improved in doing so.

A Value Engineering process can recommend making the following kinds of changes:

- Changing the raw materials and components you use (make substitutions for more effective, efficient, and value-adding products)
- Removing redundant features that are not used or valued by customers
- Combining existing functions and components for greater efficiency
- Improving build processes (from changing the order of assembly to outsourcing where appropriate)

There are no 'wrong ideas' at this point - every perspective and possibility is explored and added to a list of potential ideas.

5.4 EVALUATION PHASE -

In the evaluation phase, the advantages and disadvantages of each idea you have explored are listed. When the disadvantages exceed the advantages, the alternative should be dropped in favor of other more solid alternatives. The team typically performs a weighted matrix analysis to group and rank alternatives, and the best alternatives are selected for consideration in the next phase.

5.5 DEVELOPMENT PHASE –

This is where we take a deeper dive into the highest-ranking ideas coming out of the creative workshops. This phase of the process entails:

- Detailed development of chosen ideas
- Descriptions, sketches and estimates
- ROI calculations
- Project plan preparation

Ensuring you are building a tight case around the potential for savings is essential. Make sure your re-design ideas are sound and your savings' calculations are robust.

For example, how long will it take to re-coup the non-recurring engineering costs involved in your ideas? Spending £10K for an annual saving of £1K across the remaining five years of a product's life cycle may not make great business sense!

5.6 PRESENTATION PHASE -

Your VE lead now needs to bring your ideas to the board for approval.

- Prepare your presentation and report for the board
- Ideas should include more than one option
- They should be backed up by meaningful numbers
- Including timescale/project plans

At this stage, the board should have all the details they need to approve your recommendations. They may want to add in or tweak suggestions of their own, but as soon as this has been done you should be in a position to roll out the suggested changes. Don't go in to this meeting under prepared, or the whole process risks stalling.

The "systematic application of recognized techniques," referred to in the definition of value engineering, is embodied in the Job Plan. It is an organized plan of action for accomplishment of VE studies, including implementation of recommended changes in a design.

No single phase of a Value Study is apt to show anything startling to new Value Study Team members. Rather, it is the arrangement and application of the segments of the VE methodology, the use of creative techniques at the proper time, and the general philosophy that are new and unique. This is what makes VE effective. It is not "something we (designers) do all the time."

Value Engineering is a procedure enabling one to exercise underutilized human creative potential to solve problems. This is accomplished through adherence to a precise sequence of steps known as the Job Plan.

The key features separating the Job Plan from other methods used to solve routine engineering problems or to carry on cost reduction activities are:

• Analysis of function
• Use of specific creative effort to develop many designs alternatives
• The principle of not degrading the performance needed by the user
• Assigning costs to perform each function.

In VE, as in other problem-solving methods, a systematic approach produces better results than undisciplined ingenuity. Strict adherence to the Job Plan provides:

1. A vehicle to carry the Value Study from inception to conclusion.
2. A convenient basis for maintaining a written record of the effort as it progresses.
3. Assurance that consideration has been given to facts that may have been missed in the creation of the original design or plan.
4. A logical separation of the Value Study into units that can be planned, scheduled, budgeted, and assessed. The use of the Job Plan and its associated techniques of analysis of function and application of creativity often yields more cost reduction without adversely affecting performance. In many cases, through design simplification, reliability, maintainability and quality is improved.

The following table illustrates the actions required, decisions to be made, and the responsible decision-maker at key points in the Value Study.

Job Plan Points of Decision			
POINT OF DECISION	**ACTION / CONSIDERATION**	**DECISION**	**WHO MAKES THE DECISION**
Selection of Project	Select projects for the study. Estimate the potential of the study candidates	Decide to proceed with a study for the project	Management
After the Information Phase	Select specific elements within the project for study	Decide to proceed with study for the project	Value Study Team
After the Evaluation Phase	Select Ideas likely to be successful. Estimate the potential of the Ideas	Decide to proceed with the Development of the best Ideas	Value Study Team
After the Presentation Phase	Consider the impact of the proposed Recommendations	Decide to Implement the proposed Recommendations	Management
Upon Completion of the Job Plan	Review the results	Decide further program action	Management

Figure 4. Point of Decision Table "(Value Engineering-Workshop Guide)."

To apply the Job Plan, two important factors must be recognized:

1. An effective VE effort must include all phases of the Job Plan. Omissions of any one of the phases will hamper accomplishment of the objectives. The amount of attention given to each phase, however, may differ from one project to another.

2. Execution of the Job Plan requires a team effort. The cooperation and active participation of several people produces the most effective results. Group dynamics play an important role, and illustrate that the results of a team of five professionals is greater than the sum of five individual efforts.

6- CASE STUDY 1 – PROTOTYPE -01 (PASSPORT PROJECT).

6.1 PROJECT DESCRIPTION

The project site area is approximately 22,012 m2 and it is designed in a prototype approach so that it can be constructed in many cities in Kingdom of Saudi Arabia

approach so that it can be constructed in many cities in Kingdom of Saudi Arabia.

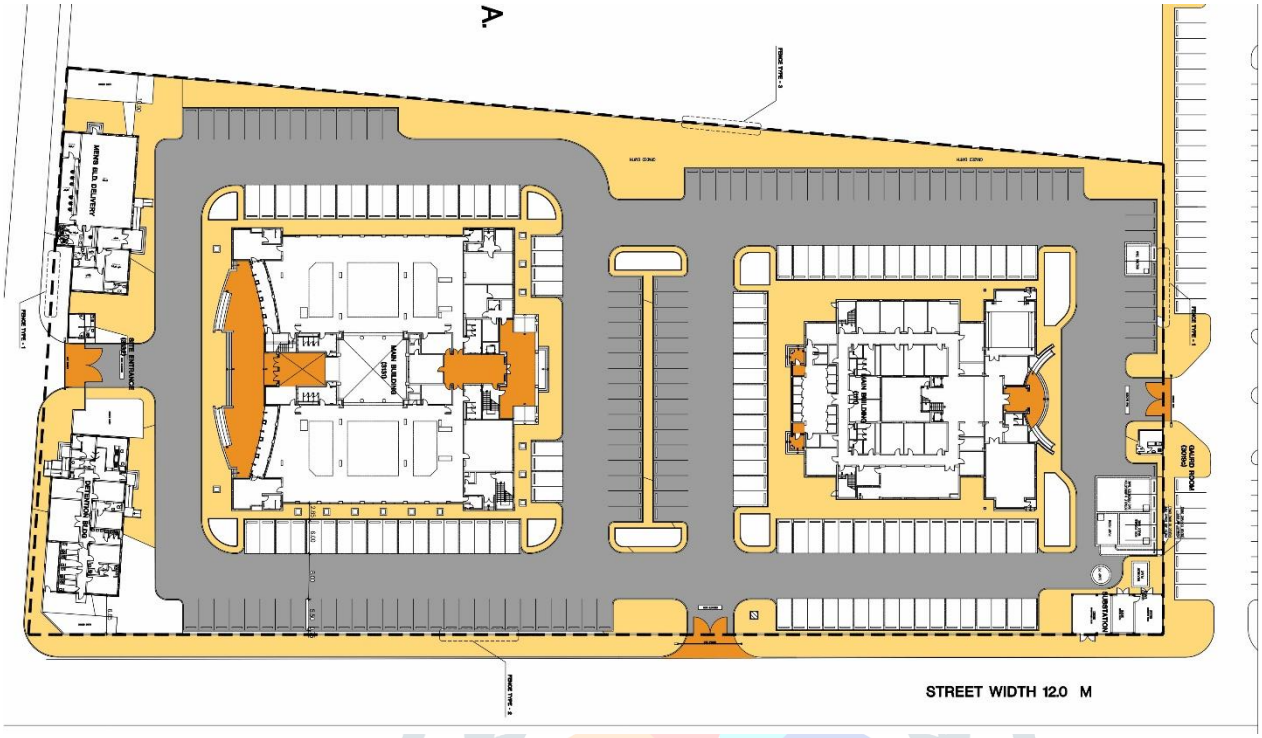


Figure 5. Prototype -01 Master plan

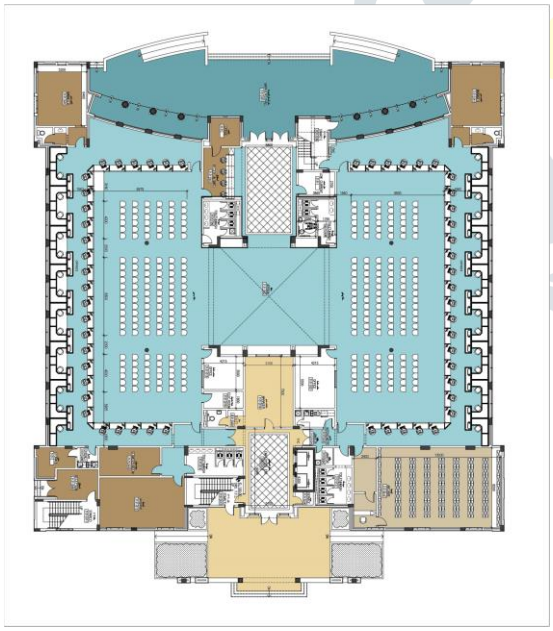


Figure 6. Main Building 1111

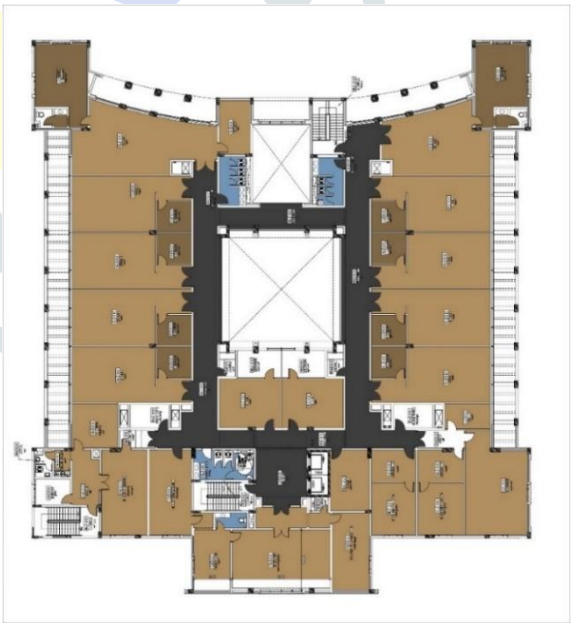


Figure 7. Main Building 13131

The project buildings include the following structures and facilities:
The break of total development area as follow:

Total Site Area (m2)	22,012
Main Building 1111 (m2)	6,297
Main Building13131 (m2)	3,842
Ancillary Building (m2)	867
Ancillary -2 Building (m2)	354

Delivery Buildings (m2)	354
Site Entrance (m2)	21
Guard Room (m2)	20
Sub-Station (m2)	116
Site Development (m2)	11,066

Figure 8. The break of total development area

6.2 VALUE ENGINEERING STUDY

The VE study is organized into three distinct parts as indicated in **Figure 9**: (1) Pre-workshop Preparation; (2) VE Study Workshop; and, (3) Post-workshop Implementation. **Figure 10** is the Value Enhancement - Task Flow Diagram which outlines the VE study procedures.

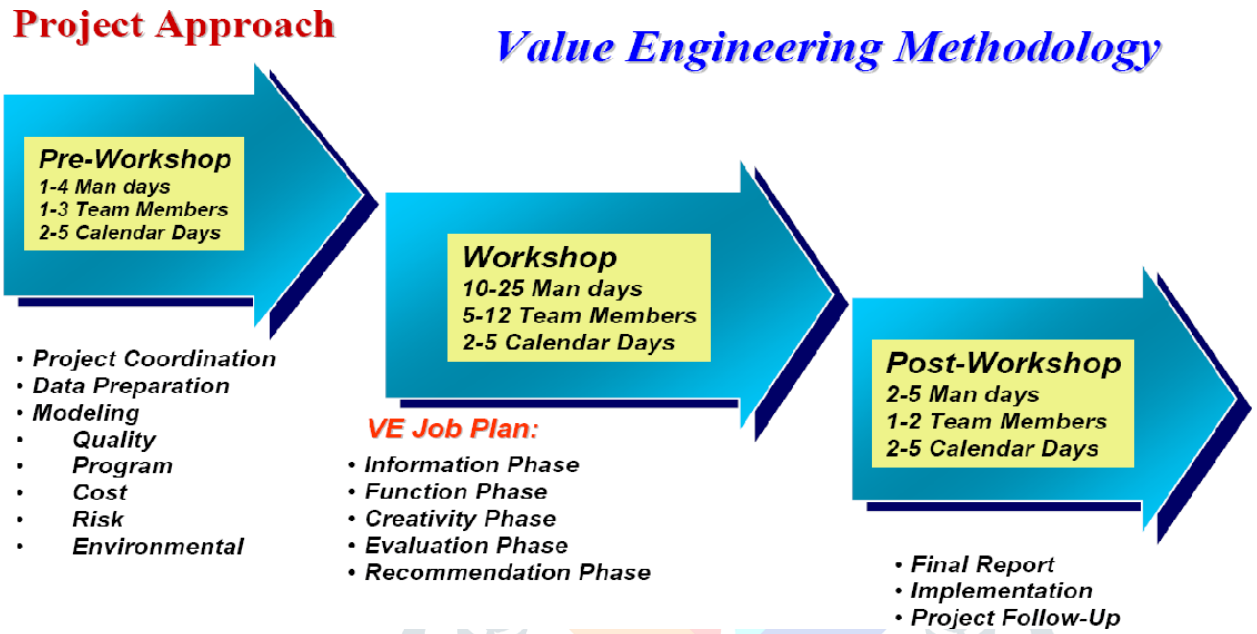


Figure 9. value engineering procedures "Ratnam Jeyakumar (2013)."

Value Enhancement - Task Flow Activities	
Pre-Study	
Project Coordination:	Distribute plans, specifications, notes & project cost estimate
Data Preparation:	Prepare agenda, attendance list, function analysis, FAST diagram
Modeling:	Quality (if applicable), Risk, Cost, Cost Model, Pareto Chart etc
Study Workshop (Phases)	
Information:	Secure facts, determine the cost, and fix costs on specific requirements.
Function:	Verb/noun definitions of function, value function relationships (function logic diagrams) and cost/resource loaded functions.
Creativity:	Establish positive thinking; develop creative ideas in a team setting.
Evaluation:	Refine and combine ideas, establish costs on as many ideas as possible, develop function alternatives and evaluate by comparison.
Recommendation:	Present proposals that resolve the study issues and mandate action.
Post-Study Implementation Procedures	
Study Report Acceptance and Implementation of Proposals & Project Follow-up	

Figure 10. Value Enhancement - Task Flow Activities "Ratnam Jeyakumar (2013)."

6.2.1 PRE-WORKSHOP STAGE

Pre-Study Preparation The success of the VE study is largely dependent on proper preparation and coordination. Information and documents are furnished by the owner and are distributed to the team to prepare them for their area of study. All participants are briefed on their role and responsibility during the study.

The pre-study effort includes the following activities:
Identification of constraints to the VE study
Review of project documentation and distribution of information to team members

Finalization of team and team assignments
Preparation of cost model
Preparation of other models such as appropriate (energy, quality, LCC, time, risk, etc.)
Finalization of arrangements for workshop

The VE team relies on the owner for the completeness and organization of the material to be furnished. The following data is normally provided for the study:
Facility Program and Objectives (Basis of Design)
Design Standards & Codes
Master Site Plan (including Site Analysis)
Design Calculations (as appropriate), Soil Borings
Design Drawings and Preliminary Specifications
Estimate of Construction Cost (including back-up)
Architectural and Engineering Concepts Description

Space Model
Space information for the all the building was used during the study is normally prepared by the design team's estimators and handed over to the VE team leader on the first day of this study. Based on available information space model was prepared,

Cost Model
Cost information used during the study is normally prepared by the design team's estimators and handed over to the VE team leader on the first day of this study. A cost model could be prepared from this information. The cost model distributes costs by function and is used by the VE team to help identify areas of potential savings. For this project, detail cost estimate was available; therefore, the function cost\ worth model was developed for the final design submittal.

Figure 11. Value Formula "(Value Engineering-Workshop Guide)."

A functional cost analysis approach was employed during the VE workshop.

Risk Model
The risk model identifies the areas of high, medium and low risk within the project. This will make the VE team focus on high and medium risk areas and generate ideas to mitigate and minimize risk within the project. A risk model was developed for this project.

Risk Model

ELEMENTS	RISK AREAS	N/A	LOW	MEDIUM	HIGH
A. MANAGEMENT, FINANCIAL & ADMINISTRATIVE RISKS	Public and political perspectives		●		
	Budget limitations, approvals process, & other constraints		●		
	Site acquisition				●
	Permit delays		●		
	Agency jurisdictions and conflicts		●		
	Project mgt., organization, decision-making processes, info flow		●		
	Labor union issues		●		
	Budget Allocation		●		
B. ENVIRONMENTAL, GEOTECHNICAL RISKS	Inclement weather, storms, floods		●		
	Hazardous waste disposals, site remediation		●		
B. ENVIRONMENTAL RISKS	Environmental restrictions (air quality, noise, toxic mat., etc.)		●		
	Contaminated soils remediation		●		
	Groundwater remediation		●		
	Underground cavities		●		
	Inadequate subgrade geotechnical testing	○			
	Unanticipated archaeological or historical findings		●		
	Corona Pandemic		●		
C. TECHNICAL RISKS	Systems, processes, and material		●		
	New, unproven systems, processes and materials		●		
	Other:	○			
D. IMPLEMENTATION RISKS	Design approvals and changes		●		
1. Design	Design errors and omissions		●		
	Untested and unproven design features and innovations		●		
	Other:	○			
2. Construction	Availability of qualified contractors or skills		●		
	Construction material requirements		●		
	Inadequate or unclear specs for mat'ls & workmanship		●		
	Labor negotiations/work stoppages		●		
	Operator training/certification		●		
	Management of Contractor/ subcontracts		●		
	Other:	○			
3. Change Orders	Design Basis Changes		●		
	Design Development Changes		●		
	Field Changes		●		

ELEMENTS	RISK AREAS	N/A	LOW	MEDIUM	HIGH
	Rejects, defects		●		
	Malfunctions or failures		●		
	Other:	○			
5. Project Controls	Planning		●		
	Scheduling		●		
	Estimating and cost control				●
	Other: Contract Management		●		
6. Logistics, Transportation	Laydown areas limitations		●		
	Traffic congestion at site or access to site			●	
	Transportation difficulties for construction mat'ls		●		
	Other:	○			
7. Interference and Maintenance of Services	Interference with other work		●		
	Maintenance of certain essential services during construction		●		
	Tie-ins/cutovers with utilities		●		
8. Condition of Existing (For renovation, rehab. repair projects)	Condition of existing structure and material	○			
	Tie-ins	○			
	Relocation of transformers	○			
	Other:	○			
9. Safety and Hazards During Construction	Safety to contractor and project personnel		●		
	Safety to owner and non-project personnel		●		
	Other:	○			
10. Process start-up and Commissioning	Testings' and test planning and scheduling		●		
	Malfunctions and failures		●		
	Security		●		
	Inadequate documentation and/or training		●		
	Other:	○			

Figure 12.Risk Model

Cost Model

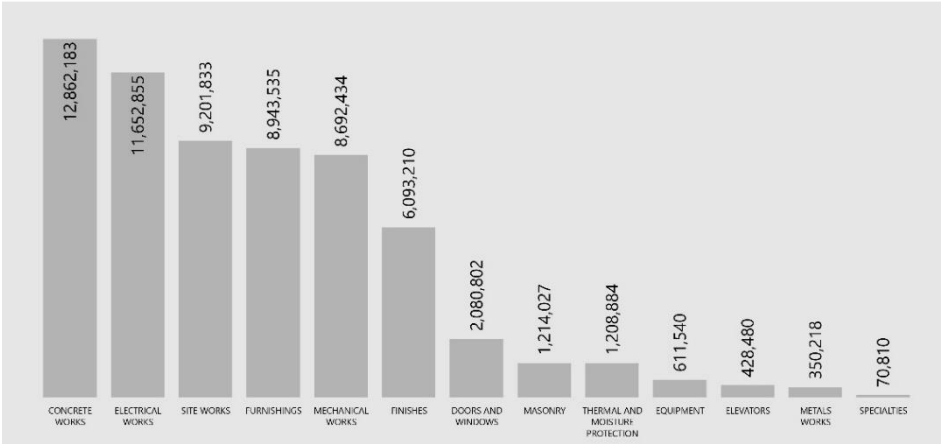


Figure 13. Cost Model

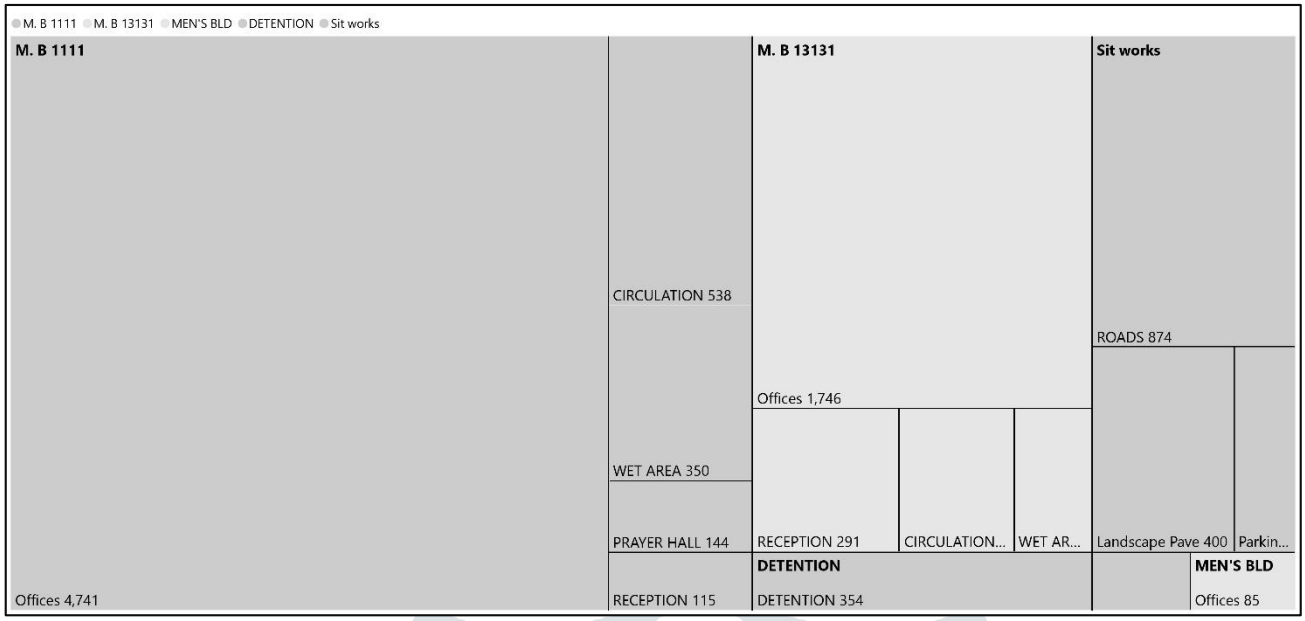


Figure 14. Space Model

6.2.2 WORKSHOP STAGE

During the actual workshop portion of the VE study, VE Job Plan is followed. The VE Job Plan is an organized approach for searching out high-cost areas in the design and developing alternate solutions for consideration. The workshop session uses a multi-disciplined team following an agenda which details the Job Plan to arrive ultimately at recommendations for implementation.

The VE Job Plan follows five key steps:

- Information Phase
- Function analysis Phase
- Creativity Phase
- Evaluation Phase
- Recommendation Phase

6.2.2.1 Information Phase

At the beginning of the VE study, it is important to understand the background and decisions that have influenced the development of the design. For this reason, the Owner/Designer normally presents orally, the building and process designs to the VE team. The site, building layout, process flows, and process equipment, architectural, structural, mechanical and electrical systems are discussed. The information phase also includes further refinement of the cost, space and other models that are prepared before the workshop session. These models are updated based on information received during the Owner/Designer's initial presentation. These models also form the basis of the VE team function analysis, which follows.

The following information is normally provided to the certified value specialist (CVS) two weeks prior to the value engineering study:

Economic Data

1. Desired return on investment (ROI)
2. Percent of equity by Owner
3. Financing period
4. Interest rate
5. Inflation rate on product market value
6. Escalation rates to be used for this project.
7. Life span to be used for analysis purposes
8. Cost estimate (breakdown) or all process equipment and facilities expected to be procured.

Other Data

1. Project goals and objectives
2. Project constraints
3. Special requirements or criteria (i.e., flexibility, O&

Building/ Process Data

1. Plans
2. Specifications
3. Equipment Lists
4. Project Cost Estimate
5. Geotechnical Report
6. Systems Design Calculations. “Ratnam Jeyakumar (2013)

6.2.2.2 Function analysis Phase

The required functions of the project are the controlling elements in the overall VE approach. This procedure is beneficial to the VE team because it forces the participants to think in terms of function, and the cost associated with that function.

This VE Study utilized the data collected from the information phase to produce several new ideas and proposals unique to this type of study.

A. Function Logic Diagram-

In order that the team might better understand the overall functions of the project, a "Function Logic Diagram" is prepared. Reading from left to right, it is used to help explain **How** the designer chose to solve the functions. The function logic diagram, **why** read from right to left, also helps answer why these functions are important to the owner.

This diagram normally translates production goals, objectives and tasks into a hierarchical logic diagram of functions for a better in-depth understanding of the owner needs. The FAST diagram prepared by the VE team leader during this VE workshop was used as a baseline for this VE study. The diagram was reviewed by the VE team and the owners.

B. Function-Cost-Worth

This technique associates' tasks performed with functions required to satisfy customer needs. Costs are identified for performing the functions. The worth of a function is usually determined by comparing the present design in performing the function with other alternatives that performing essentially the same functions for less cost and higher quality. Therefore, worth can be defined as the least cost to perform a function and it is determined through special skills like experience, knowledge from previous or similar projects, judgment of the VE team, or by bench marking like comparing the relative

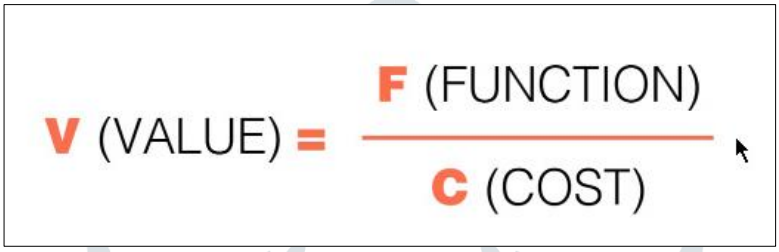


Figure 15.Valu Index "GARRY NESS (2023)."

costs of alternative ways of performing the functions or by setting an objective or target of saving range that the VE team will try to achieve as a goal during the VE workshop to

meet project budget. The worth indicated in the function analysis sheet is established after associating cost to functions then projecting the worth of functions by VE team participants experiences; then it was used to determine the value index which is the ratio of cost over worth ratio of each function of the project. The value index is a good measure of value which indicates the high-cost items and also identifies the poor value areas in the project. These specific areas and other related components were addressed during evaluation phase after the creativity phase to search for better alternative solutions that can improve value and improve function-cost relationship.

How is value maintained or increased for a customer?

You can increase the value of a product to a customer by increasing or maintaining the function, or by reducing the cost, or by a mixture of both: "(GARRY NESS)

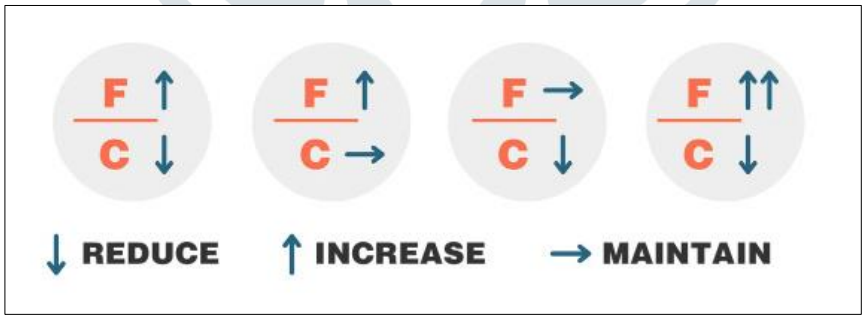


Figure 16. function/cost formula. "GARRY NESS (2023)."

No.A 4:M 41	ITEM	FUNCTION		KIND	PROJECT SPACES	COST (SR) / M2	PROJECT COST (SR)		VALUE INDEX	COMMENTS
		VERB	NOUN		ACTUAL		COST	WORTH		
B = Basic Function				S = Secondary Function			RS = Required Secondary			
1	Main Building 1111	Manage	Office Work	B	6,297		19,298,775	13,972,220	1.38	value imporvment potential
1.1	MAIN ENT. HALL	receive	employees	RS	115	3,064.76	352,447	352,447	1.00	good value
1.2	LECTURE HALL	transfer	knowledge	S	144	3,064.76	441,325	441,325	1.00	good value
1.3	PRAYER HALL	perform	prayer	S	144	3,064.76	441,325	441,325	1.00	good value
1.4	Offices	perform	work	RS	4,741	3,064.76	14,530,013	10,000,000	1.45	value imporvment potential
1.5	Sairs& Lift	Transfer	People	RS	538	3,064.76	1,648,839	1,400,000	1.18	value imporvment potential
1.6	TOILET	dispose	Human waste	RS	505	3,064.76	1,547,702	1,000,000	1.55	value imporvment potential
	Kitchen	prepare	food	S						value imporvment potential
1.7	STORE	Store	Material	S	110	3,064.76	337,123	337,123	1.00	good value
2	Main Building 13131	Manage	Public Work	B	3,842		17,711,562	14,500,000	1.22	
2.1	audience hall	Manage	Visitor	RS	1,224	4,609.99	5,642,622	4,500,000	1.25	value imporvment potential
2.2	MAIN ENT.	receive	Visitor	RS	150	4,609.99	691,498	500,000	1.38	value imporvment potential
2.3	ATRIUM./Courtyard	allow	Sunlight	S	141	4,609.99	650,008	500,000	1.30	value imporvment potential
2.4	Offices	perform	work	RS	1,746	4,609.99	8,049,034	7,000,000	1.15	value imporvment potential
2.5	TOILET	dispose	Human waste	RS	155	4,609.99	714,548	500,000	1.43	value imporvment potential
	Kitchen	prepare	food	S						
2.6	.Sairs& Lift	Transfer	People	RS	226	4,609.99	1,041,857	800,000	1.30	value imporvment potential
2.7	ARCHIVE	Maintain	Record /document	S	200	4,609.99	921,997	700,000	1.32	value imporvment potential
3	Ancillary Buildings	Support	PASSPORT BUREAU	RS	867		8,307,843	6,940,805	1.20	
3.1	DETENTION BUILDING	Interrogate	Suspect	RS	354	6,568.59	2,325,281	2,325,281	1.00	good value
3.2	MEN`S BLD. DELIVERY	deliver	document	RS	354	5,537.07	1,960,123	1,500,000	1.31	value imporvment potential
3.3	SITE ENTRANCE (3132)	allow	traffic	Rs	21	22,550.87	473,568	250,000	1.89	value imporvment potential
3.4	GAURD ROOM (3019c)	Secure	Premises	RS	20	12,482.18	249,644	250,000	1.00	good value
3.5	SUBSTATION	Transfer	Power	RS	116	27,445.71	3,183,703	2,500,000	1.27	value imporvment potential
3.6	KIOSK	control	Traffic	S	2	57,762.18	115,524	115,524	1.00	good value
Sub Total for Buildings					11,006	186,069.80	45,318,181	35,413,025	1.28	
4	Site Development	Develop	Site	RS	22,012		5,714,702	3,419,956	1.67	
4.1	Sit works	Improve	Site Features	RS	400	6,613.62	2,645,446	2,200,000	1.20	value imporvment potential
4.2	Car shade	protect	Vehicle	S	174	12,352.30	2,149,300	300,000	7.16	value imporvment potential
4.3	Roads	Facilitate	Vehicular Movement	RS	874	1,052.58	919,956	919,956	1.00	good value
Sub Total for Site Works					22,012	1812.49	39,896,617	3,419,956		
5	MEP Works (Equipment)	Control	Building Operation	RS			12,377,880	10,000,000		
5.1	HVAC	Control	Temperature	RS			3,864,726	3,000,000	1.29	value imporvment potential
	Fire Fighting	Extinguish	Fire	RS						
	Plumbing	Transport	Water	RS						
5.3	Electrical Works	Power	Equipment	RS			8,513,154	7,000,000	1.22	value imporvment potential
Sub Total for MEP							12,377,880	10,000,000	1.24	value imporvment potential
Total Project Cost							63,410,762	48,832,981	1.30	value imporvment potential

Figure 18. VE workshop function analysis worksheet.

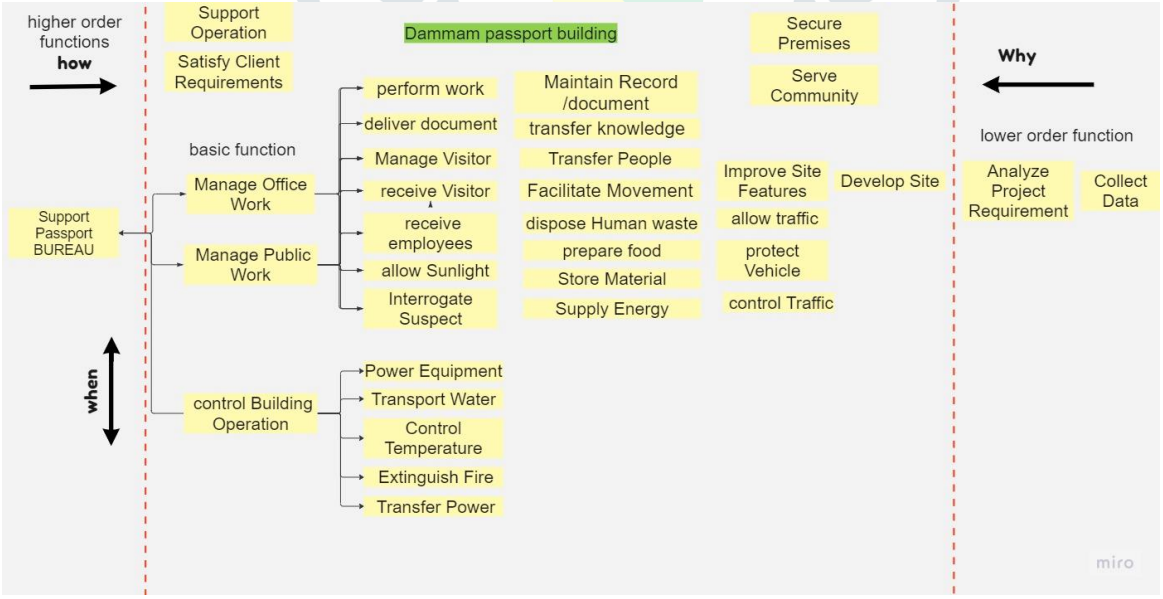


Figure 17. Function Logic Model - FAST.

6.2.2.3 Creativity Phase

This step in the value engineering study involves the listing of creative ideas. During this time, the value engineering team thinks of as many ways as possible to provide the necessary functions within the project at a lesser cost to the owner. During this creative session, judgment of the ideas is not permitted. Ideas to enhance the best features and ideas to improve on the weakest features are then generated. The best and weakest features are contained in this section of the VE report. The value engineering team is looking for quantity and association of ideas which will be screened in the next phase of the study. Many of the ideas brought forth in the creative phase are a result of work done in the function analysis. This list may include ideas that can be further evaluated and used in the design. The creative ideas generated during the workshop are included in this section of the VE report on the **Creativity / Evaluation Worksheet.**

6.2.2.4 Evaluation Phase

In this phase of the project, the value engineering team judges the ideas resulting from the creative session. The advantages and disadvantages of each idea are discussed. Ideas are ranked based on the evaluation criteria mentioned below. Ideas found to be not worthy of additional study are ranked low and those ideas that represent the greatest potential are ranked high for proposal development. A weighted evaluation is applied in some cases to account for impacts other than costs.

Evaluation Criteria:

- Meet functions
- Ease of Construction
- O&M
- Cost
- Quality
- Acceptability

Ideally, the value engineering team would like to develop all ideas, but time constraints usually limit the number that can be prepared. The ideas ranked highest by the value engineering team are selected for further review with members of the design team for their input. During this phase many of the ideas are expanded into workable solutions. This development of these ideas consists of preparing estimated initial and life cycle costs, a descriptive evaluation of the advantages and disadvantages and engineering calculations as appropriate proposed recommendations. It is important that the value engineering team convey the concept of their recommendation to the owner/design team. Therefore, each recommendation is prepared with a brief narrative to compare the original design method to the proposed change. Sketches and associated materials, where appropriate, are also prepared in this part of the study.

No.	Idea Description	Meet Function	Improve Quality & add Value	Enhance O & M	Ease of Implementation	Owner Acceptability	Rank	
A	ARCHETICTURE							
A-01	Use Mobile Applications to facilitate automated services to reduce the number of visitors. (50% reduction in waiting area)	8	8	7	7	6	7	H
A-02	Use open space concept to save areas for other functions.	8	6	7	8	4	7	H
A-03	Provide Food and Beverage Areas in the two main buildings.	8	8	4	6	8	7	H

Figure 19. Creativity / Evaluation Worksheet.

6.2.2.5 Recommendation Phase:

The last phase of the value engineering study is the presentation of recommendations. The VE recommendations are further screened by the VE team before formal presentation. The oral presentation of results is made on the last day of the workshop to the owner/design team. The recommendations, the rationale that went into the development of each proposal and a summary of the cost savings are presented at this time so that the owner/design team can initiate an evaluation of the value engineering recommendations prior to the receipt of the formal VE report.

SUMMARY OF RECOMMENDATIONS

the Value Engineering Workshop provided valuable recommendations from an architectural standpoint for various spaces and functions in government projects. These recommendations aim to enhance the visitor experience, optimize office layouts, and identify investment areas for improved sustainability. By incorporating these suggestions, government projects can achieve better outcomes in terms of functionality, cost-efficiency, and environmental impact.

Proposal	Use Mobile Applications to facilitate automated services to reduce the number of visitors. (50% reduction in waiting area)	A-01
Original Design		
The original design of the audience hall encompassed a vast area of 1224 square meters		
Proposed Design		
A proposal has been put forward to leverage mobile applications and self-service machines as automated solutions to streamline services and decrease visitor numbers. By implementing these technologies, it is anticipated that the waiting area can be reduced by 50%, leading to more efficient processes and improved customer satisfaction.		
Advantages & Disadvantages		
Advantages:	**Disadvantages:**	

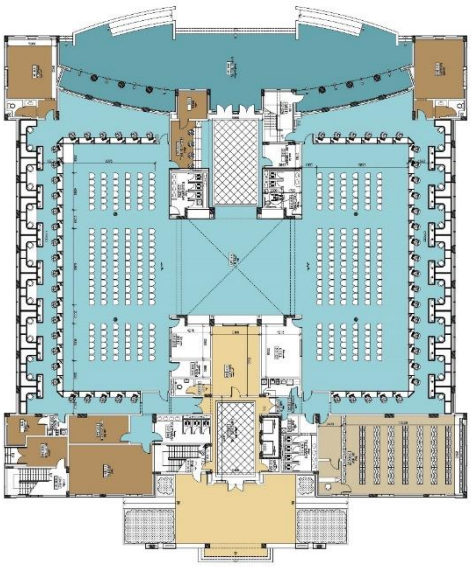
1.	Increased Efficiency: By leveraging automation	1	Dependency on Technology:
2.	scheduling Virtual queuing and appointments	2	Learning Curve and User Experience:
3.	Enhanced Customer Experience	3	Accessibility Challenges
4.	Reduced Waiting Area Congestion	4	Limited Personalized Assistance:
5	Improved Resource Allocation:		
6	Cost savings: By reducing the required space for appointment scheduling and services		
7	Integration and Data Insights: These technologies can be integrated with existing systems		

Discussion

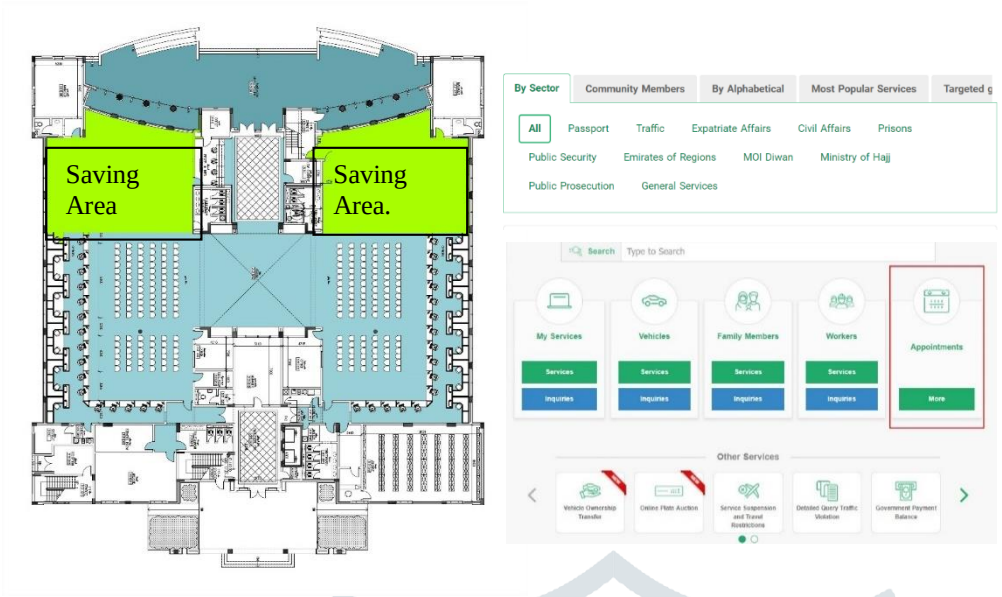
The idea of utilizing mobile applications and self-service machines to automate services and decrease visitor numbers has several advantages, including increased efficiency, enhanced customer experience, and reduced congestion. It offers cost savings, flexibility, and the potential for data insights. However, potential disadvantages include technological barriers, reduced personal interaction, accessibility challenges, security concerns, and dependency on technology. Striking a balance between automation and human touch, addressing user needs, and ensuring inclusivity are essential for successful implementation. Careful consideration and support are necessary to create a positive and satisfactory experience for visitors.

Sketch Worksheet	A proposal has been put forward to leverage mobile applications and self-service machines as automated solutions to streamline services and decrease visitor numbers. By implementing these technologies, it is anticipated that the waiting area can be reduced by 50%, leading to more efficient processes and improved customer satisfaction.	**A-01**

Original Design



Sketch Worksheet	A proposal has been put forward to leverage mobile applications and self-service machines as automated solutions to streamline services and decrease visitor numbers. By implementing these technologies, it is anticipated that the waiting area can be reduced by 50%, leading to more efficient processes and improved customer satisfaction.	**A-01**
Proposed Design		


Saving Area
Saving Area.
By Sector
Community Members
By Alphabetical
Most Popular Services
All
Passport
Traffic
Expatriate Affairs
Civil Affairs
Prisons
Public Security
Emirates of Regions
MOI Diwan
Ministry of Hajj
Public Prosecution
General Services
Search
Type to Search
My Services
Vehicles
Family Members
Workers
Appointments
Services
Inquiries
More
Other Services

Sketch Worksheet	A proposal has been put forward to leverage mobile applications and self-service machines as automated solutions to streamline services and decrease visitor numbers. By implementing these technologies, it is anticipated that the waiting area can be reduced by 50%, leading to more efficient processes and improved customer satisfaction.	**A-01**

Original Design

Item	Quantity	Unit	Unit Cost	Total
Main Building 13131-audience hall	1,224	m2	4,610	**5,642,622**
Subtotal				**5,642,622**
Markups		**%**		
			Total Cost (SR)	**5,642,622**

Proposed Design

Item	Quantity	Unit	Unit Cost	Total
Main Building 13131-audience hall	800	m2	4,610	**3,687,988**
Subtotal				**3,687,988**
			Total Cost (SR)	**3,687,988**

Potential Savings

			Potential Savings (SR)	**1,954,634**
Potential Savings %				**35 %**

Proposal	The adoption of an open space concept for office areas, as opposed to traditional closed spaces	A-02
Original Design		
The original design of the office area utilized enclosed spaces as a concept		
Proposed Design		
it is proposed to adoption of an open space concept for office areas, as opposed to traditional closed spaces		

Advantages & Disadvantages

Advantages:		**Disadvantages:**	
1.	Space Optimization	1	Lack of Privacy
2.	Collaboration and Communication	2	Noise and Distractions:
3.	Flexibility and Adaptability	3	Lack of Personalization
4.	Cost Savings	4	Difficulty in Managing Distractions
5	Enhanced Creativity and Innovation:		
6	Natural Light and Well-being:		

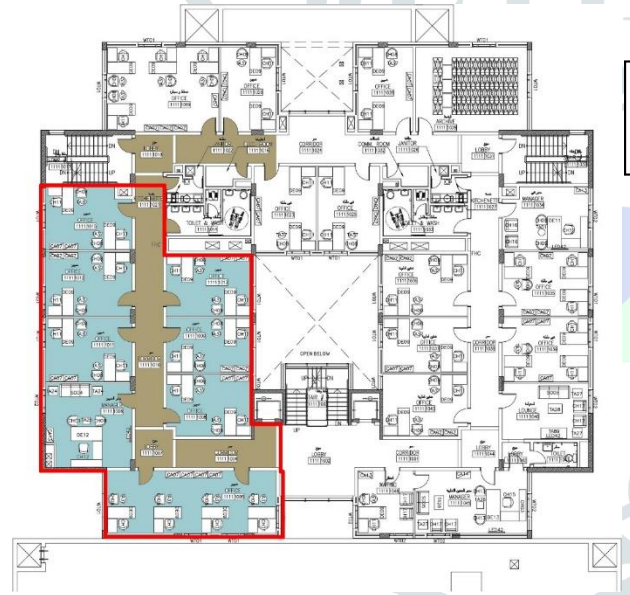
7	Cost-Efficient Technology Integration		

Discussion

Adopting an open space concept for office areas involves creating a collaborative and flexible work environment by eliminating individual cubicles or enclosed offices. It optimizes space utilization, promotes collaboration, and potentially saves costs. However, privacy concerns, distractions, and employee well-being must be addressed. Solutions like designated quiet areas and involving employees in the design process are important. The goal is to create a dynamic and productive workspace that balances collaboration and individual focus.

Proposal	The adoption of an open space concept for office areas, as opposed to traditional closed spaces	A-02

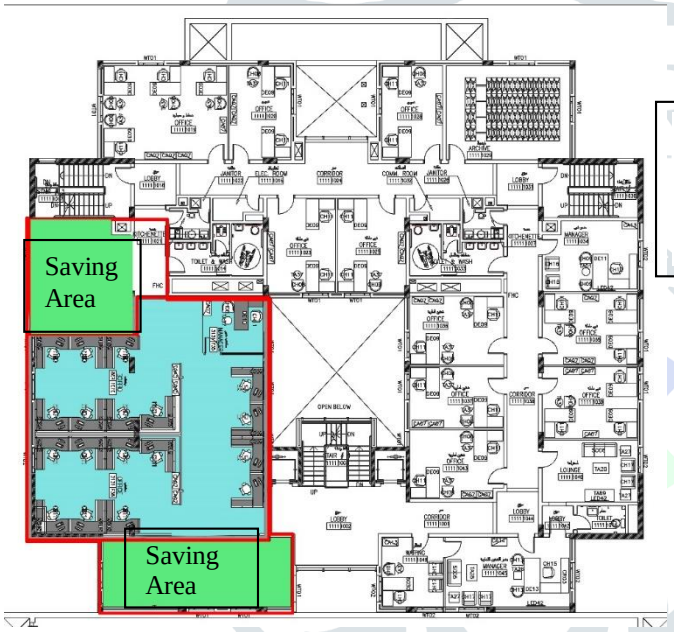
Original Design



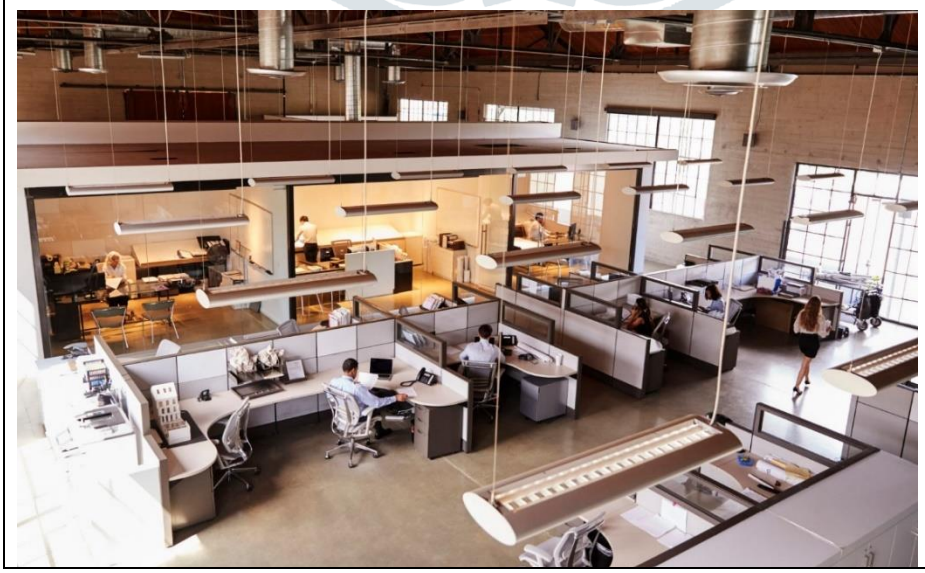
Number of offices = 16 offices
+ 1 Manger
Total area =266 m2

Proposal	The adoption of an open space concept for office areas, as opposed to traditional closed spaces	A-02

Proposed Design



Number of offices = 18 offices + 1 Manger
Total area =172 m2
Proposed saving area = 94 m2
Saving % = 35%



Proposal	The adoption of an open space concept for office areas, as opposed to traditional closed spaces	A-02

Original Design

Item	Quantity	Unit	Unit Cost	Total
Main Building 1111- offices area	4,741	m2	3,065	**14,530,013**
Subtotal				**14,530,013**
Markups		**%**		
			Total Cost (SR)	**14,530,013**

Proposed Design

Item	Quantity	Unit	Unit Cost	Total
Main Building 1111- offices area 25%	3556	m2	3,065	**10,899,140**
Subtotal				**10,899,140**
			Total Cost (SR)	**10,899,140**

Potential Savings

			Potential Savings (SR)	**3,630,873**

Potential Savings % **25 %**

Proposal	Proposed to providing food and beverage areas within the main buildings adds investment value for main building.	A-03
Original Design		
the original design not Consider adding food and beverage areas to the main buildings.		
Proposed Design		
it is to Proposed to providing food and beverage areas within the main buildings adds investment value for main building.		

Advantages & Disadvantages

Advantages:		**Disadvantages:**	
1.	Convenience for employees	1	increased demand for seating and space during peak hours.
2.	Time-saving, eliminating the need to leave the office premises.	2	Potential for additional noise and disruptions in the vicinity.
3.	Improved employee satisfaction and work-life balance.	3	Potential challenges in managing food safety and hygiene
4.	Foster social interaction and networking.	4	Limited food options or lack of variety.

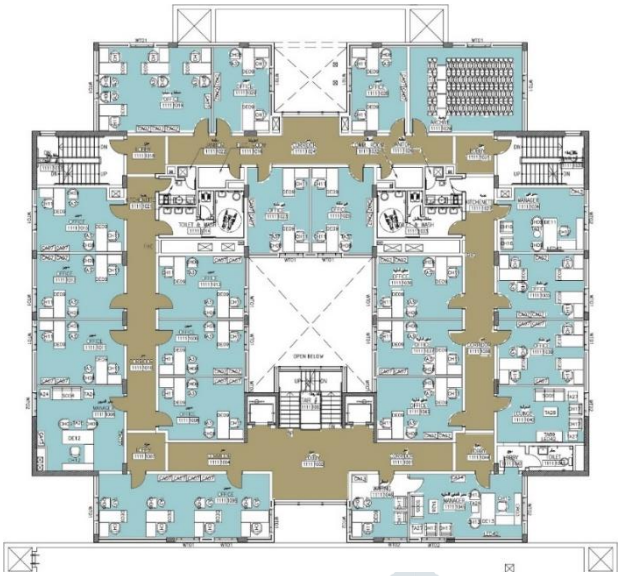
5	Enhance collaboration and cross-functional communication.		
6	Create a sense of community and belonging.		
7	Optimize space utilization.		

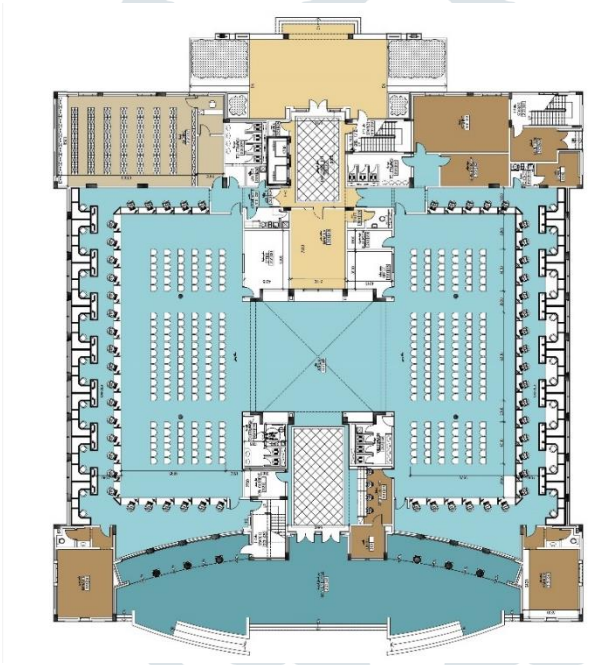
Discussion

Adding food and beverage areas within the two main buildings offers several advantages. It provides convenience for employees, saving them time and effort by eliminating the need to leave the office premises for meals. This enhances employee satisfaction, work-life balance, and overall well-being. The areas also foster social interaction, networking, and collaboration among colleagues. By offering diverse food options, including healthy choices, employee wellness is prioritized. However, potential drawbacks include increased costs, noise disruptions, and management challenges. Careful planning is required to optimize space, address seating demands, and ensure a positive dining experience for employees.

Proposal	Proposed to providing food and beverage areas within the main buildings adds investment value for main building	A-03

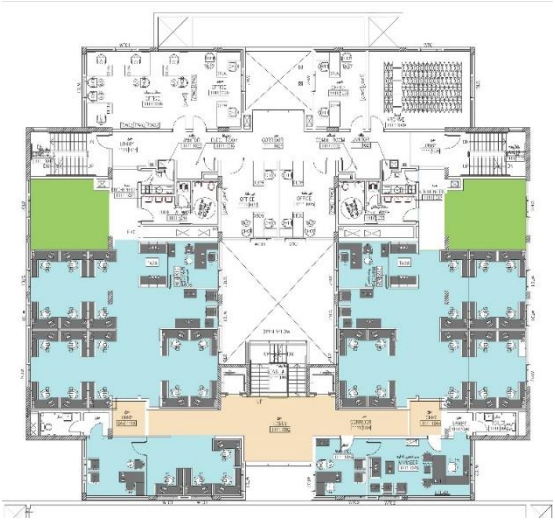
Original Design

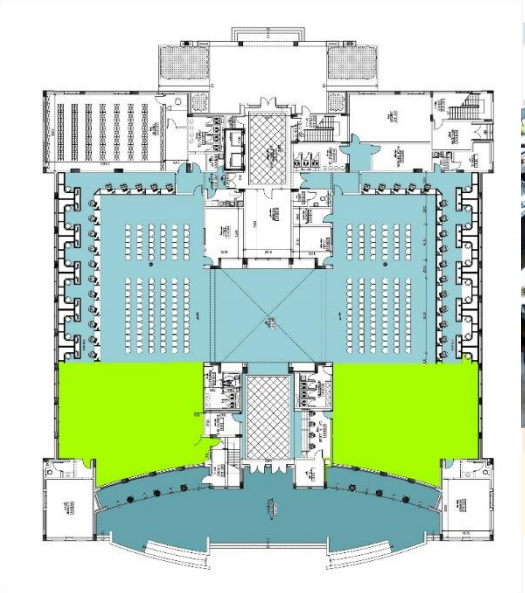




Proposal	Proposed to providing food and beverage areas within the main buildings adds investment value for main building.	A-03

Proposed Design





Proposal	Proposed to providing food and beverage areas within the main buildings adds investment value for main building.	A-03

Original Design

Item	Quantity	Unit	Unit Cost	Total

Markups		**%**		
			Total Cost (SR)	
Proposed Design				
Item	**Quantity**	**Unit**	**Unit Cost**	**Total**
Main Building 1111- Audience area- (F&B)	400	m2	4,610	**1,844,000**
Main Building 13131- offices area - (F&B)	180	m2	3,065	**551,700**
Subtotal				**2,395,700**
			Total Cost (SR)	**2,395,700**
Potential Savings				
			Potential Savings (SR)	**2,395,700**
Potential Savings %				**25 %**

6.2.3 POST STUDY PROCEDURES

The post study portion of the VE study includes preparation and submittal to the owner/design team, the Final Value Engineering Report incorporating the recommendations developed in the workshop. The owner/design team responds by either incorporating the recommendations into the design or presenting reasons for rejection. A summary of the cost savings resulting from the study is normally included in the owner/designer's response report.

This post study effort also requires continued project follow-up to resolve any questions remaining with the VE proposals. Either the value engineering team leader or the appropriate VE team member responsible for the proposal in question works directly with the owner/design team to finalize implementation.

7- CASE STUDY 2 – PROTOTYPE -02(CIVIL AFFAIRS PROJECT).

7.1 PROJECT DESCRIPTION

The project site area is approximately 23,107 m2 and it is designed in a prototype approach so that it can be constructed in many cities in Kingdom of Saudi Arabia.

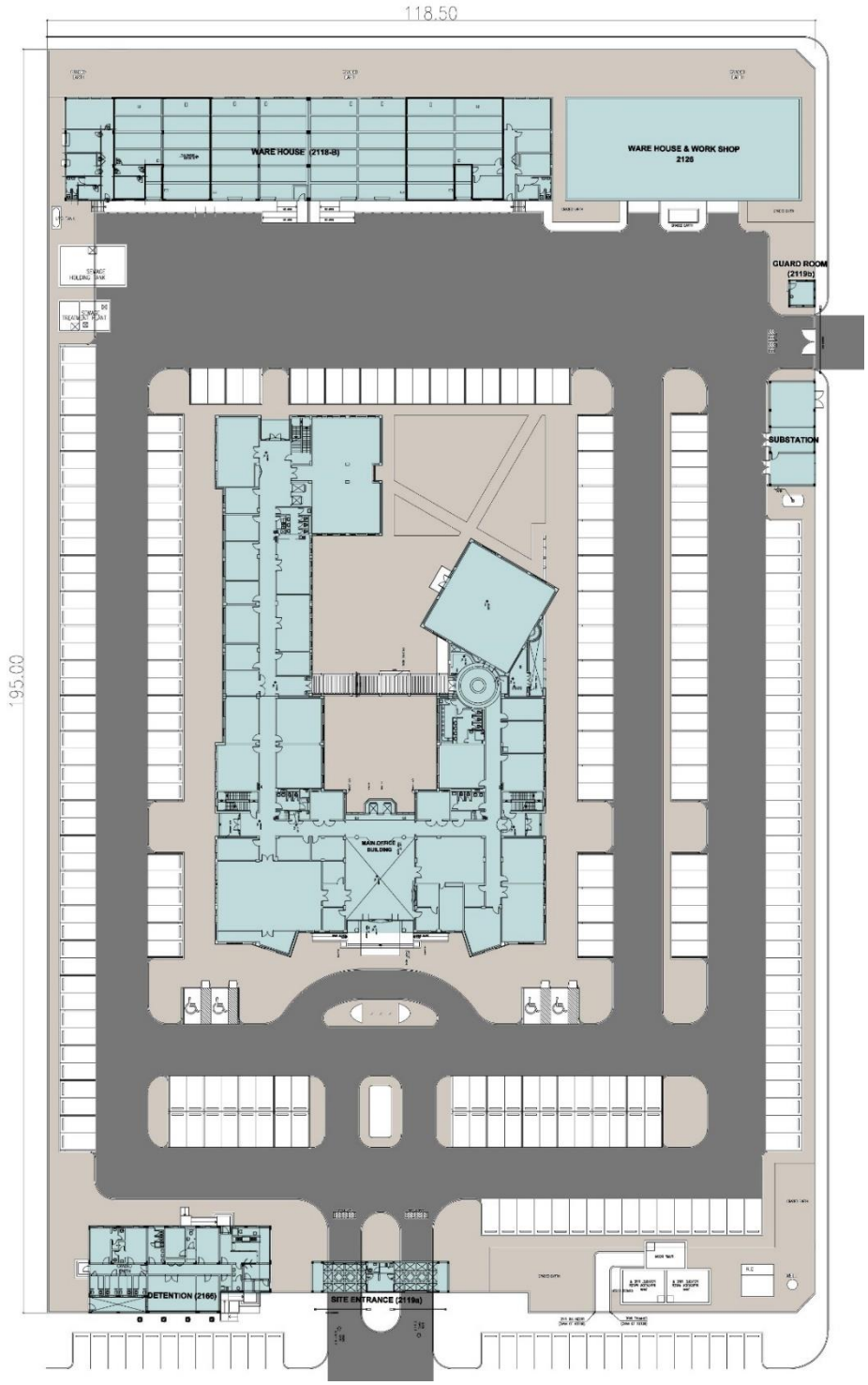


Figure 20. Master plan

The project buildings include the following structures and facilities:
The break of total development area as follow:

Total Site Area (m2)	23,107
Main Building (m2)	7,477
WAREHOUSE (m2)	1203
WORKSHOP (m2)	583

Ancillary Building (m2)	355
SUBSTATION (m2)	117
Site Entrance (m2)	102
Guard Room (m2)	18
Site Development (m2)	13,500

Figure 22. The break of total development area

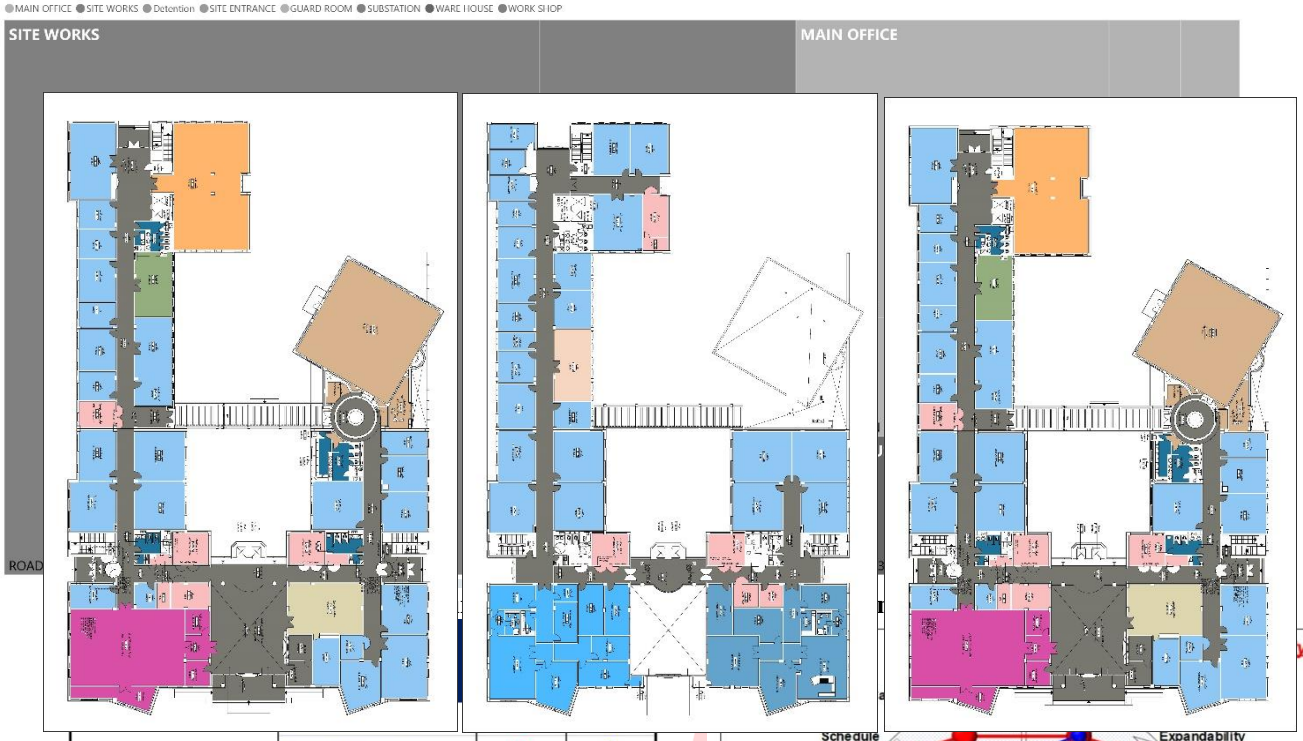


Figure 25. MB-F. Floor

Figure 24. MB-Sec. Floor

Constructibility	Expandability	9	7
	Material availabiity	8	8
Image	Building layout	9	6
	Site Feature/Landsape	9	7
	Architectural Perspective	8	7
Technology	System Performance	10	7
	Safety & Security	10	9
	Security Control Equipment	9	8
Resources	O & M/ LCC Cost	9	7
	Schedule	9	7

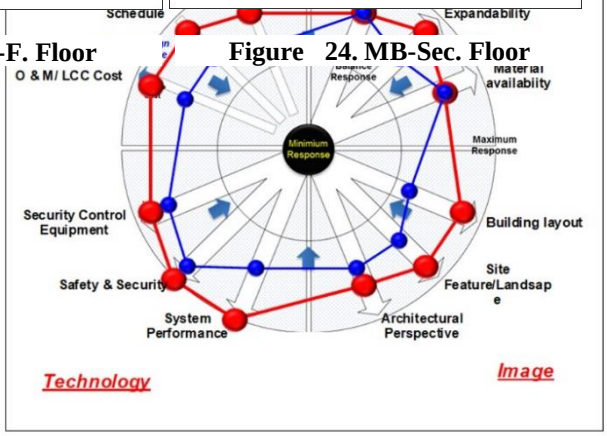


Figure 27. Quality Model

Figure 23. MB- G. Floor

RISK MODEL

Telecommunication Systems Head Quarter-KSA MOI

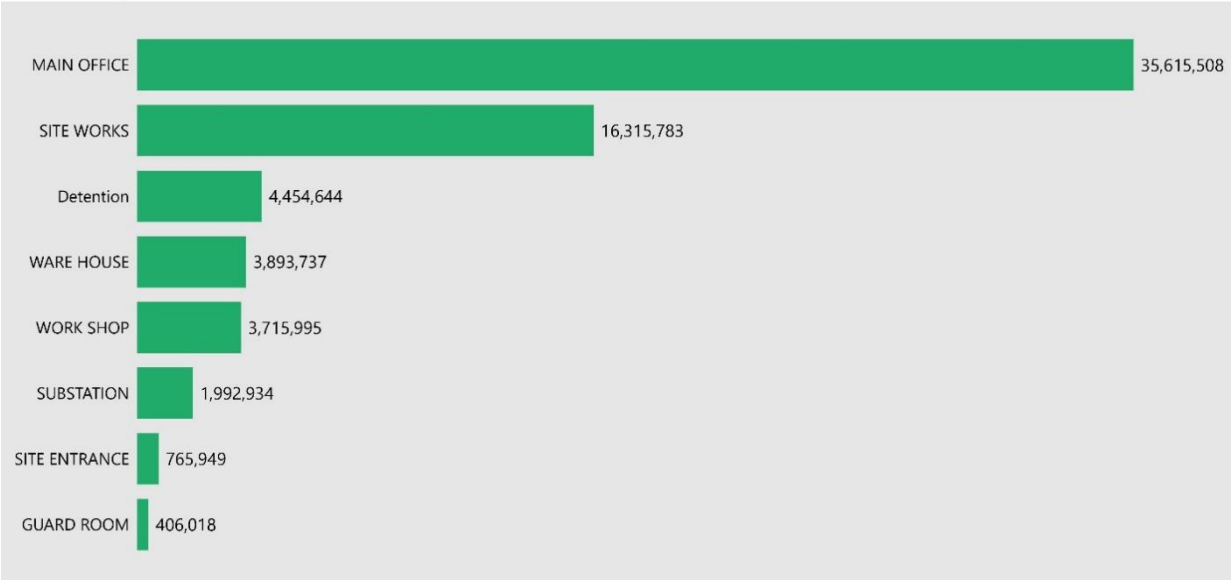
A. MANAGEMENT, FINANCIAL & ADMINISTRATIVE RISKS	Public and political perspectives	○		
	Budget limitations, approvals process, & other constraints		●	
	Permit delays	○		
	Agency jurisdictions and conflicts		●	
	Project mgt., organization, decision-making processes, info flow		●	
	Labor union issues		●	
	Budget Allocation	○		
B. ENVIRONMENTAL, GEOTECHNICAL RISKS	Inclement weather, storms, floods			●
	Hazardous waste disposals, site remediation		●	
B. ENVIRONMENTAL RISKS	Environmental restrictions (air quality, noise, toxic mat., etc.)		●	
	Contaminated soils remediation		●	
	Groundwater remediation		●	
	Underground cavities		●	
	Inadequate subgrade geotechnical testing	○		
	Unanticipated archaeological or historical findings		●	
	Corona Pandemic		●	
C. TECHNICAL RISKS	Systems, processes, and material		●	
	New, unproven systems, processes and materials		●	
	Other:	○		
D. IMPLEMENTATION RISKS 1. Design	Design approvals and changes		●	
	Design errors and omissions		●	
	Untested and unproven design features and innovations	○		
	Other:	○		
2. Contruction	Availability of qualified contractors or skills			●
	Construction material requirements			●
	Inadequate or unclear specs for mat'ls & workmanship			●
	Labor negotiations/work stoppages			●
	Operator training/certification			●
	Management of Contractor/ subcontracts			●

Figure 26. Risk Model

3. Change Orders	Design Basis Changes		●	
	Design Development Changes			●
	Field Changes			●
4. Equipment/Material	Availability		●	
	Rejects, defects			●
	Malfunctions or failures			●
	Other:	○		
5. Project Controls	Planning		●	
	Scheduling		●	
	Estimating and cost control		●	
	Other: Contract Management		●	
6. Logistics, Transportation	Laydown areas limitations			●
	Traffic congestion at site or access to site			●
	Transportation difficulties for construction mat'ls			●
	Other:	○		
7. Interference and Maintenance of Services	Interference with other work		●	
	Maintenance of certain essential services during construction		●	
	Tie-ins/cutovers with utilities		●	
8. Condition of Existing (For renovation, rehab. repair projects)	Condition of existing structure and material	○		
	Tie-ins	○		
	Relocation of transformers	○		
	Other:	○		
9. Safety and Hazards During Construction	Safety to contractor and project personnel		●	
	Safety to owner and non-project personnel		●	
	Other:		●	
10. Process start-up and Commissioning	Testings' and test planning and scheduling		●	
	Malfunctions and failures		●	
	Security		●	
	Inadequate documentation and/or training		●	
	Other:	○		

	POSITIVE	NEGATIVE
INTERNAL	**Strengths** 1. *Site Location* 2. *Security Control* 3. *Vehicular Circulation* 4. *Pedestrian Circulation* 5. *Easy Constructability* 6. *Easy availability of Material*	**Weaknesses** 1. *Poor future Expansion* 2. *Missing Comfort Areas/Spaces* 3. *Missing Food & Beverage Area* 4. *Inappropriate Mosque location and area* 5. *Poor building layout* 6. *Wastage of area in reception hall* 7. *Extra spaces in all functional areas* 8. *Extra cost of furniture for MPH*
EXTERNAL	**Opportunities** 1. *Use of e-gov application system* 2. *Enhance processing of public services through e-gov and smart techniques.* 3. *Reduce no of processes to facilitate public services like "one window"*	**Threats** 1. *Excessive no of employees* 2. *Outdated technology and operational systems* 3. *Poor environmental sustainability of project buildings Design* 4. *Poor environmental sustainability of project material*

Figure 28. SWAT Model



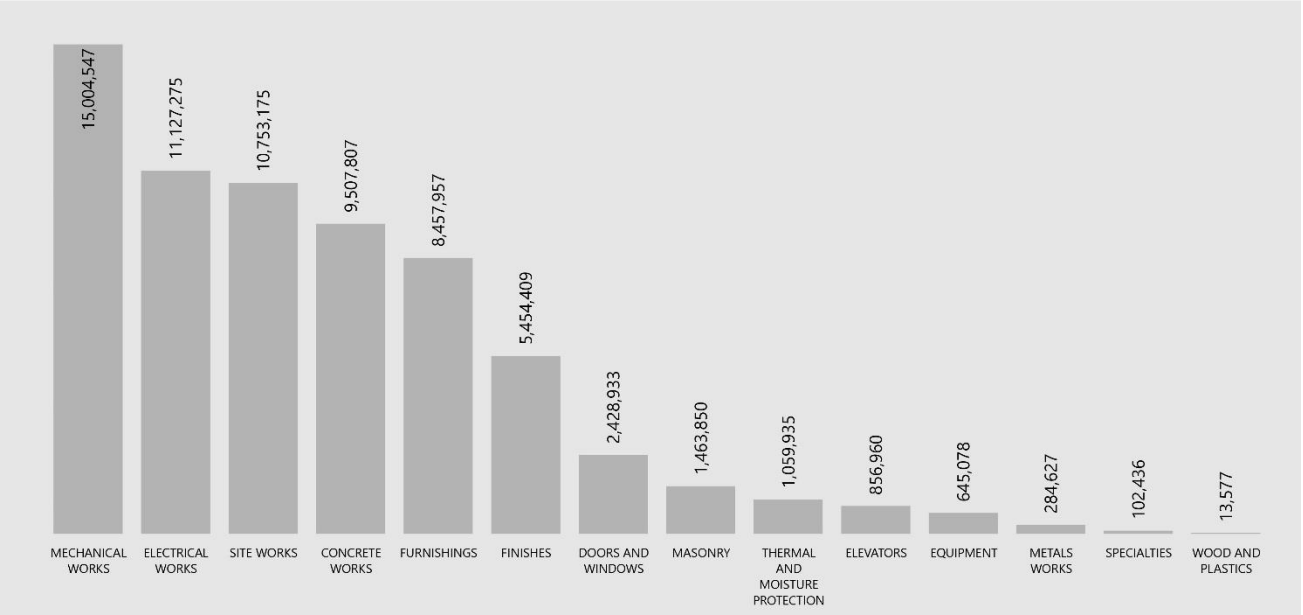


Figure 29. Cost Model

7.2 WORKSHOP STAGE

During the actual workshop portion of the VE study, VE Job Plan is followed. The VE Job Plan is an organized approach for searching out high-cost areas in the design and developing alternate solutions for consideration. The workshop session uses a multi-disciplined team following an agenda which details the Job Plan to arrive ultimately at recommendations for implementation.

The VE Job Plan follows five key steps:

- Information Phase
- Function Phase
- Creativity Phase
- Evaluation Phase
- Recommendation Phase

7.2.1 Information Phase

At the beginning of the VE study, it is important to understand the background and decisions that have influenced the development of the design.

The following information is normally provided to the certified value specialist (CVS) two weeks prior to the value engineering study:

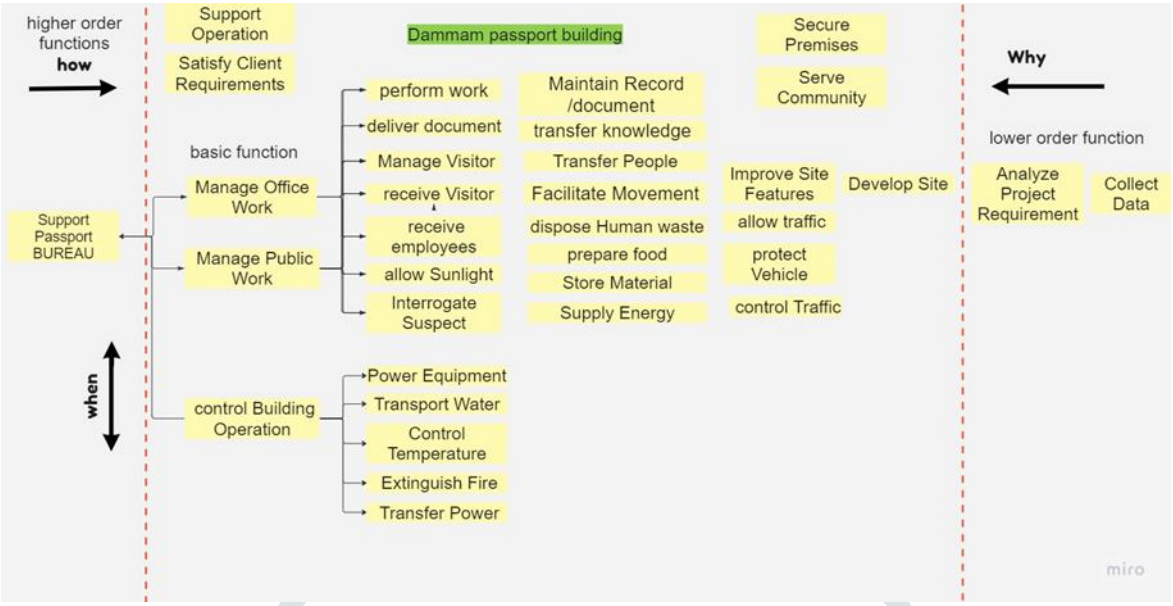
- **Economic Data**
- **Other Data**
- **Building/ Process Data**

7.2.2 Function Phase

The required functions of the project are the controlling elements in the overall VE approach. This procedure is beneficial to the VE team because it forces the participants to think in terms of function, and the cost associated with that function.

This VE Study utilized the data collected from the information phase to produce several new ideas and proposals unique to this type of study.

A. Function Logic Diagram-



B. Function-Cost-Worth

No.	ITEM	FUNCTION		KIND	AREA (M2)	COST (SR) / M2	PROJECT COST (SR)		VALUE INDEX
		VERB	NOUN				COST	WORTH	
B = Basic Function				S = Secondary Function			RS = Required Secondary		
1	Main Building	Manage	Telecommunication Operation	B					#DIV/0!
1.1	Employee Offices	Perform	Work/Task	RS	3,599	3,100.00	11,156,900	10,077,200	1.11
1.2	GM Office	Manage	Work/Task	RS	333	3,350.98	1,115,876	999,000	1.12
1.3	Asstt GM Office	Control	Work/Task	RS	331	2,700.00	893,700	959,900	0.93
1.4	Archives	Store	Information/Data	S	206	2,300.00	473,800	412,000	1.15
1.5	Library	Share	Knowledge	S	60	3,200.00	192,000	168,000	1.14
1.6	Computer Hall	Operate	Systems	RS	59	3,400.00	200,600	177,000	1.13
1.7	Main Entrance Hall	Receive	Users	RS	199	3,300.00	656,700	597,000	1.10
1.8	Revision Hall	Serve	Visitors	S	109	3,100.00	337,900	283,400	1.19
1.9	Multipurpose Hall	Conduct	Events	S	238	3,100.00	737,800	666,400	1.11
1.10	Cafeteria	Serve	Food	S	52	2,400.00	124,800	124,800	1.00
1.11	Kitchen	Prepare	Food	S	243	2,700.00	656,100	656,100	1.00
1.11	Toilet	Maintain	Hygiene	S					
1.12	Sairs & Lift	Transfer	People	S	1,443	2,750.00	3,968,250	3,607,500	1.10
[illegible]									1.00
1.14	MEP	Support	Operation	RS	198	3,980.00	788,040	788,040	1.00
	Sub Total for Main Building				7477	2,985.15	22,319,966	20,533,840.00	1.086984526
2	Ancillary Buildings	Support	Operations	RS	2,378				#DIV/0!
2.1	DETENTION BUILDING	Interrogate	Suspect	S	355	2,400.00	852,000	781,000	1.09
2.2	WORKSHOP	Maintain	Vehicle	S	583	2,999.07	1,748,457	1,457,500	1.20
2.3	WAREHOUSE	Store	Supplies	S	1,203	3,000.00	3,609,000	3,007,500	1.20
2.4	SITE ENTRANCE	Control	Access	RS	102	2,950.00	300,900	255,000	1.18
2.5	GAURD ROOM	Secure	Premises	RS	18	3,500.00	63,000	45,000	1.40
2.6	SUBSTATION	Transfer	Power	RS	117	4,490.00	525,330	292,500	1.80
	Sub Total for Ancillary Buildings				2,378	2,985.15	7,098,687	5,838,500	1.22
3	Site Development	Develop	External Areas	RS					
3.1	Landscape area	Enhance	Appearance	S	2,000	518.09	1,036,174	800,000	1.30
3.2	Car shade	Protect	Vehicle	S	3,500	1,074.00	3,759,000	3,430,000	1.10
3.3	Roads	Facilitate	Vehicular Movement	RS	11,500	518.00	5,957,000	4,600,000	1.30
	Sub Total for Site Works				17000		10,753,175	8830000	1.22
4	MEP Works (Equipment)	Operate	Facilties	RS					
4.1	HVAC	Control	Indoor Climate	S			15,004,547	12,000,000	1.25
	Fire Fighting	Extinguish	Fire	RS					
	Plumbing	Transport	Water	RS					
	Elevators	Transport	Loads	S			856,960	750,000	1.14
4.2	Electrical Works	Power	Equipment	RS			11,127,274	10,000,000	1.11
	Sub Total for MEP						26,988,781	22,750,000	1.19
	Total Project Cost						67,160,609	57,952,340	1.16

Figure 31. function logic model - FAST.

Figure 30. VE workshop function analysis worksheet.

7.2.3 Creativity Phase
7.2.4 Evaluation Phase

No.	Idea Description	Meet Function	Improve Quality & add Value	Enhance O & M	Ease of Implementation	Owner Acceptibility		Rank
A	**ARCHITECTURE**							
A-01	removing the audience hall and implementing a mobile application for appointment scheduling to regulate visitor access	8	7	8	8	7	**8**	**H**
A-02	Adopt an open space concept to save areas that can be used for other functions.	8	8	8	8	7	**8**	**H**
A-03	To optimize the storage space from 206m2 to 100m2 and implement new data storage technology,	7	8	7	9	7	**8**	**H**
A-04	Create investment areas to save initial funds.	7	8	7	9	7	**8**	**H**

Figure 32. Creativity / Evaluation Worksheet.

7.2.5 Recommendation Phase:

The last phase of the value engineering study is the presentation of recommendations. The VE recommendations are further screened by the VE team before formal presentation. The oral presentation of results is made on the last day of the workshop to the owner/design team. The recommendations, the rationale that went into the development of each proposal and a summary of the cost savings are presented at this time so that the owner/design team can initiate an evaluation of the value engineering recommendations prior to the receipt of the formal VE report.

SUMMARY OF RECOMMENDATIONS

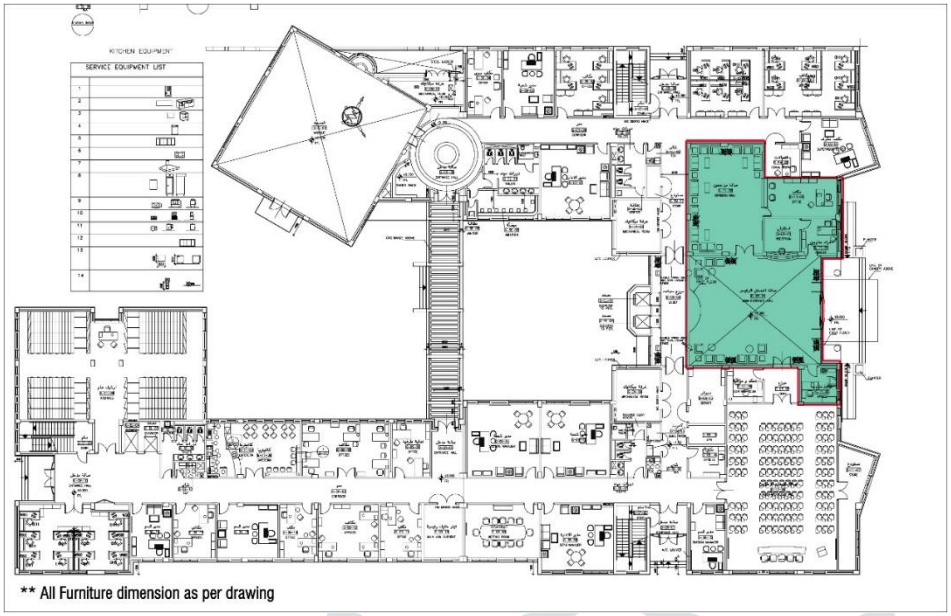
the Value Engineering Workshop provided valuable recommendations from an architectural standpoint for various spaces and functions in government projects. These recommendations aim to enhance the visitor experience, optimize office layouts, and identify investment areas for improved sustainability. By incorporating these suggestions, government projects can achieve better outcomes in terms of functionality, cost-efficiency, and environmental impact.

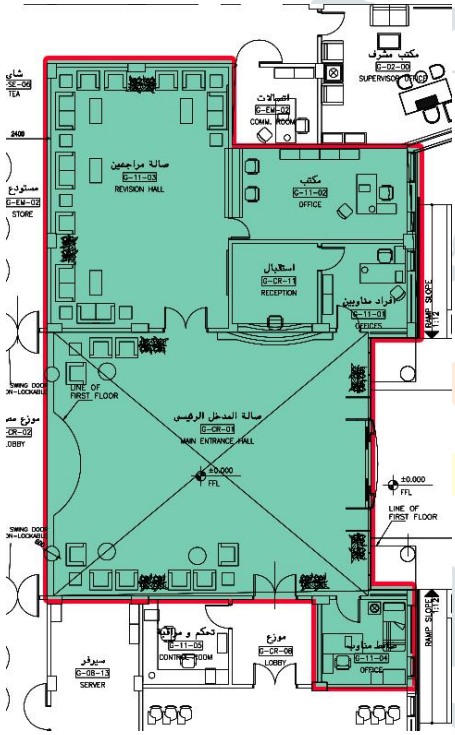
Proposal	removing the audience hall and implementing a mobile application for appointment scheduling to regulate visitor access.	A-01
Original Design		
the original design suggests a reception area and an audience hall with a total area 275m2		
Proposed Design		
It is proposed to removing the audience hall and implementing a mobile application for appointment scheduling to regulate visitor access.		

Advantages & Disadvantages			
Advantages:		**Disadvantages:**	
1.	Space Optimization	1	Limited accessibility
2.	Cost savings.	2	User adoption:
3.	Enhanced visitor experience:	3	Dependency on technology:
4.	Efficient visitor management	4	Potential resistance to change
5	Data collection and analysis		
6	Sustainability: By reducing the utilized area		
7	Space Optimization		
Discussion			

The proposed change for the project involves removing the audience hall and implementing a mobile application for appointment scheduling. This aims to optimize space utilization by reducing the area from 275 m2 to 166 m2 and enhance visitor management. The mobile application will provide a convenient and efficient platform for visitors to schedule appointments, reducing waiting times and improving overall visitor experience. This change aligns with modern technological trends and offers a streamlined approach to regulate visitor access.

Sketch Worksheet	removing the audience hall and implementing a mobile application for appointment scheduling to regulate visitor access.	**A-01**
Original Design		

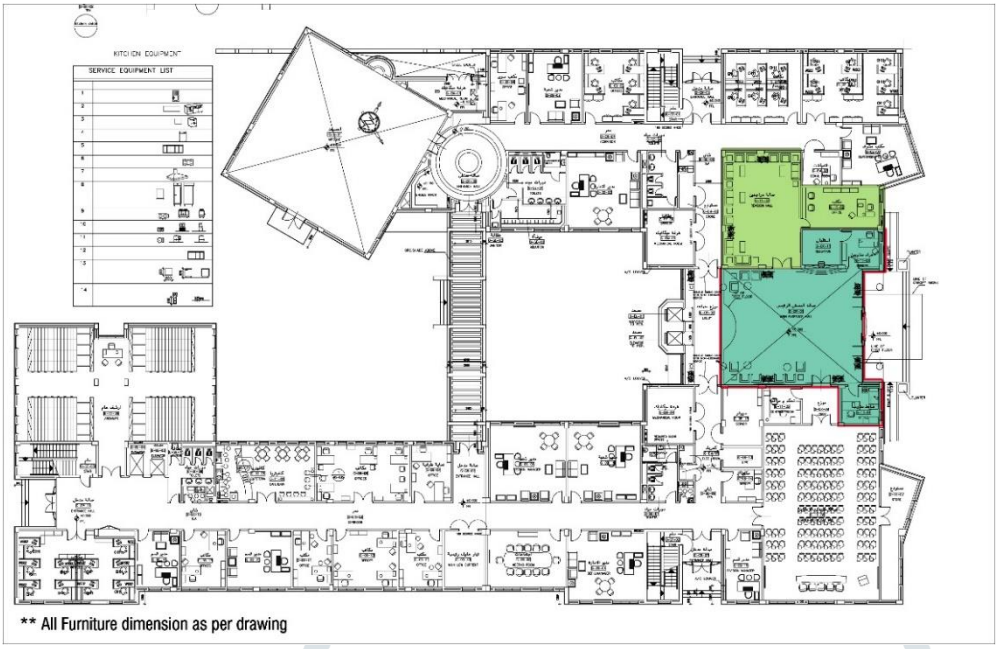




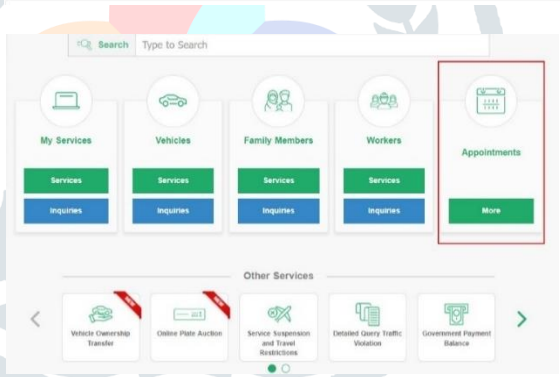
reception area and an audience hall with a total area 275m2

Sketch Worksheet	removing the audience hall and implementing a mobile application for appointment scheduling to regulate visitor access.	**A-01**

Proposed Design



Propose reception area with a total area 166m2 saving



Sketch Worksheet	removing the audience hall and implementing a mobile application for appointment scheduling to regulate visitor access.	**A-01**

Original Design

Item	Quantity	Unit	Unit Cost	Total
Reception and audience hall	275	m2	3,300	907,500
Subtotal				**907,500**
Markups		**%**		

			Total Cost (SR)	**907,500**

Proposed Design				
Item	**Quantity**	**Unit**	**Unit Cost**	**Total**
Reception and (Eliminate audience hall)	166	m2	3,300	547,800
Subtotal				**547,800**
			Total Cost (SR)	**547,800**

Potential Savings		
	Potential Savings (SR)	**359,700**
Potential Savings %		**40 %**

Proposal	Adopt an open space concept to save areas that can be used for other functions	A-02
Original Design		
The original Design of the main building depended on closed spaces and closed office areas as a concept design.		
Proposed Design		
It is proposed to Adopt an open space concept to save areas that can be used for other functions		

Advantages & Disadvantages

Advantages:		**Disadvantages:**	
1.	Space Optimization	1	Noise and Distractions:
2.	Cost Savings: Reduced construction, rent, and maintenance expenses.	2	Lack of Privacy
3.	Collaboration and Communication: Promotes teamwork and spontaneous interaction.	3	Reduced Focus and Concentration
4.	Enhanced Teamwork: Facilitates cooperation, knowledge sharing, and team cohesion	4	Potential for Increased Stress:
5	Improved Accessibility		
6	Aesthetics and Natural Light		

Discussion

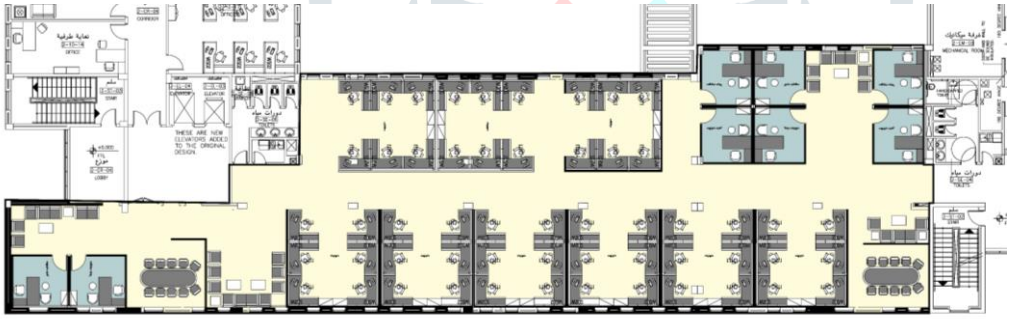
In the original design, the office area occupied a total of 3600m2, consisting of 8 manager offices and 36 individual offices. However, by implementing the proposed open space concept, the office area can be optimized, resulting in a reduced total area of 2500m2. This optimized layout includes 8 manager offices, 9 group workstations accommodating 54 individuals, 2 meeting areas, and 3 comfortable areas. The implementation of this concept allows for a substantial area reduction of more than 30% from the original allocation.

Sketch Worksheet	Adopt an open space concept to save areas that can be used for other functions	A-02

Original Design

Sketch Worksheet	Adopt an open space concept to save areas that can be used for other functions	A-02

Proposed Design



Proposal	Adopt an open space concept to save areas that can be used for other functions	A-02

Original Design

Item	Quantity	Unit	Unit Cost	Total
Employee Offices space	3,599	m2	3,100	**11,156,900**
D3 model 1000 x 2200mm (20 minutes fire resistant)	14	no	2,948	**41,275**
150 mm thick walls model (M1)	6,240	m2	61	**383,573**
Painting works for plastered walls, reference (P06)	11,250	m2	40	**446,625**
Subtotal				**12,028,373**
Markups		**%**		
			Total Cost (SR)	**12,028,373**

Proposed Design

Item	Quantity	Unit	Unit Cost	Total
Employee Offices space	2,500	m2	3,100	**7,750,000**
D3 model 1000 x 2200mm (20 minutes fire resistant)	0	no		
150 mm thick walls model (M1)	4,400	m2	61	**270,468**
Painting works for plastered walls, reference (P06)	7,550	m2	40	**299,735**
Subtotal				**8,320,203**
			Total Cost (SR)	**8,320,203**

Potential Savings

Potential Savings (SR)	**3,708,170**
Potential Savings %	**31 %**

Proposal	optimize the storage space from 206m2 to 100m2 and implement new data storage technology,	A-03
Original Design		
The original Design of the main building depended on closed spaces and closed office areas as a concept design.		
Proposed Design		
It is proposed optimize the storage space from 206m2 to 100m2 and implement new data storage technology,		

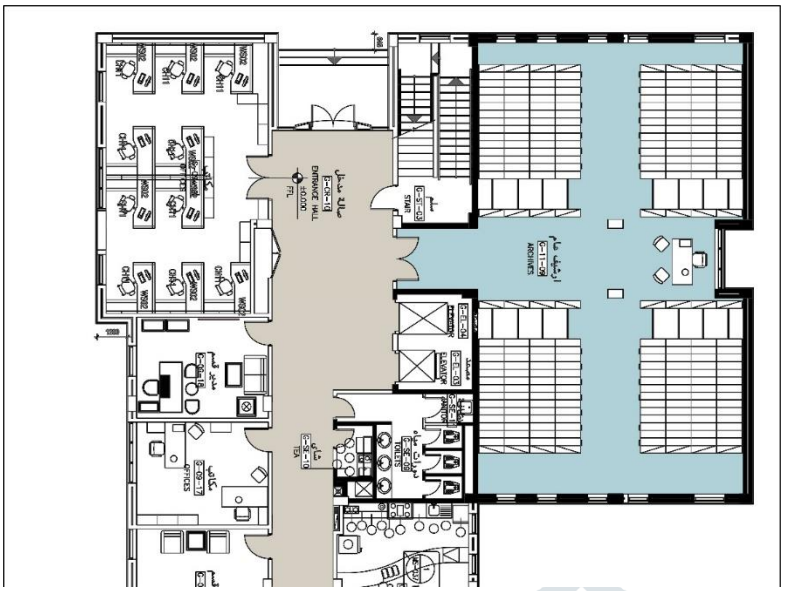
Advantages & Disadvantages

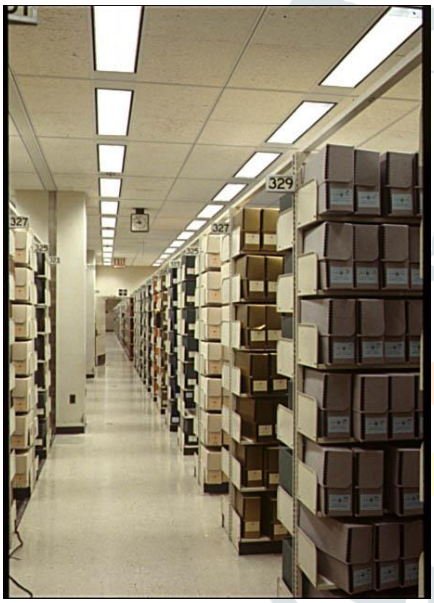
Advantages:		**Disadvantages:**	
1.	Space Efficiency	1	Data Transfer and Migration
2.	Cost Savings	2	Obsolescence and Upgrades
3.	Enhanced Organization	3	Limited Physical Storage
4.	Data Security	4	Learning Curve and Training:
5	Disaster Recovery:		
6	Environmental Sustainability		

Discussion

The proposed idea focuses on optimizing storage space from 206m2 to 100m2 and implementing new data storage technology. This aims to enhance efficiency, organization, and accessibility of archived data. The benefits include cost savings, improved indexing and search capabilities, remote access, enhanced security, scalability, and disaster recovery measures. However, challenges such as data migration, initial investment, compatibility issues, and dependence on technology should be considered. Overall, the idea aims to optimize storage, streamline data management, and leverage modern technology for greater efficiency and effectiveness.

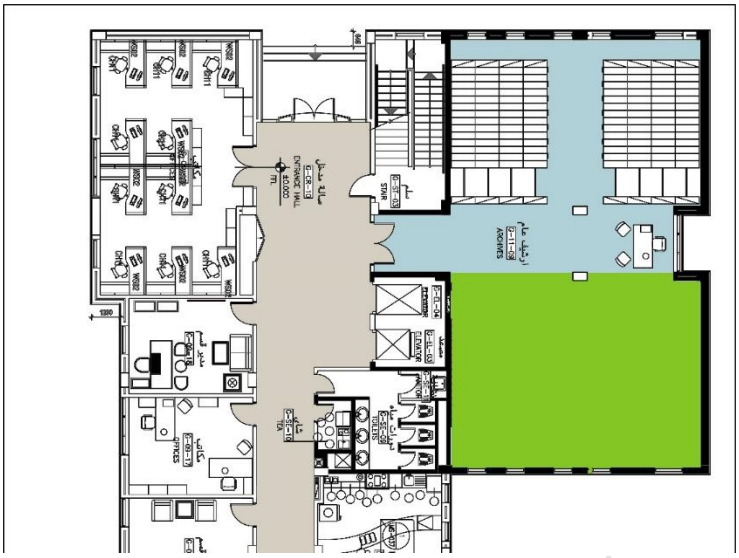
Sketch Worksheet	optimize the storage space from 206m2 to 100m2 and implement new data storage technology,	A-03
Original Design		

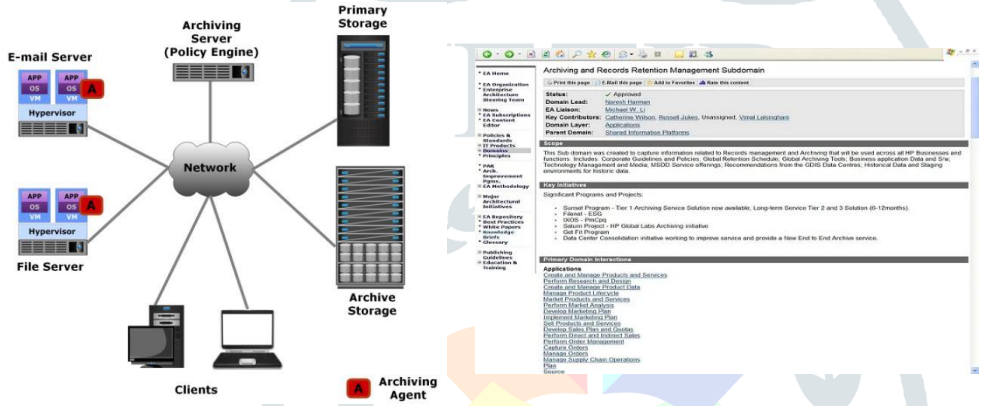




Sketch Worksheet	optimize the storage space from 206m2 to 100m2 and implement new data storage technology,	A-03

Proposed Design





Proposal	optimize the storage space from 206m2 to 100m2 and implement new data storage technology,	A-03

Original Design

Item	Quantity	Unit	Unit Cost	Total
Archived space	206	m2	2,300	**473,800**
Subtotal				**473,800**
Markups		%		

			Total Cost (SR)	**473,800**
Proposed Design				
Item	**Quantity**	**Unit**	**Unit Cost**	**Total**
Proposed Archived space	100	m2	2,300	**230,000**
Subtotal				**230,000**
			Total Cost (SR)	**230,000**
Potential Savings				
			Potential Savings (SR)	**243,798**
Potential Savings %				**50 %**

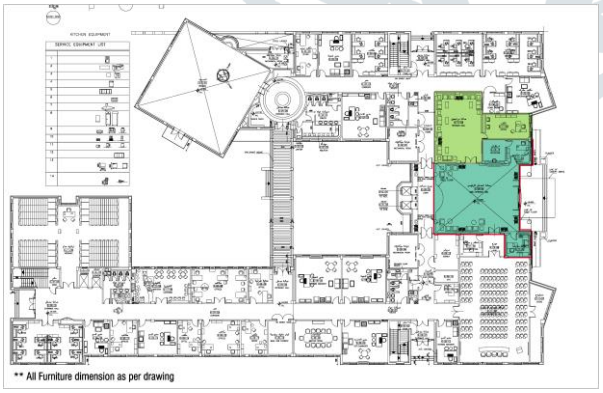
Proposal	Create investment areas to save initial funds.	A-04
Original Design		
the original design missing in providing investment areas to save initial cost.		
Proposed Design		
It is proposed to create some investment areas from saving Areas from the previous ideas to save initial funds.		

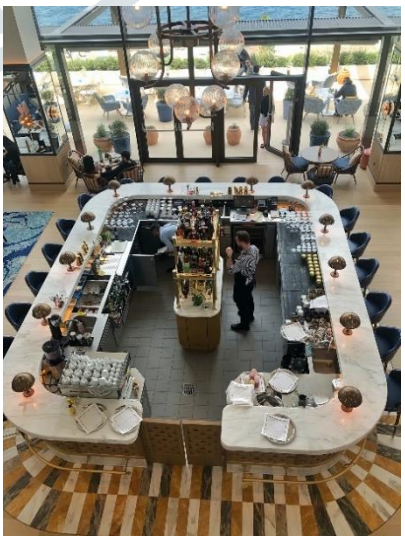
Advantages & Disadvantages			
Advantages:		**Disadvantages:**	
1.	Business Growth Opportunities	1	Uncertain Returns
2.	Competitive Advantage:	2	Lack of Diversification
3.	Innovation and Adaptability:	3	Implementation Challenges
4.	Risk Mitigation:	4	Investment Risk: All investments carry some level of risk,
5	Talent Acquisition and Development	5	Changing Market Dynamics
6	infrastructure and Technology Upgrades		
Discussion			

The idea involves utilizing saved initial funds to create investment areas. This approach offers advantages such as providing capital for strategic initiatives, fueling business growth, gaining a competitive edge, fostering innovation, mitigating risks, attracting talent, upgrading infrastructure and technology, and promoting long-term sustainability. However, there are potential disadvantages, including opportunity costs, uncertain returns, lack of diversification, implementation challenges, financial constraints, regulatory considerations, investment risks, and changing market dynamics. Organizations should carefully evaluate these factors and conduct risk assessments before allocating funds. A balanced approach, diversification, and proper planning are essential for maximizing the potential benefits of this idea while mitigating potential downsides.

Sketch Worksheet	Create investment areas to save initial funds.	A-04

Original Design





Proposal	Create investment areas to save initial funds.	A-04

Original Design

Item	Quantity	Unit	Unit Cost	Total
Employee Offices saving area 25%	900	m2	3,100	**2,790,000**
Audience Hall saving 107m2	107	m2	3,100	**331,700**
Subtotal				**3,121,700**
Markups		**%**		
			Total Cost (SR)	**473,800**

Proposed Design

Item	Quantity	Unit	Unit Cost	Total
Employee Offices saving area 25%	900	m2	3,100	**2,790,000**
Audience Hall saving 107m2	107	m2	3,100	**331,700**
Subtotal				**3,121,700**
			Total Cost (SR)	**3,121,700**

Potential Savings

Potential Savings (SR)	**3,121,700**

8- RESULTS DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

The Passport and Civil Affairs projects serve as examples of the impact of the value engineering process on government construction projects related to government services. These projects showcase the effective division of government services into two main aspects: receiving requirements and delivering services.

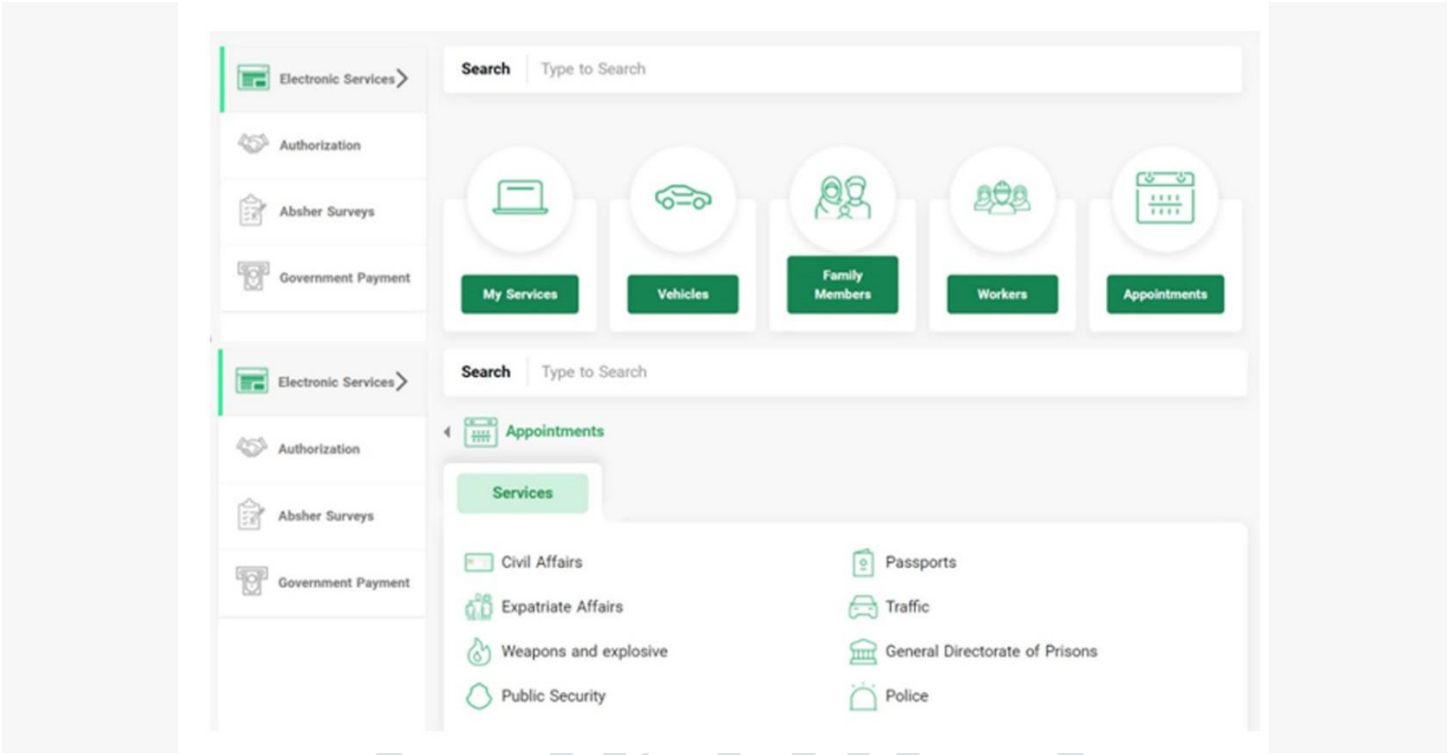


Figure 33. Absher Public Services "(https://www.absher.sa)."

Under the receiving requirements aspect, three categories are identified: personal attendees, online services, and self-services. Personal attendees involve individuals physically visiting government offices to fulfill their requirements. Online services enable remote access to government services through digital platforms. Self-services empower individuals to independently utilize government resources to meet their needs.

On the delivering services side, four categories are identified: personal attendees, online services, self-services, and cargo services. Personal attendees involve government representatives providing services in person. Online services are delivered digitally, allowing users to access and utilize government services remotely. Self-services enable individuals to independently access and utilize government services without direct involvement from government employees. Cargo services handle the transportation and delivery of physical goods or documents related to government services.

In summary, the Passport and Civil Affairs projects demonstrate the division of government services into receiving requirements (personal attendees, online services, and self-services) and delivering services (personal attendees, online services, self-services, and cargo services). This division allows for a comprehensive understanding of the different modes through which government services are provided, enabling value engineering interventions to optimize efficiency, effectiveness, and user satisfaction.

through a value engineering job plan specifically in the function analysis phase, we can highlight the most affected function in the below function analysis worksheet.

No.	*ITEM*	*FUNCTION*		*KIND*
		VERB	*NOUN*	
1	**Main Building**	**Manage**	**Work**	**B**
1.1	**Employee Offices**	Perform	Work/Task	**RS**
1.2	**Main Entrance Hall**	Receive	Users	**RS**
1.3	**Audience HALL**	Serve	Visitors	**RS**
1.4	**Archives**	Store	Information/Data	**S**
1.5	**delivery Hall**	deliver	document	**S**
1.6	**Meeting Room**	Conduct	Meeting	**S**
1.7	**Training Hall**	Learn	Skills	**S**

Figure 34. VE workshop function analysis worksheet.

also, the impact this has on function logic model - fast

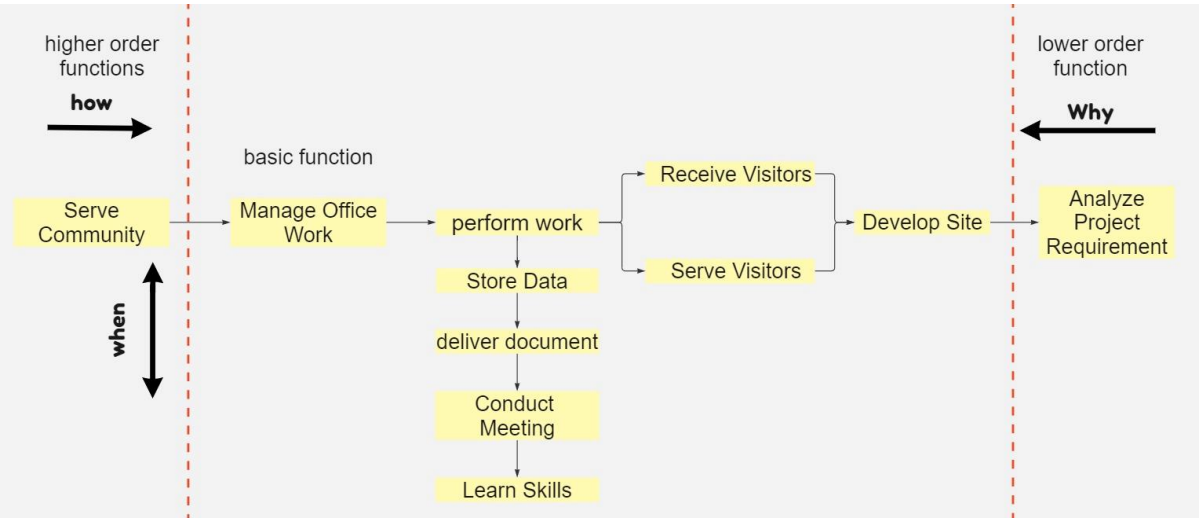


Figure 35. Function Logic Model - FAST.

From the results of the function analysis phase, we can proceed to the next phase known as the creativity phase. During this phase, the objective is to generate a wide range of ideas and potential solutions based on the identified functions and their improvement opportunities. The following examples illustrate some of the ideas that can be generated:

8.1 EMPLOYEE OFFICES

No.	*ITEM*	*FUNCTION*		*KIND*	*alternatives*
		VERB	*NOUN*		
1	**Main Building**	**Manage**	**Work**	**B**	
	Employee Offices	Perform	Work/Task	**RS**	
	1 Open-Plan Layout: Consider adopting an open-plan layout for office areas				
	2 Shared Workstations: Implement a shared workstation concept where employees can utilize shared desks or workspaces on an as-needed basis				
	3 Hot-Desking: Introduce a hot-desking system				
	4 Modular Furniture: Utilize modular furniture systems that can be easily reconfigured and adapted to different office layouts and requirements				
	5 Digital Storage and Paperless Processes: Embrace digital storage solutions and implement paperless processes wherever possible.				
	6 Efficient Storage Solutions: Optimize storage areas by utilizing space-saving storage solutions such as mobile shelving or vertical storage systems				
	7 Multi-Purpose Rooms: Designate multi-purpose rooms that can serve multiple functions				
	8 Remote Work and Flexible Schedules: Encourage remote work options and flexible schedules for employees				
	9 Efficient Lighting and HVAC Systems: Install energy-efficient lighting systems and optimize heating, ventilation,				
	10 Utilize Co-Working Spaces: Consider utilizing co-working spaces or shared office facilities for certain departments or functions.				

Figure 36. Creativity / Evaluation Worksheet. Employee Offices

8.2 Main Entrance Hall and Audience HALL

No.	ITEM	FUNCTION		KIND	alternatives
		VERB	NOUN		
2	Main Entrance Hall	Receive	Users	RS	
3	Audience HALL	Serve	Visitors	RS	
	1 Open-Plan Layout: Consider adopting an open-plan layout for office areas				
	2 Shared Workstations: Implement a shared workstation concept where employees can utilize shared desks or workspaces on an as-needed basis				
	3 Hot-Desking: Introduce a hot-desking system				
	4 Modular Furniture: Utilize modular furniture systems that can be easily reconfigured and adapted to different office layouts and requirements				
	5 Digital Storage and Paperless Processes: Embrace digital storage solutions and implement paperless processes wherever possible.				
	6 Efficient Storage Solutions: Optimize storage areas by utilizing space-saving storage solutions such as mobile shelving or vertical storage systems				
	7 Multi-Purpose Rooms: Designate multi-purpose rooms that can serve multiple functions				
	8 Remote Work and Flexible Schedules: Encourage remote work options and flexible schedules for employees				
	9 Efficient Lighting and HVAC Systems: Install energy-efficient lighting systems and optimize heating, ventilation,				
	10 Flexible Seating Arrangements: Use flexible seating arrangements in the Audience Hall				

Figure 37. Main Entrance Hall and Audience HALL

8.3 Archives

No.	ITEM	FUNCTION		KIND	alternatives
		VERB	NOUN		
4	Archives	Store	Information/Data	S	
	1 Digital Document Management System: Implement a comprehensive digital document management system that allows for the scanning, indexing, and storage of physical documents in electronic format.				
	2 Cloud Storage Solutions: Utilize cloud storage solutions to securely store and manage digital documents and data.				
	3 Off-Site Data Storage: Consider partnering with professional off-site data storage providers who specialize in secure document storage and management.				
	4 Off-Site Data Storage: Consider partnering with professional off-site data storage providers who specialize in secure document storage and management.				
	5 Hybrid Storage Approach: Adopt a hybrid storage approach that combines physical and digital storage. Utilize physical storage for documents that require legal or regulatory compliance, while transitioning non-essential or less frequently accessed documents to digital storage				

	6 Data Lifecycle Management: Implement a data lifecycle management strategy that defines the retention periods and storage requirements for different types of data.
	7 Automated Records Management: Utilize automated records management systems that facilitate the organization, tracking, and disposal of records according to established retention schedules.
	8 Data Backup and Disaster Recovery: Implement robust data backup and disaster recovery systems to ensure the protection and availability of digital data
	9 Regular Data Purging: Establish policies and procedures for regular data purging to remove obsolete or redundant data from both physical and digital storage.

Figure 38. Archives

8.4 DELIVERY HALL

No.	ITEM	FUNCTION		KIND	alternatives
		VERB	NOUN		
5	**delivery Hall**	**deliver**	**document**	**S**	
	1 Self-Service Machines: Install self-service machines in the delivery hall where individuals can pick up or drop off packages				
	2 Cargo Service: Partner with a reliable cargo service provider to handle package deliveries and pickups in the government building.				
	3 Drone Services: Explore the use of drones for package delivery within the government building premises. Drones can be used for small and lightweight packages, especially in cases where immediate delivery is required.				
	4 Digital Package Tracking: Implement a digital package tracking system that allows users to track the status and location of their packages.				
	5 Package Lockers: Install package lockers in the delivery hall, similar to those used in residential buildings or shopping centers.				
	6 Centralized Receiving Point: Designate a centralized receiving point where all incoming packages are collected and sorted.				
	7 Time-Slot Delivery: Implement a time-slot delivery system where users can schedule specific delivery windows for their packages				
	8 Return and Recycling Stations: Create dedicated areas within the delivery hall for package returns and recycling.				
	9 Mobile Delivery Solutions: Utilize mobile delivery solutions where staff members can directly deliver packages to specific departments or individuals within the government building using handheld devices or mobile carts.				
	10 Vendor Delivery Coordination: Coordinate with vendors and suppliers to consolidate deliveries and minimize the frequency of deliveries to the government building.				

Figure 39. delivery Hall

8.5 MEETING ROOM

No.	ITEM	FUNCTION		KIND	alternatives
		VERB	NOUN		
6	Meeting Room	Conduct	Meeting	S	
	1 Flexible Room Configurations: Design meeting rooms with flexible configurations, using movable partitions or collapsible walls.				
	2 Mobile Applications for Room Booking: Implement a mobile application or online platform that allows employees to book meeting rooms in advance				
	3 Room Scheduling System: Install a room scheduling system outside each meeting room that displays the availability and schedule of the room.				
	4 Video Conferencing and Collaboration Tools: Invest in video conferencing and collaboration tools to facilitate virtual meetings.				
	5 Multi-Functional Meeting Spaces: Designate certain areas within the office as multi-functional meeting spaces				
	6 Huddle Rooms: Create small, informal "huddle rooms" equipped with basic audio-visual equipment and seating for a few people.				
	7 Shared Meeting Spaces: Implement shared meeting spaces that can be used by multiple departments or teams.				
	8 Virtual Meeting Room Solutions: Explore virtual meeting room solutions that provide a digital platform for conducting meetings, presentations, and collaborations.				
	9 Smart Room Technology: Install smart room technology that automates lighting, temperature control, and audio-visual equipment in meeting rooms.				
	10 Utilize Common Areas: Encourage the use of common areas, such as lounges or break rooms, for informal meetings or discussions.				

Figure 40. Meeting Room

8.6 TRAINING HALL

No.	ITEM	FUNCTION		KIND	alternatives
		VERB	NOUN		
7	Training Hall	Learn	Skills	S	
	1 Mobile Applications for Training Materials: Develop or utilize mobile applications that provide access to training materials, resources, and interactive modules.				
	2 Virtual Training Platforms: Implement virtual training platforms that enable remote training through webinars, live streaming, or pre-recorded sessions.				
	3 Blended Learning Approaches: Combine online learning modules with in-person training sessions.				
	4 Interactive Learning Tools: Utilize interactive learning tools, such as gamification or simulations, that can be accessed through mobile applications or online platforms.				
	5 On-Demand Training Modules: Develop on-demand training modules that participants can access at their convenience.				
	6 Virtual Reality (VR) Training: Explore the use of virtual reality technology for training purposes.				
	7 Collaborative Learning Spaces: Designate flexible collaborative learning spaces within the organization where employees can engage in group discussions, knowledge sharing, and peer-to-peer learning.				

8	Just-in-Time Training: Implement just-in-time training methodologies, where training materials or resources are provided to individuals as and when they need them
9	Training Evaluation and Feedback through Mobile Apps:
10	Online Assessments and Certification: Utilize online assessment tools and digital certification platforms to evaluate participant learning outcomes and issue training certifications.

Figure 41. Training Hall

Acknowledgment

A special thanks to Mohammad Amin, a Certified Value Specialist, (CVS), (PVM) led two workshops on passport and civil affairs, providing valuable guidance and a comprehensive value engineering job plan template. His expertise and leadership enhanced learning and equipped teams with practical skills for value-based improvements.

9- REFERENCES

[1] Value Engineering-Workshop Guide.
[2] https://www.absher.sa
[3] https://www.escatec.com/blog/value-analysis-and-value-engineering-va/ve-explained-for-oems
[4] The Implementation and Effectiveness of Value Engineering in the United Arab Emirates -
[5] Ratnam Jeyakumar
[6] The New Jersey Department of Transportation (NJDOT) Value Engineering Process Guideline
[7] Mohammad Amin, Certified Value Specialist (CVS), (PVM)