

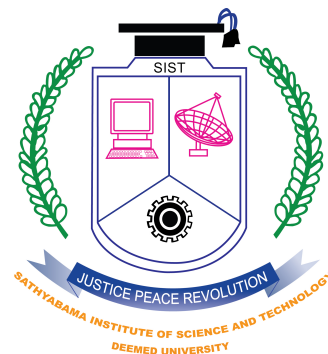
FACILITIES PLANNING AND MANAGEMENT IN THE HOSPITALITY SECTOR

A Thesis

Submitted in partial fulfillment of the requirements for the award of
Master of Architecture degree in Building Management

by

DIVYA EZHILARASU (40840004)



**DEPARTMENT OF ARCHITECTURE
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

MAY 2022



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE

www.sathyabama.ac.in

BONAFIDE CERTIFICATE

This is to certify that this Report is the bonafide work of **DIVYA EZHILARASU (40840004)** who carried out the Thesis entitled "**FACILITIES PLANNING AND MANAGEMENT IN HOSPITALITY SECTOR**" under our supervision from January 2022 to May 2022.

Internal guide
(Ar. DEEPALAKSHMI)

Internal Panel Member
(Ar. SUKIRTHA SURESH)

External guide
(Mr. S. KAVIN KUMAR)

DR. DEVYANI GANGOPADHYAY
Head of the Department

Submitted for Viva voce Examination held on **MAY 6th 2022**

Internal Examiner

External Examiner

DECLARATION

I, **DIVYA EZHILARASU** hereby declare that the Thesis Report entitled “**FACILITIES PLANNING AND MANAGEMENT IN HOSPITALITY SECTOR**” done by me under the guidance of **Ar.DEEPALAKSHMI** (Internal Guide) and **Mr. S. KAVIN KUMAR** (External) at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Master of Architecture degree in Building Management.

DATE: 6-5-2022

PLACE: Chennai



SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this Thesis project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. Devyani Gangopadhyay, Dean and Head of the department, Dept. of Architecture, School of Building and Environment**, for providing me necessary support and details at the right time during the progressive reviews.

My special thanks to **Dr. Suresh Kuppusamy**, our Design chair and **Mr. S. Kavim Kumar** (External guide), **Ar. Deepalakshmi** (Internal Guide) and **Ar. Sukirtha Suresh** (Thesis Coordinator) for their valuable comments and guidance during the project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Architecture who were helpful in many ways for the completion of this Thesis.

ABSTRACT

The thesis topic on “Facility Planning and Management in Hospitality Sector”, maps the role of planning and management of facilities (FPM) for the smooth operation of the building. The primary aim of facilities management is to increase productivity and enhance efficiency.

The study kickstarted by focusing on the broad aspects like workspace arrangement, integrated approaches and reviewing the information related to occupancy. It focused on the triad of requirements-to observe, identify and improve. This study has assessed the existing plans in place and pinpointed the shortcomings. This has brought out the gaps in performance and proposes alternatives to enhance efficiency.

The different categories of people, technologies, building practices, policies and processes are contributing factors to facility planning. Hotels are user oriented, revenue generating buildings. FPM plays an integral role as there is a constant need to improve the process involved in everyday functioning to achieve optimal results. The study is validated with tools such as prioritization matrices, performance indices and data records

The challenge faced was to identify the scope of study, restricting and detailing a single core area. The literature and case studies carried out helped with identifying the engineering department as the focal area. A series of surveys, observations and work sampling helped identify the functions and activities of the department. User side interviews provided an insight to the factors affecting the revenue of a hotel. A few of these included-prompt service, amenities, service quality, sanitation and safety. The next step was to establish a connection between the staff side, the systems, the user and final impact on revenue.

Tools like the risk matrix, congruence model, 5Why analysis and fish bone models helped identify 10 gaps in performance. These were gaps in performance, communication, service, perception, delivery, labour, skill, inventory etc. The identification of the lapses in performances helped model the methodology of overcoming these issues. There is a need to evaluate areas of manual vs digital operation, The complaint prioritization and the escalation clause. The elements work together to give us the base red flag assessment to identify the critical functions in the facility.

TABLE OF CONTENTS

CHAPTER No.	TITLE	PAGE No.
	ABSTRACT	v
	LIST OF TABLES	vii
	LIST OF FIGURES	ix
	LIST OF SYMBOLS AND ABBREVIATIONS	xi
1	INTRODUCTION	1
1.1	INTRODUCTION	1
1.2	AIM	1
1.3	ASSUMPTIONS	1
1.4	OBJECTIVES	1
1.5	RESEARCH QUESTION	2
2	LITERATURE REVIEW	2
2.1	INTRODUCTION	2
2.2	SCOPE OF FACILITY PLANNING AND MANAGEMENT	3
2.3	HOSPITALITY SECTOR	4
2.4	STAFF SIDE: THE VARIOUS DEPARTMENTS IDENTIFIED	5
2.5	IDENTIFYING THE STAKEHOLDERS IN DAILY OPERATIONS	5
2.6	DOES THE DEFINITION OF FACILITY PLANNING AND MANAGEMENT COINCIDE FROM THE CONSUMER AND STAFF POINT OF VIEW?	6
2.7	CMMS FUNCTIONS IN HOTEL OPERATIONS	6
2.8	SYSTEM ADVANTAGES	7
2.9	WORK DIVISION IN FACILITY PLANNING AND MANAGEMENT	8
2.10	OCCUPANCY MANAGEMENT	8

2.11	HOW DOES OCCUPANCY AND MAINTENANCE MANAGEMENT RELATE TO EACH OTHER?	9
2.12	NEED FOR THE HOTEL RATING SYSTEM?	10
2.13	THE INDIAN RATING SYSTEM	10
2.14	LITERATURE CASE STUDY TAKEAWAYS	12
2.15	JOURNAL REVIEW -1	15
2.16	JOURNAL REVIEW -2	18
2.17	JOURNAL REVIEW -3	23
2.18	JOURNAL REVIEW -4	26
3	METHODOLOGY	29
3.1	INTRODUCTION	29
3.2	THE RESEARCH PROCESS	29
3.3	STAGE WISE WORK PROCESS	30
3.4	DATA COLLECTION METHODS	30
3.5	ANALYTICAL TOOLS AND TECHNIQUES	30
3.6	TOOLS THAT AID	31
4	ANALYSIS AND RESULTS	31
4.1	INFLUENCING FACTORS FOR DECISION MAKING	31
4.2	OVERVIEW OF ASSUMPTIONS AND OBJECTIVES	32
4.3	NARROWING DOWN THE AREA OF STUDY	34
4.4	CASE STUDY: SELECTION JUSTIFICATION	36
4.5	CASE STUDY: OVERVIEW	36
4.6	MANAGEMENT OPERATIONS AND FOR IN HOUSE AND OUTSOURCING MAINTENANCE	39
4.7	AMC CONTRACTS	39

4.8	CASE STUDY 1: FEATHERS HOTEL	40
4.9	OVERVIEW OF FACILITIES	41
4.10	COST OVERVIEW	42
4.11	SYSTEM OVERVIEW	43
4.12	ISOLATED ISSUES IDENTIFIED IN THE CASE STUDIES	44
4.13	EQUIPMENT AS A PART OF THE CRITICAL PROCESS OF MANAGING FACILITIES	45
4.14	ANALYZING THE CURRENT CONSUMPTION OF ELECTRICITY	47
4.15	WATER CONSUMPTION DISTRIBUTION	48
4.16	WHY IS THE HLP (HEATING, LIGHTING, PLUMBING) REPORT VITAL?	49
4.17	ENERGY MANAGEMENT IN THE HOTEL FACILITY	50
4.18	WALKTHROUGH ASSESSMENT -PARAMETERS OF EVALUATION	50
4.19	HIERARCHY OF ENERGY MANAGEMENT SYSTEMS	52
4.20	ZONE WISE DIVISION FOR DISTRIBUTION	52
4.22	NARROWING DOWN TO THE CRITICAL PARAMETERS	52
4.23	CRITICAL EQUIPMENT	55
4.24	COORDINATION IN CASE OF COOLING TOWER FAILURE	57
4.25	SYSTEM CHECKS AFTER MAINTENANCE	58
4.26	CRITICAL EQUIPMENT : TRANSFORMER	59
4.27	HOW HAS THE DIVISION OF ZONES HELPED IN REMAPPING THE FACILITY PLAN?	61
4.28	THE LEAN APPROACH	61
4.29	SCENARIO ANALYSIS	62
4.31	INFERENCE FROM THE GRAPHICAL REPRESENTATION	64
4.32	PEOPLE AS A PART OF THE CRITICAL PROCESS	66
4.33	WORKER PRODUCTIVITY	69
4.34	SECURITY	70
4.35	INFLUENCE OF AESTHETICS ON SECURITY	71

4.36	SECURITY SYSTEMS AND LEVELS OF CHECK	72
4.37	SCENARIO ANALYSIS	73
4.38	CURRENT STAGE OF INFERENCE	74
5	SUMMARY AND CONCLUSION	75
5.1	HOW IS THE WORK PRODUCTIVITY PER SHIFT AND EQUIPMENT CRITICALITY RELEVANT?	75
5.2	THE GAP ANALYSIS – STAGE 1	76
5.3	THE GAP ANALYSIS –STAGE 2	78
5.4	THE GAP ANALYSIS –STAGE 3	79
5.5	HIERARCHY OF RISKS IDENTIFIED	80
5.6	PROPOSAL	81
5.7	IMPORTANCE OF VISUAL MANAGEMENT	82
5.8	DRAWBACKS IN THIS EXISTING SYSTEM	85
5.9	PRE-EMPTIVE ASSESSMENT	88
	REFERENCES	90
	APPENDICES	90

LIST OF TABLES

TABLE No.	TITLE	PAGE No.
2.1	A3 tabulation of the general hospitality scenario	7
2.2	Summary of reviews	14
2.3	Shortcomings identified from staff surveys	20
2.4	Challenges in the Facility Management Practices	20
2.5	Analyzed Results-Paired difference	22
2.6	Work scope of the engineering department	24
4.1	Description of equipment for ventilation	43
4.2	AHU Location and capacity	46
4.3	Cost analysis for electricity consumption	47
4.4	HLP consumption report	49
4.5	Equipment health card layout	54
4.6	Equipment history card layout	54
4.7	List of critical equipment	55
4.8	Criteria for cooling tower installation	55
4.9	Core Checklists for cooling tower	56
4.10	Inventory breakdown (Feathers Hotel)	65
4.11	Action plan for safety and security	74
5.1	Risk analysis for hotels in Chennai	79
5.2	Revised data sheet for digital systems	83
5.3	Red flag assessment for plumbing failure	89

LIST OF FIGURES

FIGURE No.	TITLE	PAGE No.
2.1	Facilities management activities	2
2.2	Process Breakdown	3
2.3	Planning methods	4
2.4	Parameters for evaluation in hotels	4
2.5	Types of complaints	5
2.6	Function of CMMS	7
2.7	Work Division and interconnections	8
2.8	Flow of occupancy management	9
2.9	Broad term classification of hotel success	10
2.10	Hotel classification	11
2.11	Categories in rating	11
2.12	HRACC checklist for star rating	12
2.13	Minimum and maximum points	13
2.14	Model types for assessment	16
2.15	Structure of Total Productive Maintenance	16
2.17	Asset management and reliability centered maintenance services	18
2.18	Hypothesis for the research paper	19
2.19	Approach to the research study	21
2.20	Planning strategies	23
2.21	Key factors	24
2.22	Core parameters for evaluation	25
2.23	Ranking of different layout options	26
2.24	Approach to the research	27
2.25	Planning methods	28
2.26	Planning methods	29

3.1	Research Process	30
3.2	Stages	32
4.1	Factors influencing decision making	33
4.2	User survey results	34
4.3	Distribution of complaints	35
4.4	Pillars of hotel operations	36
4.5	Narrowing the scope	37
4.6	Feathers hotel	38
4.7	GRT hotel	38
4.8	Case study justification	39
4.9	A3 analysis sheet	41
4.10	Evaluation of importance of factors	42
4.11	List of equipment and room distribution	44
4.12	Site facilities	45
4.13	Description of secondary equipment	46
4.14	Site images	47
4.15	A3 Solver sheet for performance gap	48
4.16	Resource mapping	50
4.17	Energy usage mapping	51
4.18	Water distribution	52
4.19	Function of HLP report	52
4.21	Hierarchy of energy systems	53
4.22	Zone Division	58
4.23	Equipment breakdown	59
4.24	System failure flowchart	60
4.25	LOTO Operation procedure	61
4.26	Analysis of core critical parameters	62
4.27	PDCA analysis	62
4.28	Lean approach	63

4.29	Revenue Generation (2017-2021)	64
4.30	Flowchart of expenses	66
4.31	Annual revenue and expense comparison	67
4.32	Capital distribution	68
4.33	Impact of machine downtime	68
4.34	Work order process	70
4.35	Work order cycle	71
4.36	Distribution of VA,NVA and NVAN	71
4.37	Factors compromising security	72
4.38	5 Why analysis to evaluate aesthetics as a risk to safety	72
4.39	Site images	73
4.40	Hierarchy of security levels	73
4.41	Perspectives of security	74
4.42	SWAT analysis for cast study	74
4.43	Chain-link established	76
4.44	The critical elements of FM and dependency	76
5.1	Flowchart mapping the performance gap	76
5.2	Nadler Tushman Congruence Model	77
5.3	Solver inputs for the congruence model	78
5.4	Risk matrix for evolution of parameters	79
5.5	Analysis of service quality	79
5.6	Hierarchy of gaps	80
5.7	Perspective of performance gaps	80
5.8	Visual management	81
5.9	Overview of the CMMS System in use	82
5.10	Communication flow	83
5.11	The resolution framework	85
5.12	A3 Solver for complaint Prioritization	86
5.13	Delays in decision making due to bureaucracy	87

LIST OF SYMBOLS AND ABBREVIATIONS

FPM	-	Facility Planning and Management
MCDM	-	Multiple Criteria Decision Analysis
CMMS	-	Computerized Maintenance Management Systems
CFMS	-	Computerized Facilities Management Systems
OEE	-	Overall Equipment Effectiveness
JIT	-	Just in Time
TPM	-	Total Productive Maintenance
CBM	-	Condition Based Maintenance
RCM	-	Reliability Centered Maintenance
CM	-	Condition Monitoring
HVAC	-	Heating Ventilation and Air Conditioning
NVA	-	Non-Value Added
VA	-	Value Added
NVAN	-	Non-Value Added Necessary
LCC	-	Life Cycle Costing

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Facility planning aims to keep up with the everyday demands of operating a building.

The key focus is on promoting efficiency.

The triad of requirements in facility planning is “OBSERVE”, “IDENTIFY” and “IMPROVE”.

OBSERVE

This involves a thorough knowledge and insight into the functioning of the building.

IDENTIFY

This would involve pinpointing the area of deficiency or lag.

IMPROVE

To rectify the error in the area of focus and recheck for efficiency.

The areas of Facility Planning include:

1. Communication
2. Quality
3. Technology
4. Operations and Maintenance
5. Human factors
6. Finance
7. Contingency planning
8. Real estate management
9. Sustainability and environmental stewardship

1.2 AIM

The aim is to conduct a study to document the existing facility management plans – identify gaps in productivity and propose alternatives.

1.3 ASSUMPTIONS

- The human factor is considered the core pillar of facility management.
- Communication and policy decisions play a vital role in curbing costs.
- Planning and management revolve around core competencies and identifies the opportunities for cost reduction

1.4 OBJECTIVES

The objectives of this study are:

- Strategic facility plan-To document and analyze the existing conditions.
- To identify and create a statement of organizational needs.
- To highlight the shortcomings and propose measures to rectify the same.
(Analyze the need for outsourcing)
- To formulate and assess alternative facility plans.

1.5 RESEARCH QUESTION

Is there a significant relation between forecasting trends, strategic facility planning efficiency and income generated?

2 LITERATURE REVIEW

2.1 INTRODUCTION

Facility planning is important as it gives an accurate report on the current state of the physical assets and the future potential for development. It identifies the type of spaces and the required provisions.

Facilities planning can further be subclassified as facilities location and facilities layout. The facilities' location can be scrutinized at a macro level and micro level.

At the macro level:

Selection of the site location based on a major criterion, usually cost.

At the micro level:

Organization of operational areas within the building to achieve optimal output.

The role of facility management is to ensure reliability, efficiency and comfort with regards to the assets.

- Managing services –lease, rent, catering, HVAC etc.
- Conducting regular maintenance audits.
- Compliance to health and safety standards.
- Compiling status reports and maintenance logs.



Fig 2.1 Facilities management activities



Fig 2.2 Process Breakdown

2.2 SCOPE OF FACILITY PLANNING AND MANAGEMENT

- Maintaining the available facilities and reviewing daily operations.
- Generating, recording and maintaining budgets for maintenance, procurement, repairs/renovations and contracts.
- Ensuring resource availability and seamless delivery in areas like transport, kitchen food production and waste disposal.
- Overseeing hiring processes for external services for repairs for the building, equipment or machinery. (AMC contract management)
- Manage the vendor base for a cost-efficient procurement of inventory and services.
- Compliance with local and industry-specific safety guidelines, communication and security systems for the building.

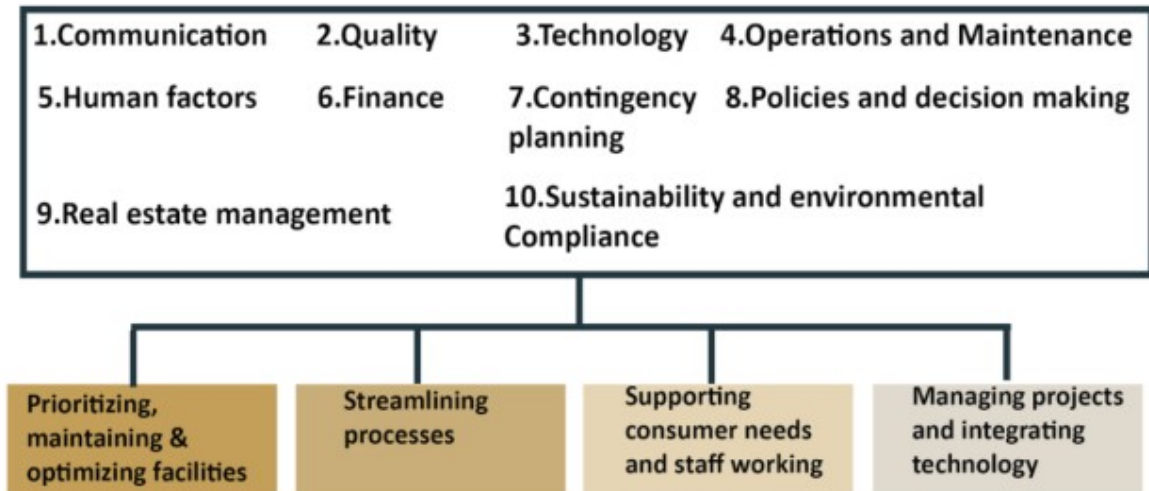


Fig 2.3 Planning methods

2.3 HOSPITALITY SECTOR

- It is a revenue-generating sector where financial success depends on the coordination between different departments to ensure maximum user comfort and experience.
- Hotels are businesses and focus on the areas of infrastructure, spatial arrangement, plant machinery and equipment and compliance to meet the business needs.
- Information and historical data regarding these categories help in the process of decision making while drafting facility management plans.

To stay a forerunner in the competitive sector ,the facilities are evaluated on parameters based on:



Fig 2.4 Parameters for evaluation in hotels

2.4 STAFF SIDE: THE VARIOUS DEPARTMENTS IDENTIFIED

1. Front Office Department
2. Housekeeping Department
3. F and B Service Department
4. Kitchen Department
5. Engineering and Maintenance Department
6. Accounts Department
7. Security Department
8. Human Resources Department
9. Sales, purchase and Marketing Department
10. IT Department

2.5 IDENTIFYING THE STAKEHOLDERS IN DAILY OPERATIONS: BROAD CLASSIFICATION OF HOTEL STAFF:

1. Concierge
2. Executive officers
3. Hotel General Manager
4. Housekeeping
5. Porter/bell boy
6. Waiter/Waitress

EXPECTATIONS IN THE ORGANISATION:

- Relationship between FM and worker productivity.
- Effect of workplace design on staff.

CUSTOMER EXPECTATION:

- Comfort
- Cleanliness and safety
- Quality
- Efficient staff
- Reasonable price
- Ambience
- Appropriate facilities
- Efficiency in dealing with customer feedback
- Parking space

Types of Hotel Guest Complaints



Fig 2.5 Types of complaints

2.6 DOES THE DEFINITION OF FACILITY PLANNING AND MANAGEMENT COINCIDE FROM THE CONSUMER AND STAFF POINT OF VIEW?

- The needs identified are similar and work in a dependent loop to enhance performance and delivery.
- Over the progressive years, consumer demand has imposed higher requirements on the services provided in the hospitality sector.
- Hence the industry has evolved in order to cater to these needs.
- This led to the incorporation of newer technology and automated response systems.

What is needed?

Customer expectations, new regulatory standards and modern technological innovations are constant driving factors that propel change in the facility management plans. Tools like:

1. Computerized Maintenance Management Systems (CMMS)
2. Computerized Facilities Management Systems (CFMS) ensure a better quality of service.

What do they do?

These generate templates, checklists, and reminders integrated into a single system and efficiently schedule operations.

2.7 CMMS FUNCTIONS IN HOTEL OPERATIONS:

The main challenges in the hotel industry are customer satisfaction, delivery time and seamless overlapping of operations.

CMMS is a digital platform that keeps track of schedules, inventories and work orders.

1. Tracks the assets:
 - There is a cloud-based portal that keeps track of all the assets involved in the functioning of the building.
 - It keeps logs and records of complaints issued in each asset category.
 - These are prioritized and a maintenance schedule is generated.
2. Reduces the cost and improves efficiency:
 - This system eliminates the need to mitigate risks that arise due to equipment /asset failure.
 - Optimal system performance is maintained by avoiding the unexpected breakdown of machinery.
 - This is done by scheduling periodic maintenance via predictive and preventive scheduling.

CMMS is used for



Fig 2.6 Function of CMMS

2.8 SYSTEM ADVANTAGES:

- Minimizes equipment downtime.
- Allows accuracy and better quality of scheduling and planning.
- Improves the lifespan of the procured asset.
- All the system information is centralized and integrated.
- CMMS systems allow remote access to monitor the operations scheduled per day.

Table 2.1 A3 tabulation of the general hospitality scenario

STAKEHOLDERS		ACTIVITY CLASSIFICATION																									
INTERNAL STAKEHOLDERS	EXTERNAL STAKEHOLDERS	IN HOUSE FUNCTIONS	OUTSOURCED ACTIVITIES																								
OWNER	End User-Customer	Concierge	Laundry																								
INVESTOR	Supplier	Housekeeping	Pool maintenance																								
MANAGER	Creditor	Front desk	Equipment maintenance																								
EMPLOYEES	Inspection authority	Switchboard operations	Food service																								
Concierge	HRACC	Porters	PR and marketing																								
Event Planner	Licensing agent	HR and admin department	Revenue management service																								
Executive Chef	Approving authority-Government	Quality management	Information Technology																								
Hotel General Manager	Competitors	Engineering department	Project management																								
Housekeeping	Public	Staff training and workshops	Operating supplies purchasing																								
Porter	Intermediaries		Help desk management																								
Waiter/Waitress	Local neighbourhood		Accounts and financing																								
Engineers			Security																								
Maintenance Operators																											
Waste management department																											
Valet																											
Repair and maintenance staff																											
Security personnel																											
Marketing department																											
HR and admin																											
FACTS AND TECHNOLOGIES		TRENDS IN THE HOSPITALITY SECTOR																									
The technology works on two main aspects i.e. order management and time management.		HOTEL OCCUPANCY RATES 2010 - 2020 <table><thead><tr><th>Year</th><th>Occupancy Rate</th></tr></thead><tbody><tr><td>2010</td><td>58%</td></tr><tr><td>2011</td><td>60%</td></tr><tr><td>2012</td><td>61%</td></tr><tr><td>2013</td><td>62%</td></tr><tr><td>2014</td><td>64%</td></tr><tr><td>2015</td><td>65%</td></tr><tr><td>2016</td><td>65%</td></tr><tr><td>2017</td><td>66%</td></tr><tr><td>2018</td><td>66%</td></tr><tr><td>2019</td><td>66%</td></tr><tr><td>2020 - Proj</td><td>38%</td></tr></tbody></table> Source: Data provided by STR		Year	Occupancy Rate	2010	58%	2011	60%	2012	61%	2013	62%	2014	64%	2015	65%	2016	65%	2017	66%	2018	66%	2019	66%	2020 - Proj	38%
Year	Occupancy Rate																										
2010	58%																										
2011	60%																										
2012	61%																										
2013	62%																										
2014	64%																										
2015	65%																										
2016	65%																										
2017	66%																										
2018	66%																										
2019	66%																										
2020 - Proj	38%																										
Device management software simplifies the guest's experience by giving access to information for cleaning, housekeeping, housekeeping machine and other processes.																											
Intelligent tools like ICTs like smartphones, laptops, desktops, laptops, tablets, IPs, sensors, alarm systems, voice response systems, etc.																											

2.9 WORK DIVISION IN FACILITY PLANNING AND MANAGEMENT

REAL ESTATE MANAGEMENT	OCCUPANCY MANAGEMENT	FINANCIAL MANAGEMENT	BUILDING SYSTEMS	ASSET MANAGEMENT	MAINTENANCE MANAGEMENT
• SALE • LEASE • TAX MANAGEMENT • LEASE ADMINISTRATION • TRACKING EXPENSES	• SPACE ALLOCATION • MONETARY COMPENSATION • POLICIES AND RULES • MARKET INTELLIGENCE REPORT	• UTILITY MANAGEMENT • BUDGETING • PERFORMANCE REPORTING	• SECURITY • AUTOMATION • CONTROL AND MONITORING • ENERGY MANAGEMENT	• FURNITURE MANAGEMENT • ASSET TRACKING • PLANNING AND EXECUTION • CONDITION MAINTENANCE	• HELP DESK • DEMAND MAINTENANCE • PREVENTIVE MAINTENANCE • COMPLIANCE TO SAFETY AND STANDARDS

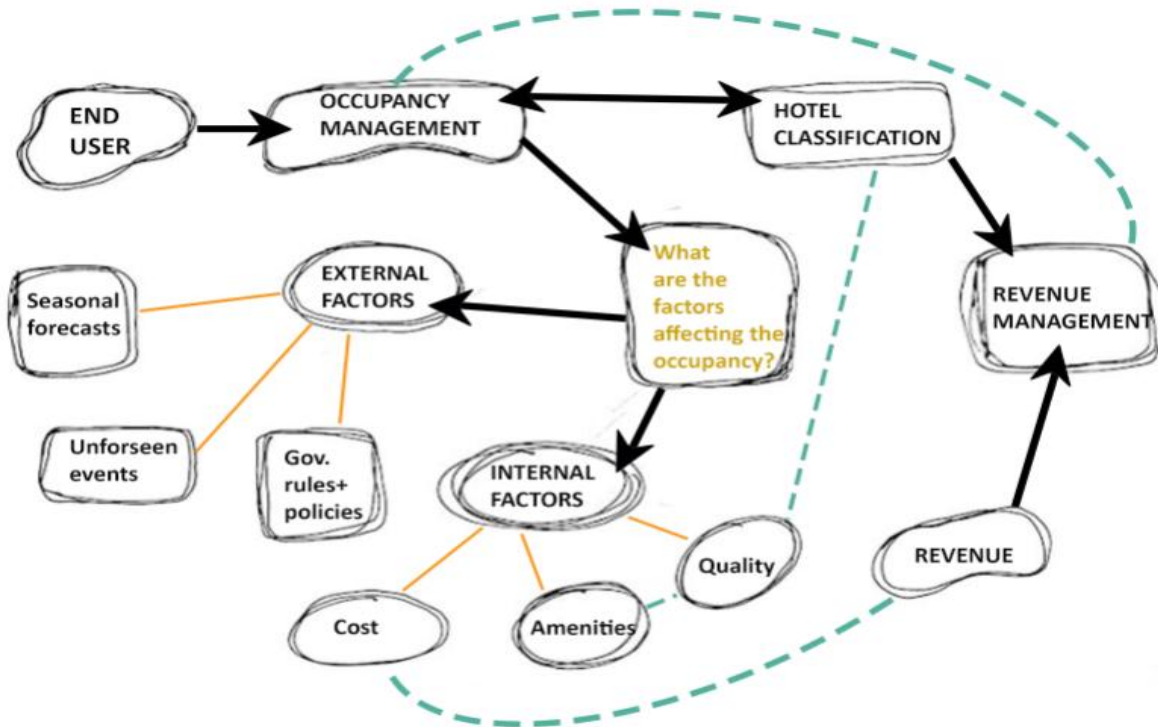


Fig 2.7 Work Division and interconnections

2.10 OCCUPANCY MANAGEMENT

- It talks about the ratio of occupancy at a given time.
- Identifies the expectations of the target category.



Fig 2.8 Flow of occupancy management

- It includes the weekly forecasts, the key indicators and challenges.
- Relation between spaces and efficiency in the arrangement. (How the staff can address the issues of user comfort and complaint.)
- Mitigation strategies to promote business. (Identify the potential risks, driving factors, and the hotel policies for workers, users, inventory and functionality).
- Business intelligence reports, influencing factors and conditions.
- It analyses the promotional events associated to enhance occupancy.

2.11 HOW DOES OCCUPANCY AND MAINTENANCE MANAGEMENT RELATE TO EACH OTHER?

- The direct impact of the maintenance system on the guest experience.
- Prompt report on failures helps speed up and improve the process.
- Continuous investment in maintenance has a positive impact not only on the hotels' equipment and facilities but also on guests' experience.

- An increase in available rooms will attract users, who in turn generate more revenue. Equipment failures have a direct impact on operations, by affecting customer loyalty and satisfaction.
- Maintenance is viewed as the long-term solution for the organization's goals.



Fig 2.9 Broad term classification of hotel success

2.12 NEED FOR THE HOTEL RATING SYSTEM?

- The hotel rating system gives a pretext for ranking the building in terms of the quality of services and facilities available.
- This is the driving factor that pushes the need for constant up-gradation of facilities and management systems.
- It is the ranking of the hotel that projects the image for it and gives a basis for the preconceived expectations of the guest category.

2.13 THE INDIAN RATING SYSTEM

In India, it is the HRACC," Hotel and Restaurant Approval and Classification Committee that classifies the hotels into various star categories.

Based on the guidelines prescribed the different categories are:

- 1 Star Hotels
- Star Hotels
- Star Hotels
- Star Hotels
- Star Hotels
- 5 Star Hotels deluxe

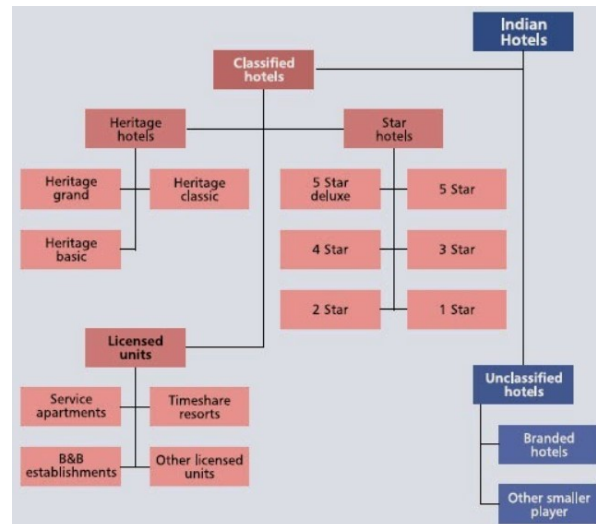


Fig 2.10 Hotel classification

The guidelines prescribed by the HRACC describe and mark which facilities are deemed “necessary” and which are “desirable”.

The facilities specified as necessary are non-negotiable and must be available.

The ranking process takes place in 2 stages:

STAGE 1: Listing the provided amenities and classification as per the guideline.

STAGE 2: Inspection for the quality of the facility provisions.

- Star-categorized hotels are required to maintain the mandated minimum percentage of skilled staff. (20% for up to 2-star hotels, 60% for 5-star hotels).
- The Guidelines provide a unified and standardized set of facilities and services that are required to be provided to customers.

General	Rooms	Public area
Integrated coms	Guest Services	Safety and security
Barrier free	Food Production	Staff and Conduct

Fig 2.11 Categories in rating

CONSUMER PERSPECTIVE:

Standardization of the classification system aids in better decision-making in regards to their choice of stay.

INDUSTRY PERSPECTIVE:

- Hotel standards provide the minimum guidelines and requirements for quality, amenities, services and operations.
- Allows up-skilling staff, thereby benefiting the hospitality industry as a whole.

FACILITIES SERVICES	&	1*	2*	3*	4*	5*/5*D	Yes/No	COMMENTS
GENERAL								
Full time operation 7 days a week in season		N	N	N	N	N		
Establishment to have all necessary trading licenses / Permissions		N	N	N	N	N		
Establishment to have public liability insurance		D	D	D	D	D		
24hr. lifts for buildings higher than ground plus two floors		N	N	N	N	N		Mandatory for all hotels. Local laws may require a relaxation of this condition. Easy access for the differently abled guests.
Bedrooms, Bathrooms, Public areas and kitchen fully serviced daily		N	N	N	N	N		
All floor surfaces clean and in good shape		N	N	N	N	N		Floor may be of any type.
GUEST ROOM								
Minimum 10 lettable rooms, all rooms with outside windows / ventilation.		N	N	N	N	N		
Minimum size of bedroom excluding bathroom in sq.ft.		120	120	130	140	200		Rooms should not be less than the specified size. The area may include the vestibule and other covered area within the room but exclude outdoor verandah/ balcony. Single occupancy rooms may be 20 sq.ft. less.
Air – conditioning - % of Rooms		25%	25%	50%	100%	100%		Air –conditioning / heating depends on climatic conditions and architecture. Room Temperature should be between 20 to 28 degree Celsius.
A clean change of bed and bath linen daily and between check –in		N	N	N	N	N		Definitely required between each check – in. On alternate days for 1 & 2 Star category hotels.
Guest linen								Good quality linen to be provided.
Minimum bed width for single 90 cm and double 180 cm.		D	N	N	N	N		
Mattress thickness minimum 10 cm		D	D	N	N	N		Cour, foam or spring foam
Minimum bedding 2 sheets, pillow and case, blanket, mattress protector / bed cover		N	N	N	N	N		Blankets available in air conditioned room as per seasonal requirement in non A/C rooms. Mattress protector is 'desirable' in 1 Star and 2 Star category hotels and 'necessary' for the other categories.
Suite (2 rooms or 2 room-bays having a bedroom and separate sitting area, having one bathroom and one powder room)		D	D	D	N	N		Minimum 1 suite. A suite must be sold as one room.
Haardriers		D	D	N	N	N		Where not provided in bathroom, must be available on request. 3 Star, 4 Star, 5 Star and 5 Star Deluxe category hotels shall provide hair dryer facility in the room on complimentary basis. In 1 Star and 2 Star hotels, this facility will be made available on request on complimentary basis.
Safe keeping / in room safe		D	D	D	N	N		1,2, and 3 Star hotels to have facilities for safe keeping in the reception. All 4 Star, 5 Star and 5 Star Deluxe hotels shall provide a safe in the room.
Mini bar / Fridge All 3 Star hotels shall have facility of a mini fridge and all 4 Star, 5 Star, and 5 Star Deluxe hotels shall have a the facility of mini bar.		D	D	N	N	N		Contents must conform to local laws.
Drinking water with minimum one glass per guest.		N	N	N	N	N		All star category hotels to provide 2 sealed bottles of branded packaged drinking water of minimum 500 ml per person per day on complimentary basis. Ultra violet treated water will not be acceptable.
Guest Linen								Good quality linen to be provided.
Shelves / drawer space		N	N	N	N	N		Necessary for hotels of 1,2 and 3 Star category to have a wardrobe.
Wardrobe with minimum 4 clothes hangers per bedding		N	N	N	N	N		In one star or two star hotels, this may be without doors.
Sufficient lighting (1 lamp per bed)		N	N	N	N	N		

Fig 2.12 HRACC checklist for star rating

2.14 LITERATURE CASE STUDY TAKEAWAYS

This study focuses on the hospitality sector in SWEDEN.

OBJECTIVES:

- To understand and evaluate factors influencing the decision of maintaining in house and outsourced services.
- To identify the challenges faced by the staff in work and functional efficiency.

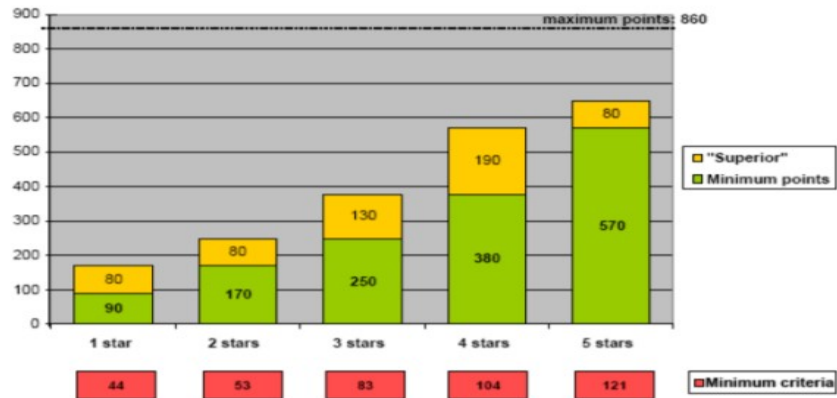


Fig 2.13 Minimum and maximum points

TRENDS IN USER POPULATION:

- Guests in the hotel are commonly classified as tourists and business personnel.
- It is observed that the requirements of these groups are not similar.
- The occupancy pattern is influenced by factors that cause slight changes in the service requirements.
- For example, changing travel conditions and better income see a peak in occupancy on the weekends.
- The focal conclusion of this study stressed the prominence of intangible assets, products and services offered.
- This was based on the evidence that intangible factors generated more value in comparison to tangible elements.
- That is there is more profit in the former.

Table 2.2: Summary of reviews

S.NO	TITLE	FOCUS AREA	INFERENCE
1	<i>Facility Management-The strategic selection of a maintenance system-Kym Fraser</i>	To explore the various models and systems in the assessment of facility planning and management strategies.	4 main models of evaluation are identified: • Total Productive Maintenance • Condition Based Maintenance • Reliability Centered Maintenance • Condition Monitoring The study concludes with the significance of developing a maintenance culture within organizations.
2	<i>Assessment of Facility Management practices In the hospitality industry in Anambra using Nigerian Development Standards –Jennifer Ijeoma</i>	To identify areas where the performance gap occurs via a site specific case study.	The areas that require efficient planning and the impacts of poor facility planning and management are documented. 8 focal factors are determined to bridge the performance gap. • Adequate Budgetary Provisions • Skilled Personnel • Material Procurement • Level of Automation • Safety and Security Provision • Bureaucracy • Benchmarking • Value Engineering
3	An integrated approach to facility planning by ELECTRE method	To analyze and evaluate the relationship with the orientation of spaces and the work impact.	This paper uses a multi criteria decision making method to evaluate the design, layout, and accommodation of people, machines and activities of a system. It identifies the set of 5 core parameters.
4	Facility Layout Planning-Pablo Perez, Joseff Mula	It identifies the approach to planning, the mathematical optimisation models employed, and the alternatives generated.	It consolidates the decision support tools that aid in assessing the efficiency of facility planning. These include: • Computer aided analysis • Heuristic methods • Mathematical models

2.15 JOURNAL REVIEW -1

International Journal of Facility Management

Facility Management-The strategic selection of a maintenance system-Kym Fraser

STUDY AREA:

An asset's reliability and usability are determined by FM.

The aim of the paper is to identify certain models and systems to aid in the assessment of facility planning and management strategies.

RESEARCH APPROACH:

- The research is condensed on the basis of exhaustive literature reviews and categorizing the models applied in evaluating facility management till date.
- The paper identified 37 management models and found that 4 of the models were popularly employed.

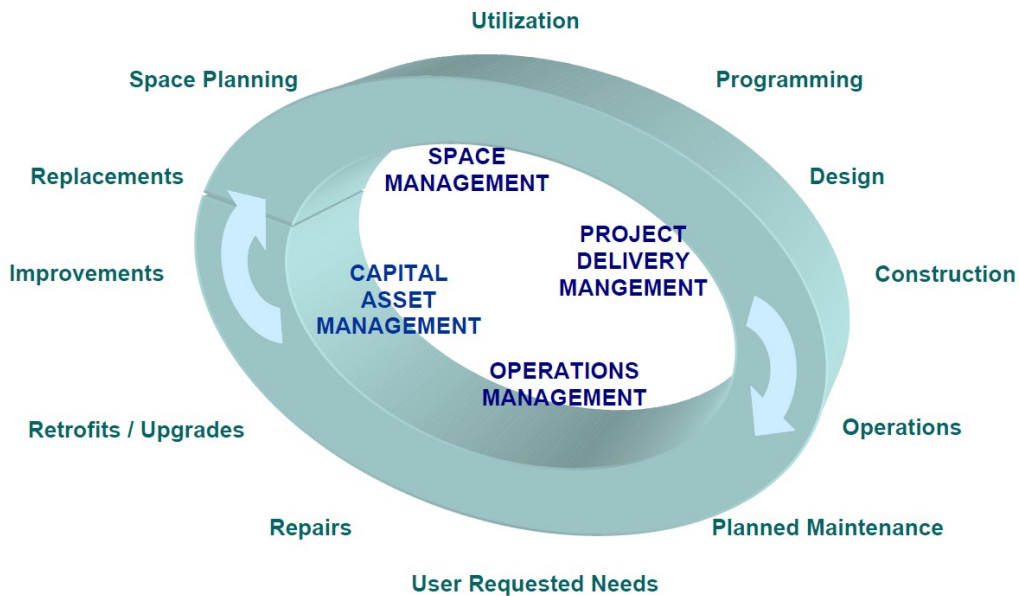




Fig 2.14 Model types for assessment

TOTAL PRODUCTIVE MAINTENANCE:

VALIDATION OF THE MODEL:

The studies show that companies that have employed TPM have

- 50 percent reduction in breakdown labor rates
- 70 percent reduction in production
- 50-90 percent reduction in setup
- There is 60 percent cost reduction per maintenance per unit.
- It is interlinked with lean manufacturing, JIT, TQM and zero defects.
- This is aimed towards preventing machinery breakdown, identifying defects and reducing the down time.

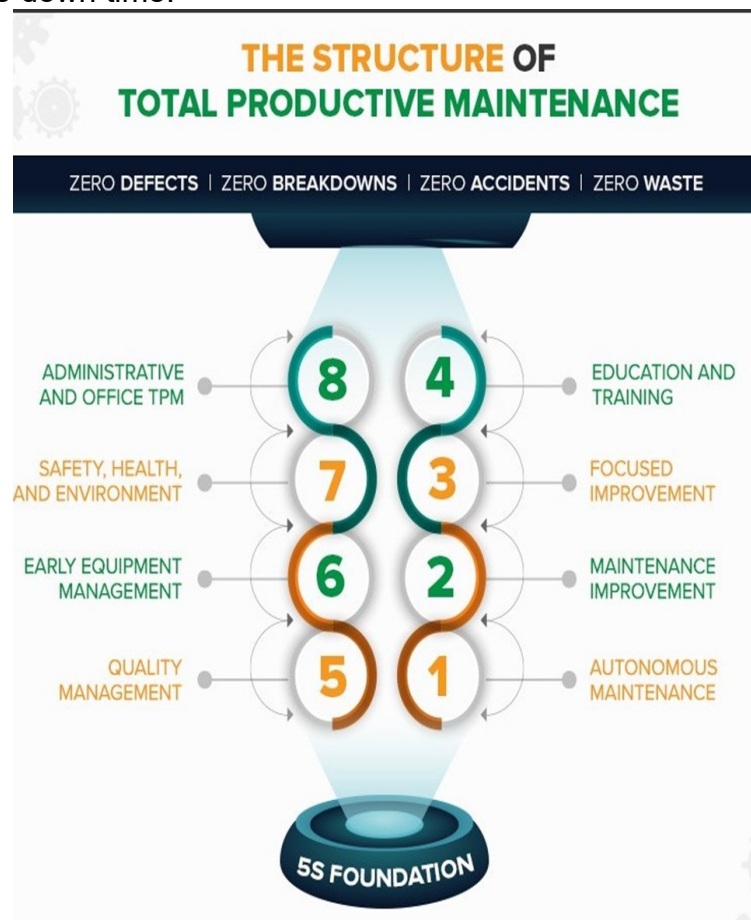


Fig 2.15 Structure of Total Productive Maintenance

CONDITION BASED MAINTENANCE:

This method relies on the detection and monitoring of equipment parameters, the interpretation of readings, the reporting of deterioration and the vital warnings of impending failure.

It is a closed loop maintenance system where the sensor readings are used to determine management strategies.

It determines the problem area, seriousness of the problem and the most efficient mitigation methods.

System defects can be classified as:

- dynamic defects, such as vibration and noise levels;
- particles released into the environment;
- chemicals diffused
- physical flaws- such as cracks, wear and deformation
- temperature rises in the equipment
- electrical malfunction

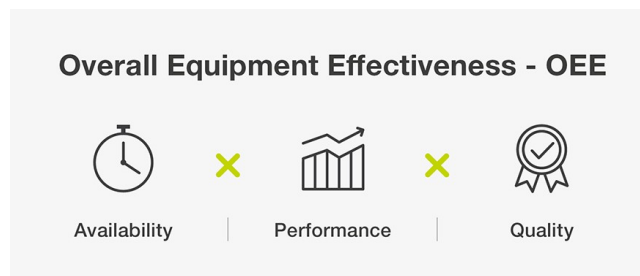


Fig 2.16 Overall Equipment Effectiveness

RELIABILITY CENTERED MAINTENANCE:

- This model is aimed to predict the maintenance required for the system employed.
- Over maintenance should be avoided.
- It defines the functions and performance standards for different assets.(product quality, customer service, operating costs and safety)
- It concentrated on the ideology of improving the existing system, instead of proposing a complete system replacement.

CONDITION MONITORING:

- This is done to evaluate the degree of deterioration in the system.
- In condition monitoring, the primary criteria are selecting the features of the failure patterns.
- Automatic fault detection systems are efficient, fast and eliminate the possibility of human error.

- Early detection is vital to maintain system operation and to reduce costs.
- It has a significant impact on the total LCC.

INFERENCES:

- The paper narrates the significance of developing a maintenance culture within organizations.
- For effective management of facilities, the need is a reliable maintenance system in place to ensure the safety of the assets .

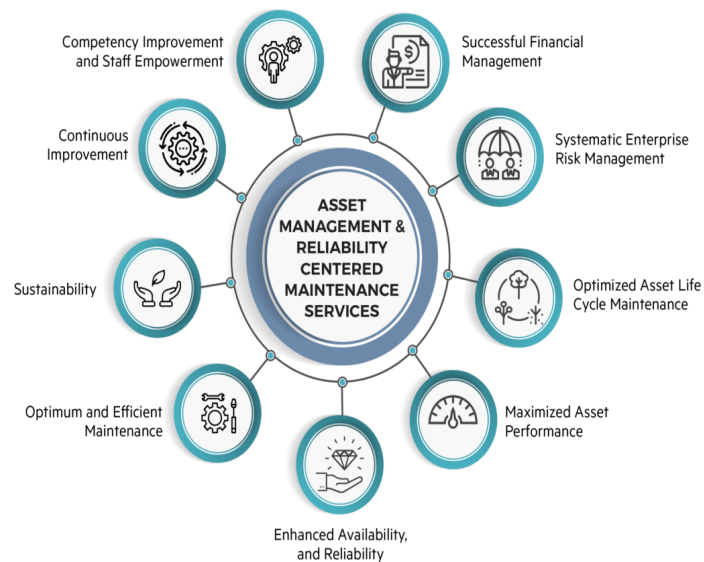


Fig 2.17 Asset management and reliability centered maintenance services

2.16 JOURNAL REVIEW -2

International Journal of Scientific & Engineering Research

Assessment of facility Management practices in the hospitality industry in Anambra using Nigerian Development Standards –Jennifer Ijeoma

STUDY AREA:

To identify the challenge areas that curb the efficiency of operations in the hospitality area.

STUDY OBJECTIVES:

1. Assess the conformity of the selected hotels to FM standards set by the Nigerian Tourism Development Corporation.
2. Highlight the shortcomings in different functional areas.
3. Adopts a holistic approach to integrated facility management.

The study adds value as it offers the stakeholders an insight of where the planning is going wrong.

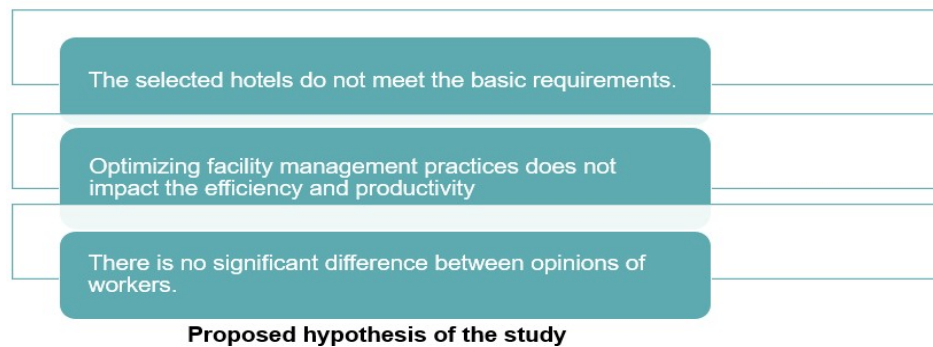


Fig 2.18 Hypothesis for the research paper

RESEARCH METHODOLOGY:

The study used field surveys and questionnaires to collect data on:



Fig 2.19 Approach to the research study

Table 2.3: Shortcomings identified from staff surveys

Table 4.11: Opinions of Hotel Staff on the shortcomings of Facilities Management Practices

S/No	Issue raised	Awka		Nnewi		Onitsha	
		Mean	SD	Mean	SD	Mean	SD
1	Lack of proper maintenance	3.1207	1.02730	3.4222	1.07638	2.6237	1.17874
2	Inadequate maintenance performance standard	4.0517	.75909	4.1556	.82450	3.4946	1.33208
3	Analytics factor	3.7759	1.09293	3.6889	1.32840	3.2151	1.45101
4	Proactive Approach in infrastructure	4.6552	.47946	4.2667	1.03133	4.2043	1.31512
5	Lack of life cycle cost budget	4.0690	1.29591	3.5333	1.42382	3.3656	1.70539
6	Budgeting for POM an utilities	3.1207	1.28524	3.4444	1.09867	2.9355	1.30889
7	Inadequate of facilities benchmarking	3.4655	1.15797	3.4222	1.17722	2.9677	1.44050
8	Computerized and internet-based facilities	3.4655	1.18789	3.5333	1.21730	3.1290	1.43122
9	Lack of Fire safety plan	3.5690	1.20105	3.7778	1.31233	3.2125	1.54013
10	Lack of creating the renovation plan	3.5517	.99424	3.4889	1.19891	3.1500	1.32264
11	Lack of complete record keeping	3.7414	1.29181	3.7333	1.25045	3.2125	1.51527
12	The maintenance of building and its systems are often neglected during the design and planning stage in project construction.	3.0345	1.61099	3.4667	1.64593	3.2625	1.67441

Table 2.4: Challenges in the Facility Management Practices

Table 4.12: Challenges against Facilities Management Practices in the Hospitality Industry as suggested by the Hotel Staff

S/No	Issue raised	Awka		Nnewi		Onitsha	
		Mean	SD	Mean	SD	Mean	SD
1	Conservatism among the stakeholders	4.1207	.32861	4.2667	.44721	4.1250	.33281
2	Conservatism among the built environments professionals	4.4310	.49955	4.5111	.50553	4.3125	.66739
3	Lack of legislation to backup practice management	4.7241	.45085	4.5778	.62118	4.6750	.67082
4	Conflict of supremacy among line managers	4.4828	.68162	4.4000	.80904	4.2151	1.10187
5	Inadequate training of facilities managers	4.2241	.89918	4.1778	.96032	3.9785	1.16076
6	Ignorance of facilities management in hospitality industry	4.4655	.70625	4.5333	.69413	4.4516	.71500
7	Lack proper investment into ICT by hospitality the industry	4.3448	.60847	4.3333	.56408	3.8495	1.16046
8	Absence of relevant database management system	4.4483	.50166	4.4444	.50252	4.2473	.98528

Source: Researcher's Field Survey, 2018.

Strategies for efficient facility management



Fig 2.20 Planning strategies

The effects of lack of facility planning and management are:

- a. Loss of customers,
- b. Low patronage,

- c. Low productivity,
- d. Business failure, and
- e. Bad record to the hospitality industry.

Table 2.5: Analyzed Results-Paired difference

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Efficient and Effective Practices for Facilities Management in Awka by Staff - Efficient and Effective Practices for Facilities Management in Awka by Customers	.4219100	.7452262	.2356612	-.1111927	.9550127	1.790	9	.107
Pair 2	Efficient and Effective Practices for Facilities Management in Nnewi by Staff - Efficient and Effective Practices for Facilities Management in Nnewi by Customers	.3879300	.7998141	.2529234	-.1842225	.9600825	1.534	9	.159
Pair 3	Efficient and Effective Practices for Facilities Management in Onitsha by Staff - Efficient and Effective Practices for Facilities Management in Onitsha by Customers	-7.758000 0E-2	.6895610	.2180583	-.5708622	.4157022	-.356	9	.730

Source: Researcher's Statistical Computations

Inferences at the end of the study:

- **Sufficient Budget:** An organization's management should map its goals and objectives to effectively operate within the prescribed budget.
- **Skilled Personnel:** The staff strength of the maintenance crew and engineering departments should be competent and able to handle situations.
- **Material Procurement:** The process of procurement should be well defined and adequate standby provisions are ensured.
- **Level of Automation:** Investment should be made in technology and software packages that are relevant to data management.
- **Safety and Security Provision** to detect equipment breakdown and rectify.
- **Bureaucracy:** There should be a well-defined management policy in place for effective decision making.
- **Benchmarking:** Benchmarking should be employed to help identify trends to achieve success in the competitive area.
- **Value Engineering:** It is imperative to eliminate irrelevant expenses.

FM's six “super challenges”



Fig 2.21 Key factors

2.17 JOURNAL REVIEW -3

International Research Journal of Engineering and Technology

**An integrated approach to facility planning by ELECTRE method-Salihah Rehman,
Muataz Hazza F. Al Hazza, Erry Yulian Triblas Adesta**

STUDY AREA:

The aim of this research is to integrate different approaches in order to evaluate, analyze and select the best facilities planning method that is able to explain the relationship between the core area and other supporting departments and its effect on human efforts.

The said study is done for an industrial production unit.

PRIMARY AREAS OF FOCUS / RESEARCH APPROACH:

- There are two different approaches that have been integrated.
- Apple's layout procedure is used as one of the analysis tools in the planning stage.

- ELECTRE method is a Multi Criteria Decision Making method (MCDM) that works to minimize the risk of poor facilities planning.
- The study was done on an industry case study and the area was divided as the whole plant area and area of the manufacturing unit.



Fig 2.22 Core parameters for evaluation

- Facility planning is related to the design, layout, and accommodation of people and system equipment.
- Based on the activities in the plant a set of criteria for evaluation were formulated.
- Various layout options were generated and assessment is carried out in a rank-based approach.

What is ELECTRE method?

- Elimination and Choice Expressing Reality, is based on the principle that there are several solutions to a problem.
- This method lists down the possible solutions, the criteria that forms their basis and assigns a weightage to each.
- This aids in the elimination by ranking process.
- The fundamental idea of the ELECTRE technique is that alternatives can be eliminated which are dominated by other alternatives to a specified degree.
- A set of parameters are consolidated and ranking is carried on the basis.
- There are two parameters used in this method to evaluate advantages and disadvantages between the alternatives, which are:
 1. Concordance index: These measures relative advantages.
 2. Discordance index: These measures relative disadvantages.

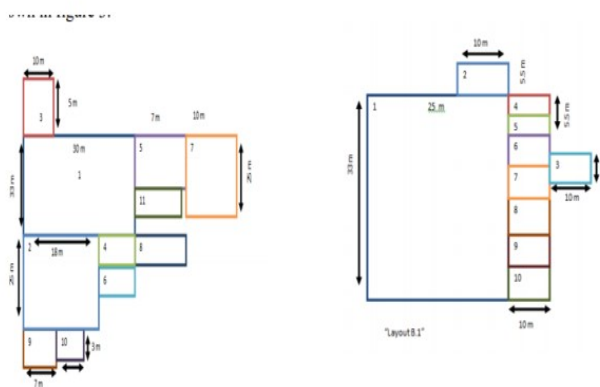
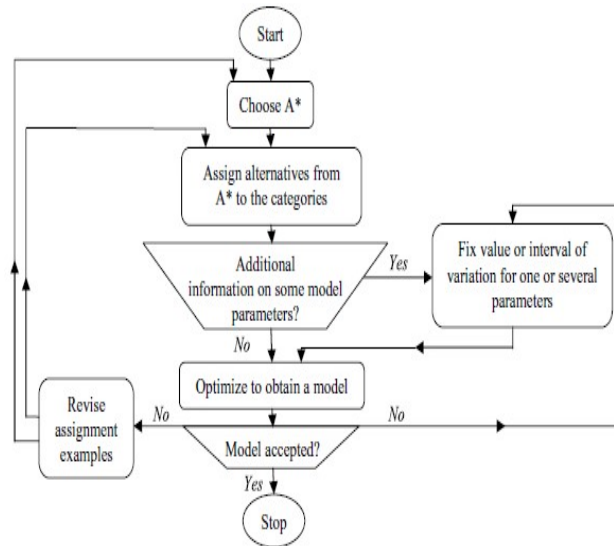


Figure 3. Original Layouts

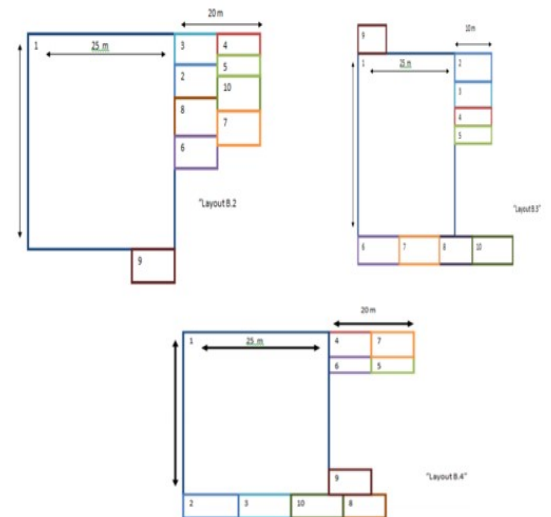


Figure 4. Alternative Layouts

Table 6. Summarized scores for the manufacturing area layouts "Layout B"

Layout	Inter department relation satisfactory Level	Distance traveled "Product"	Time traveled "Product"	Distance traveled "Workers"	Time traveled "Workers"
B.1	11	133.5	47.7	140	84
B.2	16	145	51.8	140	84
B.3	9	172	61.4	135	81
B.4	11	163.5	58.4	100	60

Based on ranking indices the results are

1. B4
2. B2
3. B2
4. B3

Fig 2.23 Ranking of different layout options

2.18 JOURNAL REVIEW -4

International Journal of Production Research Facility Layout Planning-Pablo Perez, Joseff Mula

STUDY AREA:

This paper gives a detailed overview of FLP from the perspective of operations planning.

It identifies the approach to planning, the mathematical optimisation models employed, and the alternatives generated.

The facilities layout is the process of arranging the production units in a way that successfully achieves the organisation goals.

RESEARCH APPROACH:

The research is condensed on the basis of certain categories that have been identified after referring to several sources.



Fig 2.24 Approach to the research

Efficient and inefficient layouts:

- Efficient FLP must ensure that schedules are met in the short, mid and long terms and at a lower cost.
- There should be a guarantee of flexible space layouts, minimal risks and optimal functioning.
- Inefficient layouts can lead to bottlenecks and poorly used space.
- All this can result in anxiety for workers, work accidents, and make the control of operations and personnel management infeasible.
- This is the primary reason for the production time to increase and work productivity levels to lower.

Analytical tools used:

The mathematical approach employed for efficient facility planning involves the broad categories of:

- I. problem representation
- II. nature of the objective function
- III. data type
- IV. considering demand certainty or demand uncertainty
- V. the employed distance metrics
- VI. the considered solution approaches

The next step is to analyze the priority of spaces for formulation. This helps to identify the set of constraints that arise.

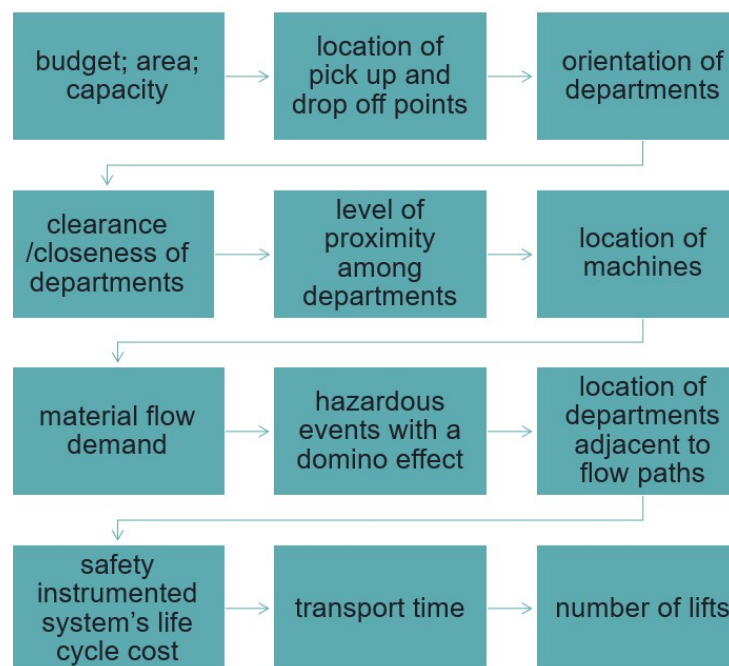


Fig 2.25 Planning methods

Results derived from the study:

1. Reduction in the total materials handling cost (MHC) is the foremost objective function in FLP optimization models (62.68%),
2. Flow distance minimization (24.4%)
3. Rearrangement cost minimization (19.62%)
4. Maximization of the closeness rating among departments (10%)

5. Minimization of the costs related to material handling equipment (8.13%).

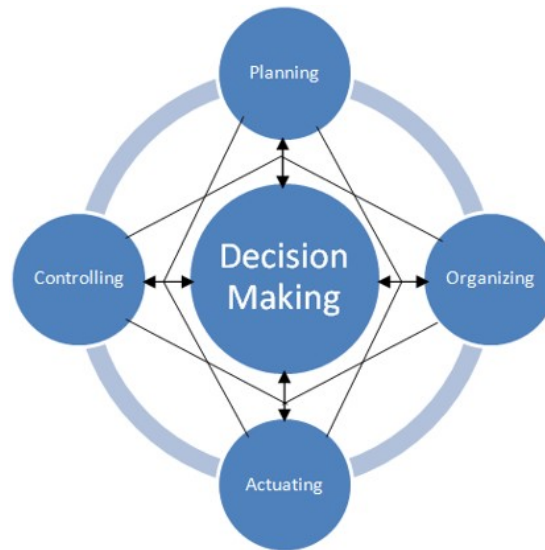


Fig 2.26 Planning methods

INFERENCE: Classifying decision support tools

There are 5 sets of decision support tools that have been identified.

Decision tool 1:

Computer-aided layout planning tools: To generate multiple options.

Decision tool 2:

Mathematical programming models: For small scale problems.

Decision tool 3:

Heuristic algorithms: To identify approximate solutions for large scale problems.

Decision tool 4:

Simulation software: To simulate and to evaluate performance in different layout scenarios.

Decision tool 5:

Computer-aided design software.

3 METHODOLOGY

3.1 INTRODUCTION

The process of formulating the research methodology initiated from a visualization of how the study should progress. The research process begins with mapping the key parameters and then building up on other aspects like the relation between the parameters and the hierarchy. It is then established in a stage wise progression and evaluated using tools.

3.2 THE RESEARCH PROCESS

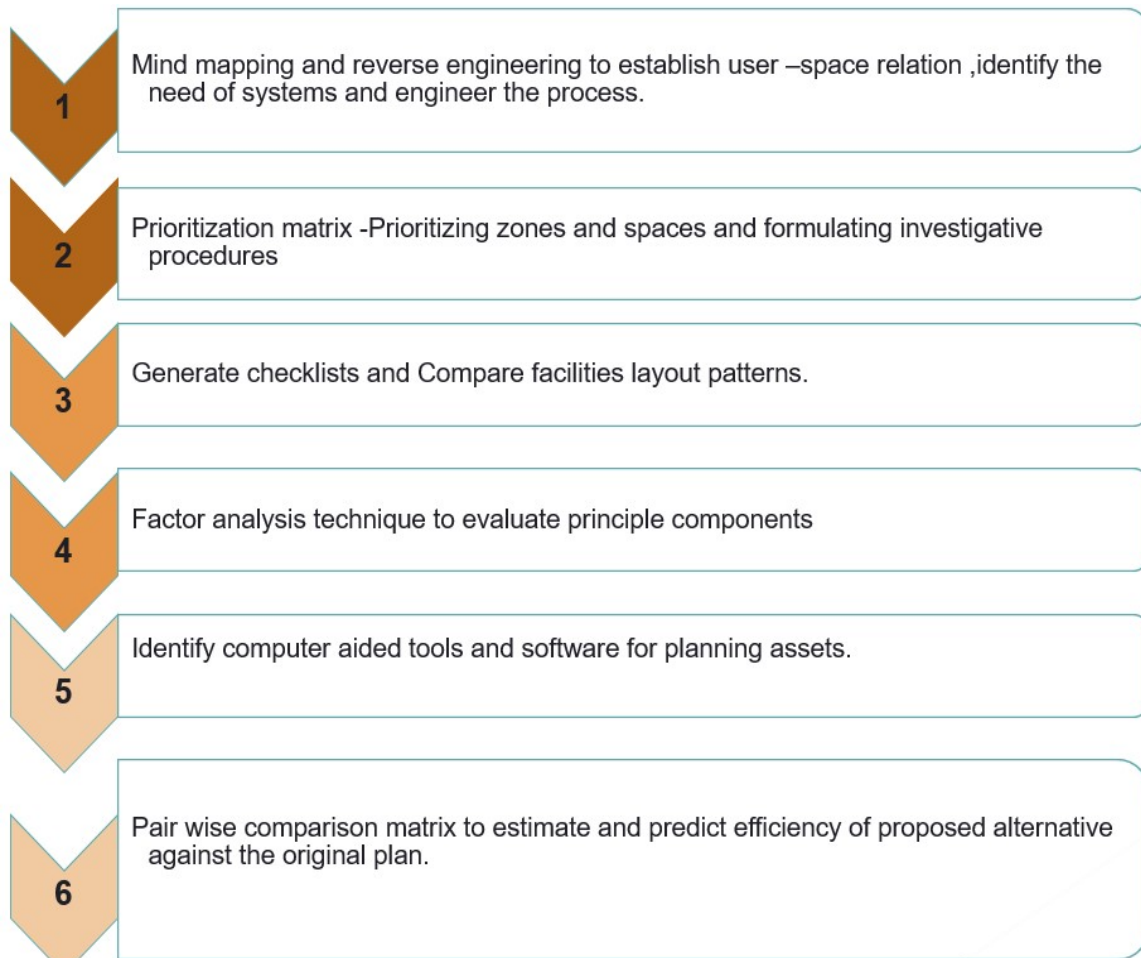


Fig 3.1 Research Process

3.3 STAGE WISE WORK PROCESS

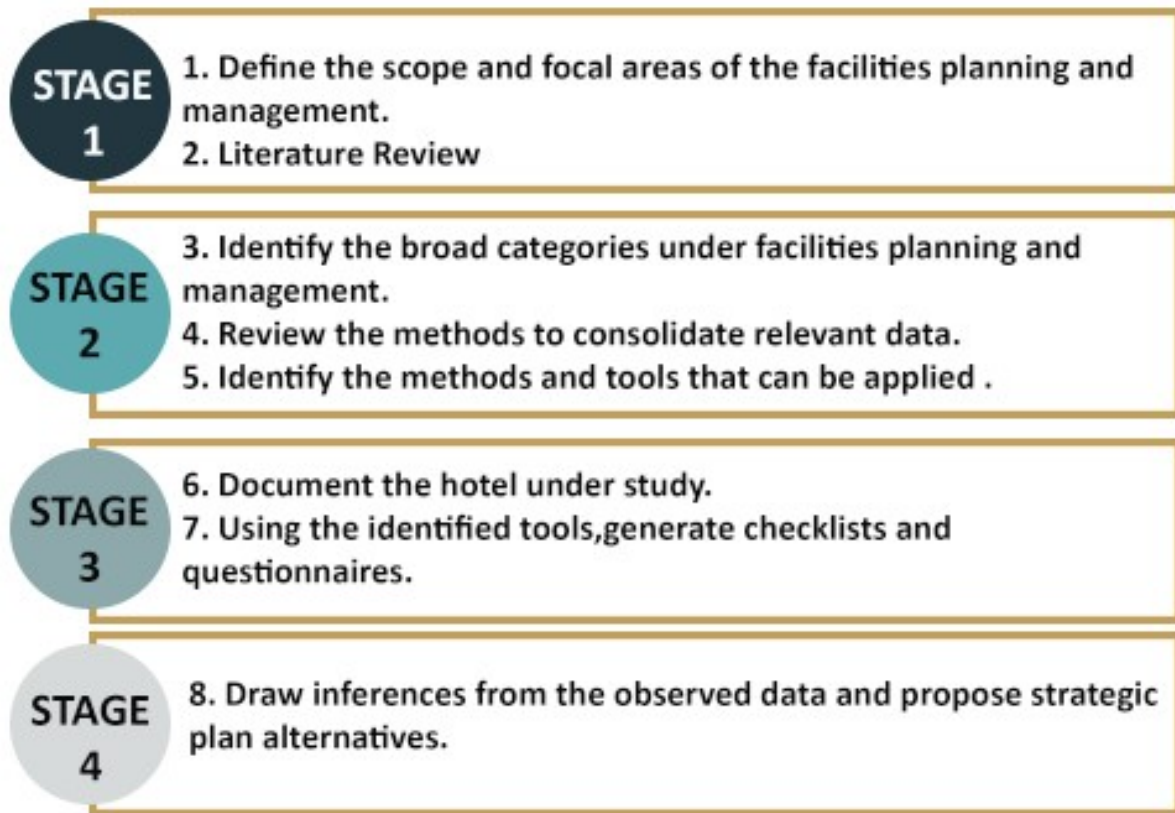


Fig 3.2 Stages

3.4 DATA COLLECTION METHODS:

- Literature reviews
- Journal reviews
- Case study
- Identifying preliminary tools and checklists
- Efficiency mapping and productivity analysis

3.5 ANALYTICAL TOOLS AND TECHNIQUES:

- Observations
- Checklists
- Priority charts
- Performance indices and data records

- Asset management systems

3.6 TOOLS THAT AID :

- A detailed questionnaire to the consumer to identify their expectations, limitations and experiences.
- Questionnaires targeted the hotel operation side to identify the mitigation strategies, revenue impacts and performance evaluation of the identified risks.
- Analyze the stakeholders, functions, cause and consequence.
- An effective time analysis to document the system complaint and response time for resolution of the range of user satisfaction.

The services are planned and analyzed via developing activity relationships. The combined result gives the relationship flow chart.

It identifies the relevance of each of the facilities and allows consideration of space utilization, resource and machine allocation.

It gives a framework and recognizes an alternative pattern of procedures and orientation of activities. This would help identify the non-value-adding steps in the entire process.

The new alternative would eliminate steps unnecessary and generate better output efficiency.

a. ELIMINATE

This step questions the necessity of the activity - Necessary or can be eliminated?

b. COMBINE

Identifies the scope to combine two or more operations under a single function.

c. CHANGE SEQUENCE

Validates the current process (or) identifies a better methodology.

d. IMPROVE DETAILS

What can be done to make it better?

4 ANALYSIS AND RESULTS

4.1 INFLUENCING FACTORS FOR DECISION MAKING IN MANAGEMENT OPERATIONS AND FOR IN HOUSE AND OUTSOURCING MAINTENANCE

Consideration Factors	Average Score	Consideration Factors	Average Score
Skills of in house technicians		Degree of system complexity	
Time constraint		Financial constraint	
Statutory requirements		Technical support from manufacturers	
Availability of in house labour force		Use of proprietary units and parts	
Use specialised tools and requirements		Historical information	
Consideration Factors	Average Score	Consideration Factors	Average Score
Health and Safety		Reliability of system	
Energy consumption		Criticality of system	
Guest Expectation		System life cycle	
Degree of influence in business activities		Annual Budget	
Environmental Impact		Feedback from other departmental heads	
Hotel Policy		Manufacturer recommendations	
Maintenance Resources (labour, tools and materials)		Equipment history records (failure mode, frequency and cause	
Legal requirement			

Fig 4.1 Factors influencing decision making

4.2 OVERVIEW OF ASSUMPTIONS AND OBJECTIVES

ASSUMPTIONS

1. The human factor is considered the core pillar of facility management.

WHY THIS ASSUMPTION?

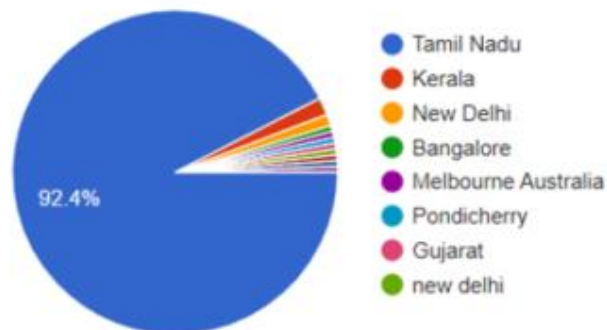
To know the end-user to determine the middle category of staff and management facilities.

HOW WAS THIS ACHIEVED?

A survey was conducted to analyze the user requirements and the corresponding link to facility planning and management.



Isolated area of study:



Priority of criteria for selection:

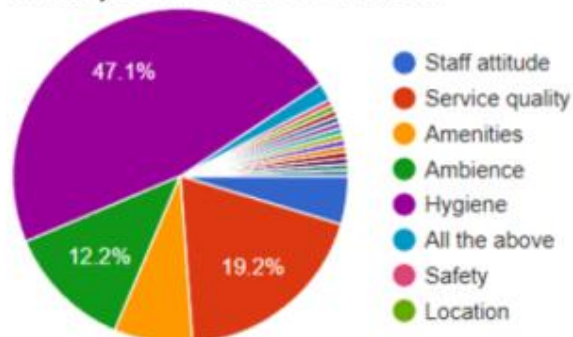


Fig 4.2 User survey results

This survey (200 respondents) made it possible to analyze the common failures of the hospitality facility management team and pinpoint the area of study.

This gives the thesis a direction to work on.

Once the areas of complaint are identified, it assists in identifying the central aspect of hotel facility management.

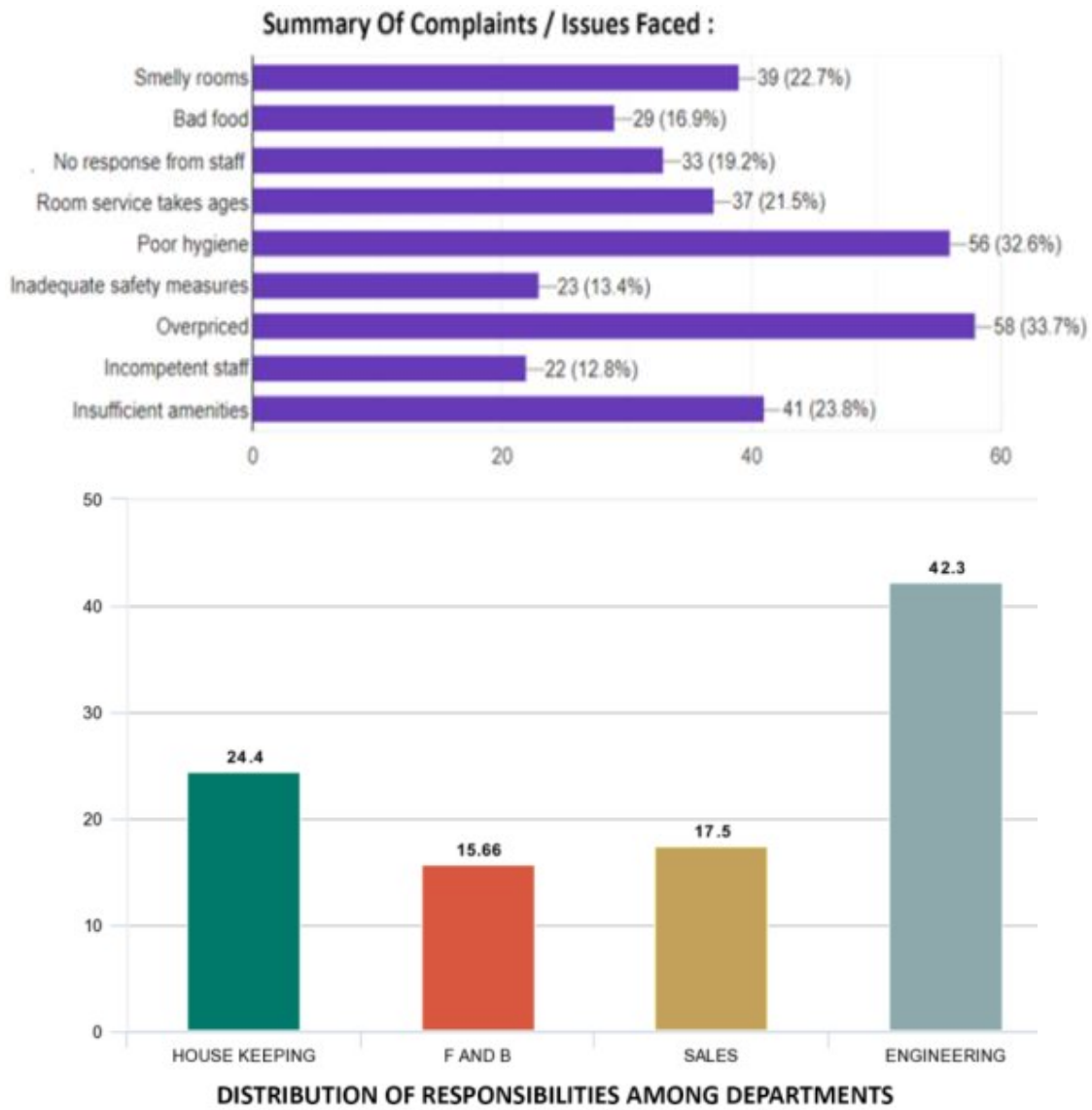


Fig 4.3 Distribution of complaints

4.3 NARROWING DOWN THE AREA OF STUDY:

From the survey, we conclude that most of the response is attributed to the responsibility of the engineering department of the facility.

THE FOUR PILLARS THAT CONTROL THE HOTEL OPERATIONS :



Fig 4.4 Pillars of hotel operations

Table 2.6 Work scope of the engineering department

S.NO	SCOPE OF WORK IN THE ENGINEERING DEPARTMENT
1.	PREVENTIVE MAINTENANCE PROGRAM
2.	GUEST ROOM/ FACILITY RENOVATION
3.	FIRE SAFETY PROCEDURES
4.	EMERGENCY PROCEDURES AND PROTOCOLS
5.	ALARMS AND MONITORING
6.	MAINTENANCE CALL LOGGING AND ACTION
7.	MAINTENANCE REQUEST FORMS
8.	PLANT AND EQUIPMENT DAILY CHECKS
	➤ HAVC ➤ PLUMBING ➤ ELECTRICAL ➤ STP ➤ LAUNDRY ➤ MONITORING WATER PH LEVELS ➤ ELEVATORS ➤ BMS SYSTEMS
9.	CONTRACTED SERVICES
10.	CONDITION OF THE BUILDING /SITE INFRASTRUCTURE
11.	ENVIRONMENT MANAGEMENT SYSTEMS
12.	INVENTORY MANAGEMENT (LOG OF SPARE PARTS)
13.	WASTE MANAGEMENT
14.	COMPLIANCE TO SAFETY AND SECURITY GUIDELINES
15.	CERTIFICATION AND ACCREDITATIONS

- The next step was the case study documentation.
- This was done with a questionnaire to break down the complex functions into simple categories.

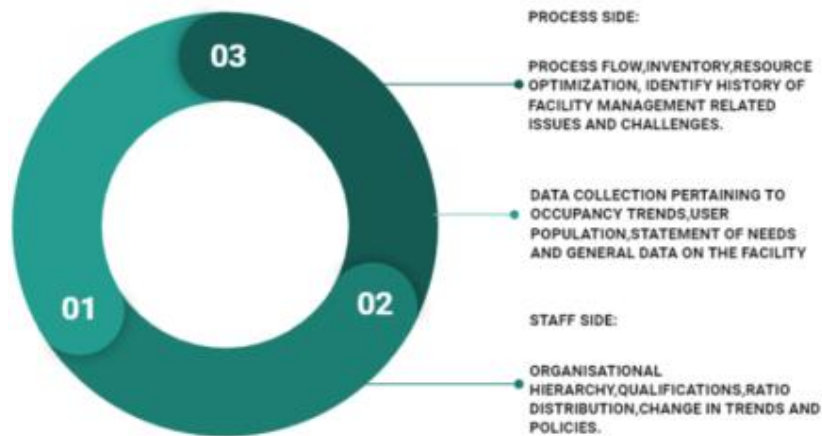


Fig 4.5 Narrowing the scope

4.4 CASE STUDY: SELECTION JUSTIFICATION:

Both the hotels selected are five star rated and located in prime locations in Chennai. The target user of each scenario was the secondary driving factor.

The third consideration was the influence of the locality on facility management. The accreditation and environmental initiatives that were undertaken played a role in the selection.

4.5 CASE STUDY: OVERVIEW

FEATHERS-A RADHA HOTEL

- LOCATION: Poonamallee high road
- SITE AREA: 2.5 acres
- BUILT-UP: 34800 sq.m approx.
- FLOORS: 10 floors
- INCEPTION: 2016
- CURRENT OCCUPANCY: 60%



Fig 4.6 Feathers hotel

GRT GRAND

- LOCATION: T.Nagar
- SITE AREA: 1.045 acres
- BUILT-UP: 16500 sq.m approx
- FLOORS: 13 floors
- INCEPTION: 1998
- CURRENT OCCUPANCY: 40%
- RATING:
- Till 2019 -4-star category
- At present it holds a 5-star certification.



Fig 4.6 GRT hotel

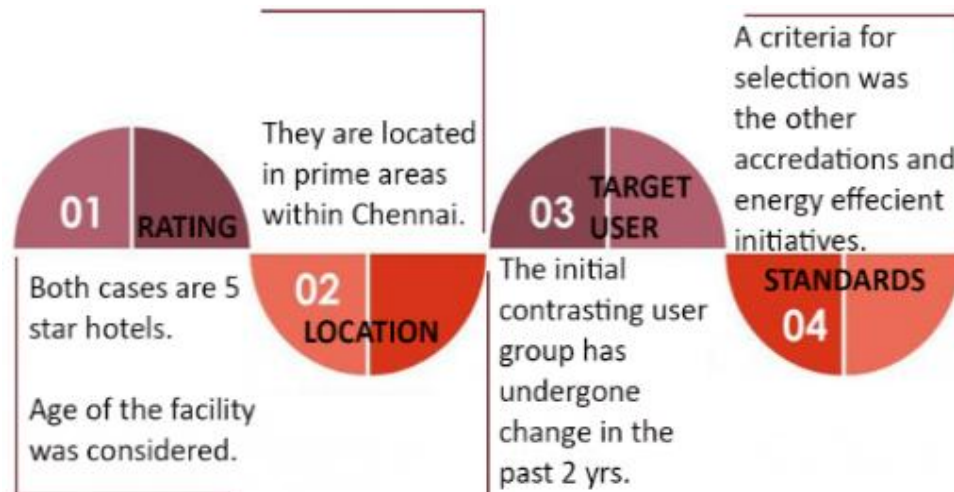


Fig 4.8 Case study justification

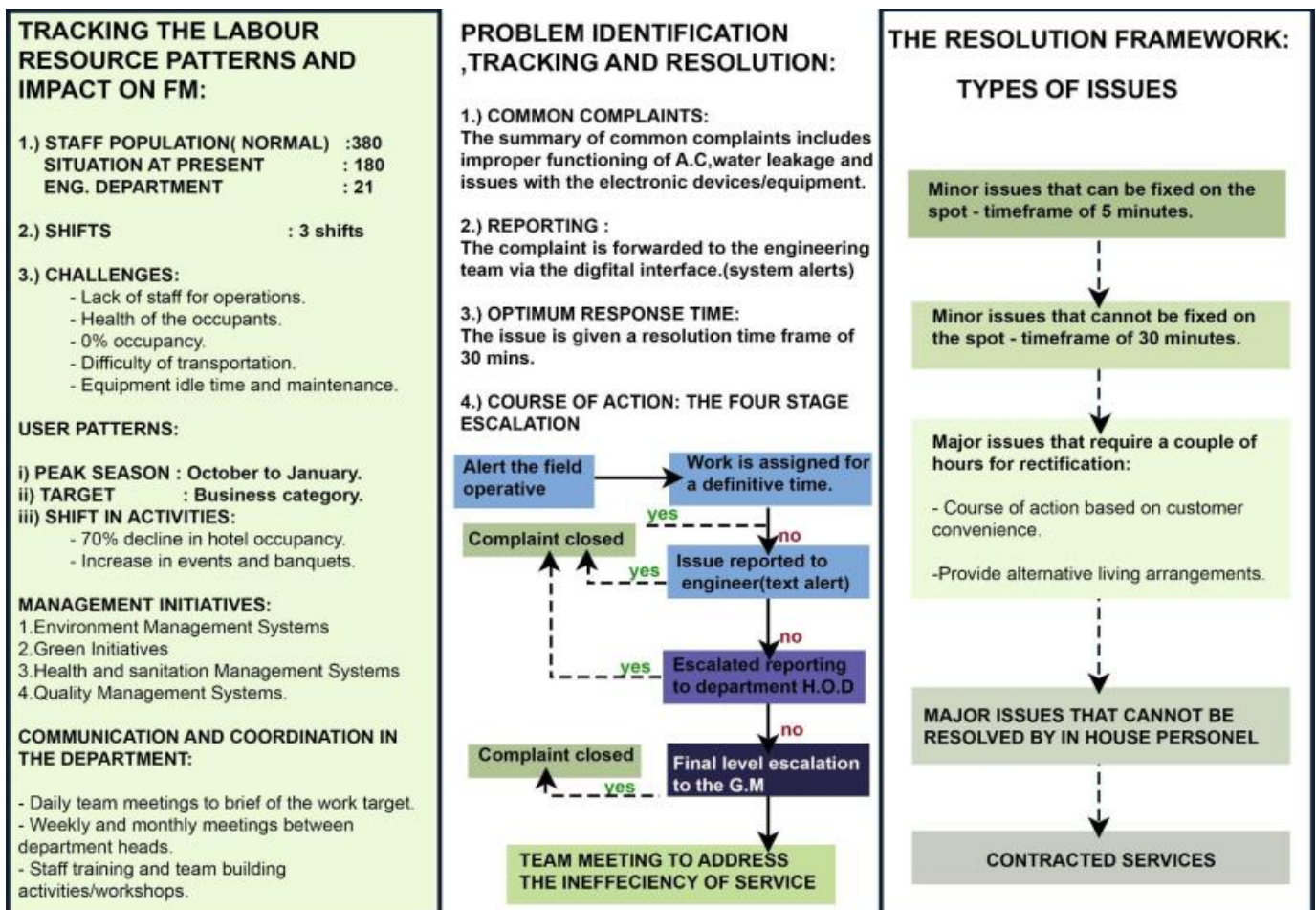


Fig 4.9 A3 analysis sheet

4.6 INFLUENCING FACTORS FOR DECISION MAKING IN MANAGEMENT OPERATIONS AND FOR IN HOUSE AND OUTSOURCING MAINTENANCE

SATTAAY SCALE OF RELATIVE IMPORATNCE:

RATING SCORE	CRITERIA	RATING SCORE	CRITERIA
1	Equal importance	6	Very strong importance
2	Moderate Importance	7	
3	Moderate Importance	8	
4	Strong Importance	9	Extreme Importance
5		10	

FACTORS TAKEN INTO ACCOUNT :

S.NO	CRITERIA	RATING	S.NO	CRITERIA	RATING
1.	Time constraint	1	6.	Degree of complexity	9
2.	Statutory compliance	2	7.	Risk involved and safety	2
3.	Technical expertise of inhouse labour	5	8.	Financial constraint	1
4.	Technical assistance from manufacturer	8	9.	Historical data and reports	2
5.	Need for specialised tools	9	10.	Availability of spare parts	9

Fig 4.10 Evaluation of importance of factors

- Description of licenses required for the hotels as observed during the case study are : the Pollution Control Board certification, fire safety, gym, CEIG(from the electricity board), lift and DG.
- While looking at the outsourced activities related to engineering this includes the AMC for different equipment, painting, polishing, woodwork treatment, laundry and renovation.

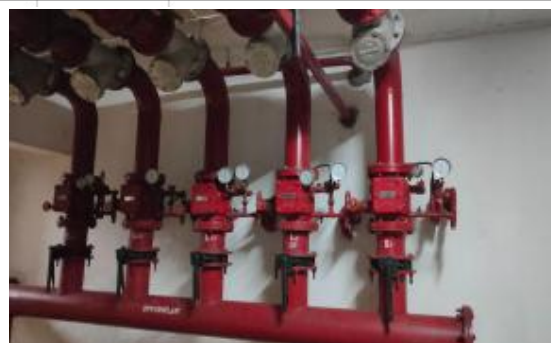
4.7 AMC CONTRACTS:

- Chiller (for 3 years)
- Laundry (for 3 years)
- DG (for 2 years)
- BMS (for 5 years)
- Lift (for 1 year)
- PA and Cameras (for 1 year)
- UPS (for 3 years)
- Gas Detection system (for 1 year)
- Fire safety systems (for 1 year)
- Gym equipment (for 1 year)

4.8 CASE STUDY 1: FEATHERS HOTEL

- BASEMENT 3:
PLANT ROOMS
- BASEMENT 2:
STP
- BASEMENT 1:
CAR PARK(250 NOS); GREASE SEPARATOR;250 KG BIODIGESTER
- GROUND:
LOBBY; BANQUET HALLS; KITCHEN
- FLOOR 1:
GYM AND SPA
- FLOOR 2:
CONFERENCE HALLS, RESTAURANTS
- FLOOR 3:
RESTAURANT, POOL
- FLOOR 4-7:
GUEST ROOMS

LIST OF EQUIPMENT				
S.NO	DESCRIPTION	BRAND	QUANTITY	CAPACITY
1	TRANSFORMER	VOLTAMP	2	1250 KVA OIL TRANSFORMER
2	DG SETS	CATERPILLAR	2	1010 KVA CONSUMING 200LPH
3	CHILLER VFD	TRANE	1	357 TR
4	CHILLER NON VFD		2	357 TR
5	WATER TREATMENT PLANT		1	15 CUM/HR
6	STP		1	175 CUM/DAY
7	HP SYSTEM (ROOM AREA)	GRUNDFOSS	1	73M HEAD/3X11KW -900LPH
8	HP SYSTEM (COMMON AREA)		1	54M HEAD/3X55 KW-750 LPH
9	HEAT PUMP	AC GROUP	3	17.22 KW AND 2200 LPH
10		EXERGY	2	8.5 KW AND 1135 LPH
11	COOLING TOWER	BELL	3X2 CELL	4587 LPH - FOR THE CHILLERS,USING 43950 CFM FAN
12			1X2 CELL	33500CFM FAN - FOR THE DG
13	DG EXHAUST FAN	KRUGER	2	15 KW
14	UPS	EMERSON	4X20 KVA	3 PHASE
15	CO DETECTION SYSTEM			



ROOM DISTRIBUTION							
S.NO	ROOM	FLOOR -4	FLOOR -5	FLOOR -6	FLOOR -7	NO	AREA(SQ. FT)
1	EXECUTIVE KING	25	25	41	36	127	344
2	EXECUTIVE TWIN	15	15	0	0	30	344
3	PREMIUM KING	3	3	3	2	11	344
4	JUNIOR SUITE	6	6	0	0	12	425
5	METROPOLITAN SUITE	0	0	3	3	6	860
6	PRESIDENTIAL SUITE	0	0	0	0	0	1450
TOTAL ROOMS= 187							

Fig 4.11 List of equipment and room distribution

4.9 OVERVIEW OF FACILITIES:



Fig 4.12 Site facilities

- There are a total of 187 rooms, with each room having a 2 TR FCU.
- Unoccupied rooms are maintained at a constant temperature of 26 degrees.
- While the conference rooms are at 24 degrees, event spaces are 23 degrees.
- The hotel has 8 elevators(5- passenger and 3 service elevators) with a 10 second travel time between floors.
- banquet halls can be clubbed into a single large hall of 9600 sq. ft.
- This flexible nature of the event space allows it to have variable seating between 200-and 1500.
- The main gas storage is equipped with a backup for 4 days.
- The gas bank is located 30 m from the building.
- As of 2017, there was a necessity to purchase 140 kl of water per day.
- The implementation of additional rainwater harvesting pits brought down this to 50 kl /day.
- There are 5 borewells of a depth of 40 feet. Chlorine is used in water treatment with an average requirement of 1000l per month.
- There are 2 fire water tanks(100kl), raw water tanks(90 kl) and treated water tanks(100kl).
- There are 2 numbers of biodigesters that have a capacity of 250 kg.
- Co sensors are used in the basement car parks, spaced at 6m.
- The fans for ventilation have automatic speed cut-offs.

S.NO	DESCRIPTION	QTY	DISCHARGE	UNITS	HEAD(M)	KW
FIRE						
1	HYDRANT PUMP	1	2850	LPM	95	90
2	SPRINKLER PUMP	1	2850	LPM	95	90
3	COMMON PUMP	1	2850	LPM	95	76.5
4	JOCKEY PUMP	1	180	LPM	95	11
5	BOOSTER PUMP	1	54	CUM/HR	42	11
WTP						
6	FILTER FEED PUMP	2	21	LPS	58	5.5
7	HNS HIGH ZONE	3	30	LPS	90	11
8	HNS LOW ZONE	3	21	LPS	73	5.5
HOT WATER SYSTEM						
9	GUEST ROOM -CIRCULATION PUMP	2	5	LPS	22	0.85
10	COMMON ARE PUMP	2	24	LPS	28	0.55
HVAC PUMPS						
11	CONDENSOR PUMP	3	76	LPS	33	37
12	PRIMARY PUMP	3	49	LPS	11	7.5
	SECONDARY PUMP					
13	ZONE 1: GUEST FLOOR	3	25	LPS	77	15
14	ZONE 2: PUBLIC ARE3AS	2	39	LPS	37	18
15	ZONE 3: CARNAATION HALL	2	25	LPS	37	15
16	DG COOLING TOWER PUMP	3	101	CUM/HR	27	11

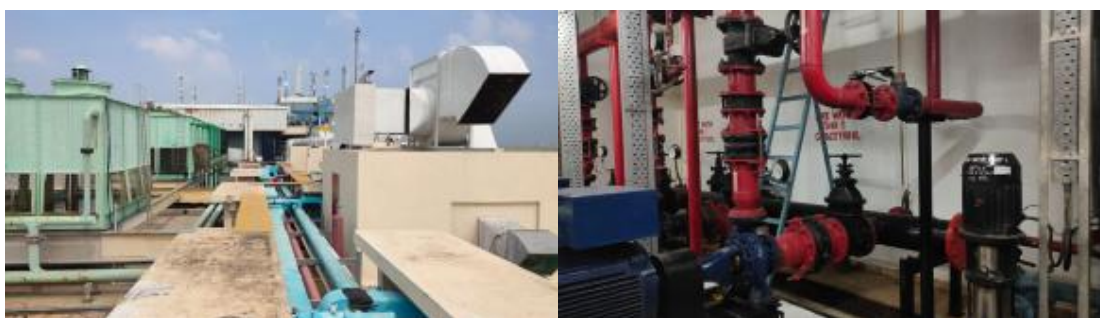


Fig 4.13 Description of secondary equipment

4.10 COST OVERVIEW

- The maintenance budget for 2020-23 is 496 lakhs.
- The cost assigned to repair and maintenance is 132 lakhs.
- The expense of the AMC alone is estimated to be 42 lakhs.
- The capital expenditure is 15-20 lakhs.
- The average water consumption on a daily basis is 120 kl.

- The electrical consumption is 17000 units per day

Table 4.1 Description of equipment for ventilation

S.NO	DESCRIPTION	BRAND	QUANTITY	KW	HP	AMPS
1	STP EXHAUST	Havells Lafert	2	11	15	20
2	LAUNDRY EXHAUST	ABB	2	5.5	7.5	11
3	RESTAURANT EXHAUST	ABB	2	5.5	7.5	11
4	RESTAURANT EXHAUST	ABB	3	15	20	28
5	CANTEEN EXHAUST	ABB	3	5.5	7.5	11
6	BAKERY EXHAUST	ABB	2	5.5	7.5	11
7	BANQUET KITCHEN EXHAUST	ABB	3	19	25	33

4.11 SYSTEM OVERVIEW

- The current interface in use is WIN HMS.
- This is an interactive cloud-based software. The data integration, service availability, technical support training and cost make this an optimal choice.
- The more advanced system is SAP.
- This has features that assign areas to various locations and maintain a historical record on any service call. It helps in better seamless operations.

Table 4.2 AHU Location and capacity

S.NO	AHU LOCATION	KW	CFM	TR
1	LAUNDRY AHU	3.7	8000	24
2	LUGGAGE ROOM AHU	1.5	3800	7
3	BANQUET COMMON SPACE 1	3.7	9000	28
4	BANQUET COMMON SPACE 2	3.7	9000	28
5	BANQUET KITCHEN	2.2	5000	15
6	LOBBY	3.7	9000	24
7	SPA	2.2	4000	9
8	BANQUET 1	5.5	12000	46
9	BANQUET 2	5.5	11470	46
10	BANQUET 3	5.5	12000	46
11	POOL BAR	2.2	5000	15
12	GYM	2.2	4200	13.5
13	F&B CORRIDOR	3.7	9000	13
14		2.2	5000	13
15	RESTAURANT 1	1.5	3900	10
16		1.5	3500	14
17		1.5	4000	16
18	RESTAURANT 2	1.1	2500	11
19		1.1	2500	11
20		1.1	2500	11
21	RESTAURANT 3	1.1	2500	11
22		1.1	2600	12
23		1.1	2600	12
24	CORRIDOR	1.5	4000	9
25		1.5	4000	9
26		1.5	4000	9
27	RESTAURENT 4	3.7	9000	31

4.12 ISOLATED ISSUES IDENTIFIED IN THE CASE STUDIES:

The case study was conducted in Feathers, Poonamallee and at GRT Grand, T.Nagar. The issues identified :

- Site drainage
- Building infrastructure
- Renovation plans
- Guest complaints
- Accident prevention
- Floor layout
- Scope for expansion
- Maintaining facilities at 0% occupancy (pandemic scenario)
- Switch over of software to enhance output

During operation, the gaps identified at Feathers were the issue of site drainage and accident prevention.

Both these issues had a common link to the canal adjacent to the site.

- The hotel has a steep ramp(12 Feet) to the basements, this brings in challenges of drainage.
- This was mitigated by allowing the water to drain into the canal.
- The fencing was kept low to cater to this demand.
- This had an impact on the guest's safety, with incidents of accidental falls into the canal bank side.
- Here, it posed a need to redesign the boundaries.



Fig 4.14 Site images

SCENARIO 2: GRT GRAND

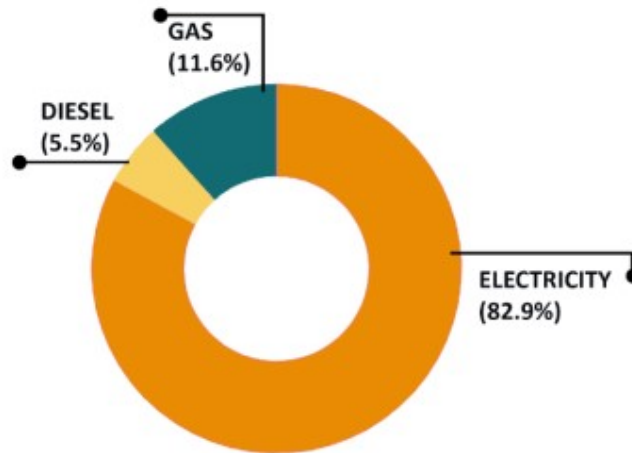
- GRT GRANT is located in T.Nagar.
- The hotel has 13 floors, where the ground floor to the first floor is occupied by restaurants, banquets and common areas.

- Floors 4-9 are the guest rooms. (133 numbers)
- basements have a capacity of 75 two-wheeler parking and 250 car parking.
- The plant rooms are located in B2, with only the generator room in basement 1.

MAPPING THE PERFORMANCE GAPS:		MITIGATION PLANS	
The major issue in the facility management plans identified in GRT GRAND was ☐ Site drainage, ☐ Response to government initiatives ☐ Shifting the plant room , ☐ Replacement of equipment ☐ Selection of equipment ☐ Renovation every 3 years ☐ Future Expansion The 2015 floods caused flooding in 3 floors including the ground floor. Replacement of equipment and renovation costed around 16 cr and was completed in 120 days.		FOR SITE DRAINAGE: ☐ The location of the site exit was such that it allowed the other neighbouring residences and the roads to drain into the hotel site. ☐ The exit was closed and the area was elevated by 2 feet. ☐ This created a higher elevation and prevented water entry. The exit was relocated to a optimum location. GOVERNMENT INITIATIVES: ☐ The road level was increased by 1 feet which led to a steeper slope for the site entry. ☐ The entry opens out to a main road having continuous vehicular movement and traffic, making entry cumbersome. EQUIPMENT SELECTION: ☐ The DG plant room was relocated to the ground floor. Here the issue was the height constraints posed by the equipment. ☐ The specification of noise insulation for the DG room related to a particular ceiling height that the basement could not accommodate. ☐ The site has no scope for future expansion. ☐ The only alternative was to identify a brand that met the requirements. Several vendor meetings led to selection of cummins brand.	
CRITICAL THREATS IDENTIFIED:		ALTERNATIVE PLANS	
The facility plan as of the early 2000 was unable to mitigate the flooding scenario. The plants in the basement were severely damage and required replacement.		ALTERNATIVE PLANS ☐ The major problem posed in the site is the lack of space for parking. ☐ This can be mitigated by hiring staff for valet services and by identifying areas/campus in the vicinity for leasing. ☐ If this is done then it provides area to place the DG plant room at a higher elevation, offering better protection.	
 Previously the exit was located here . The slope leading to the exit is steep around 15 ft. This causes a dip where all the water from the neighbourhood and the roads backflow into the		COMPLETE MAINTENANCE: Cyclic renovation and room top -down maintenance is scheduled ,blocking a period of 3-4 months for complete assessment and correction.	
		 There arised a need to reareange the location of the plant rooms. The location of the DG was prioritised . It was shifted from the basement 2 ,to the ground	

Fig 4.15 A3 Solver sheet for performance gap

4.13 EQUIPMENT AS A PART OF THE CRITICAL PROCESS OF MANAGING FACILITIES

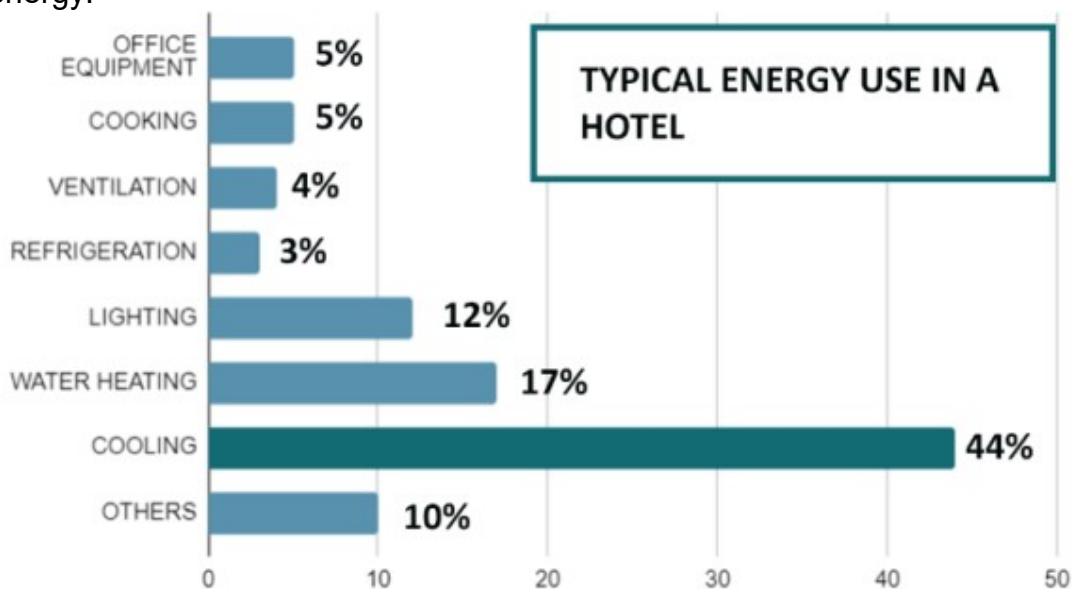


EXPENSE INCURRED FOR THREE MONTHS (JAN-MARCH)					
S.NO	ITEM	UNIT CONSUMPTION	COST	AVERAGE DAILY CONSUMPTION	AVERAGE DAILY COST
1	ELECTRICITY	154000	1199650	1400 units	11900
2	FUEL-DIESEL	5200	79900	Variable	Variable
3	WATER	80 KL/DAY	0	80 KL/DAY	0
4	GAS	2010 KL	166000	160 KG	13440
	TOTAL		1445550	AVERAGE COST PER DAY	85000

Fig 4.16 Resource mapping

This will help identify the areas of high/low energy requirements and also determine the critical areas.

It also gives an overview of the dependency of the facility in terms of different sources of energy.



HIERARCHY OF AREAS OF MAXIMUM POWER CONSUMPTION

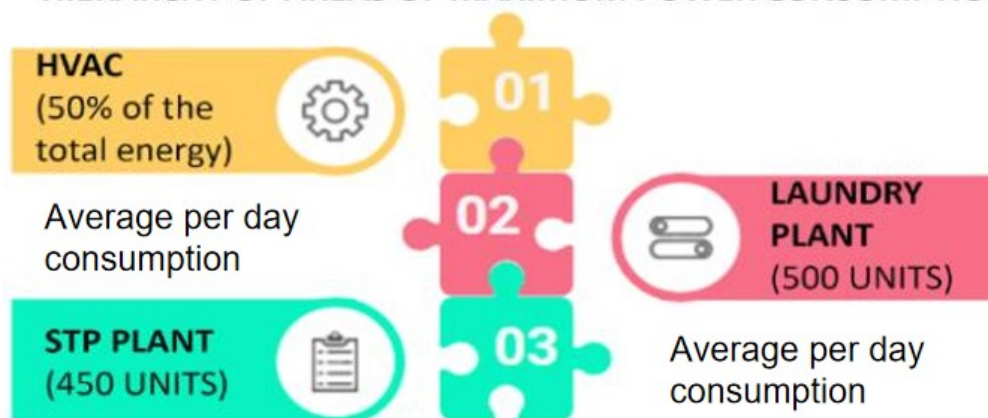


Fig 4.17 Energy usage mapping

- It is noted that the HVAC Systems are the major consumers of energy followed by the laundry and STP plants.
- The least consumption is the requirement for lighting.
- A cohesive energy management plan for the facility will help optimize consumption in due areas and have a significant impact on the overall management.

4.14 ANALYZING THE CURRENT CONSUMPTION OF ELECTRICITY:

Table 4.3 Cost analysis for electricity consumption

COST OVERVIEW			
1	UNIT CONSUMPTION IN 3 MONTHS(JAN -MARCH)	154000	Units
2	COST PER UNIT	8	RS
3	AVERAGE CONSUMPTION	1711	Units
4	TOTAL COST INCURRED	12	Lakhs (approx)

- Average units consumed per day: 1400 units
- Consumption per month (30 days) : 42000 units
- The cost per unit: Rs. 8.5
- The average cost of electricity per month:3.36 lakhs

(This is calculated on the assumption that there are no activities booked in the banquet halls.

The tabulation for energy consumption between JAN-MARCH clocked an average monthly consumption of 1700 units.)

4.15 WATER CONSUMPTION DISTRIBUTION:

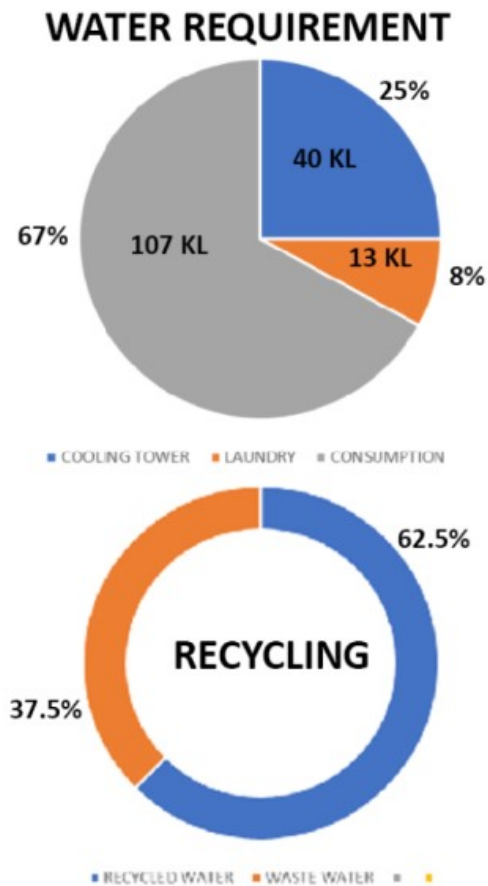
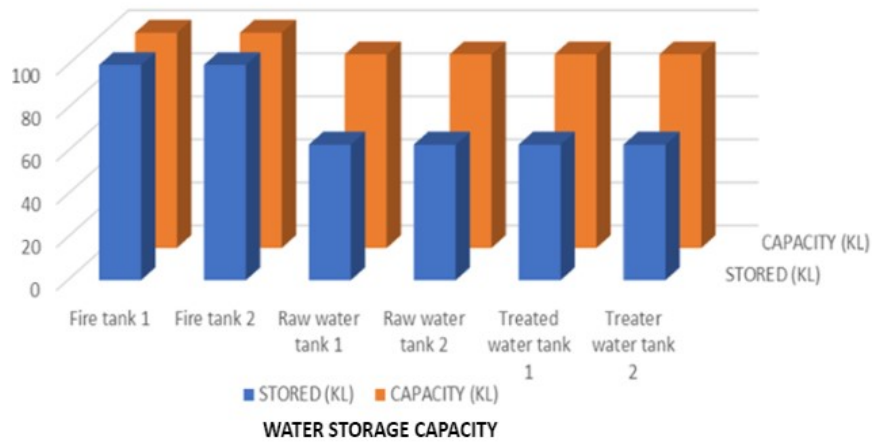


Fig 4.18 Water distribution

- As of 2017, there was a necessity to purchase 140 kl of water per day.

- The implementation of additional rainwater harvesting pits brought down this to 50 kl /day.
- There are 2 fire water tanks(100kl), raw water tanks(90 kl) and treated water tanks(100kl).
- Current need: 160 kl /day

Table 4.4 HLP consumption report

DAILY HLP REPORT				
S.NO	UNITS	CURRENT	TILL DATE	MARKET RATE
1	EB			Rs 8
2	DIESEL			Rs 92/l
3	WATER			-
4	GAS			Rs 84/ kg
S.NO	COST	CURRENT	TILL DATE	MARKET RATE
1	EB			Rs 8
2	DIESEL			Rs 92/l
3	WATER			-
4	GAS			Rs 84/ kg
	TOTAL			
AVERAGE/DAY			Rs.85000	
STOCK				
1	DIESEL	TANK 1	685	
		TANK 2	685	
		DG 1	780	
		DG 2	700	
	TOTAL		2850 L	
2	GAS	IN USE		
		EMPTY		
		FULL		
	TOTAL		561 KG	
3	WATER	FIRE TANK -1		100%
		FIRE TANK-2		100%
		RAW WATER -1		70%
		RAW WATER -2		70%
		SOFTNER -1		70%
		SOFTNER -2		70%
	TOTAL		480 KL	

4.16 WHY IS THE HLP (HEATING, LIGHTING, PLUMBING) REPORT VITAL?

- This daily log is a ledger that compiles data and real-time assessment of the working condition.
- It gives a complete overview of the energy consumption that allows easy management.



Fig 4.19 Function of HLP report

4.17 ENERGY MANAGEMENT IN THE HOTEL FACILITY:

- The past reports and tabulations have made clear that proper management of resources can optimize 20% of the total costs.
- The primary management method is the maintenance of logs and records.
- The second measure involves conducting energy audits: most commonly a walk-through assessment that determines the action plan to be carried out.

4.18 WALKTHROUGH ASSESSMENT -PARAMETERS OF EVALUATION

- Establish routine maintenance procedures
- Plan occupancy so guests are assigned in the same area of the hotel(ZONE DIVISION).
- Adjust building temperature by season.
- Check thermostat readings.

CHECK LIST	ACTION LIST	OBSERVATIONS
HVAC		
Check temperature and humidity levels in various areas: - Guest rooms - Meeting rooms - Dining rooms - Corridors - Lobby	OPERATION - Monitor outside air use - Avoid heating and cooling at the same time - Use modular, localized heating/cooling units where possible - Control system by time-of-use when possible for public areas - Use ceiling fans to increase comfort - Shut off chiller during winter if possible.	
Check ductwork and airflow Check condition of windows and doors Check refrigerant levels.	MAINTENANCE - Seal ductwork leaks- Clean filters and allow free air-flow to grills - Seal unused building openings - Install vinyl curtains in loading areas - Weather-strip doors and windows, caulk cracks - Insulate: doors, pipes, ductwork - Cover and lock thermostats and ventilation controls in public areas to prevent unauthorized adjustments - Clean boilers, chillers and condenser coils regularly, straighten fans.	
LIGHTING		
Check when lights are being used. Check lighting levels.	OPERATION - Use automated lighting Controls - o Photocells • All-night outdoor lighting - o Timers • Parking lots • Restricted-access areas - o Motion sensors • Low-traffic areas - o Dimmers • Auditoriums • Meeting rooms - De-energize fixtures/ballasts not in use - Reduce lighting to minimum acceptable level for safety/security - o Parking areas - o Storage areas - o Corridors	

Fig 4.20 Walk through assessment

4.19 HIERARCHY OF ENERGY MANAGEMENT SYSTEMS:

LEVEL 1:	LEVEL 2:	LEVEL 3:
• They are located on or in close proximity to the equipment being controlled. • The control functions include: 1. On and off time, 2. Automatic temperature set-back/set-up, 3. Single and multi-zone systems, 4. Chiller energy management controllers.	• They allow remote control. • The control functions include: 1. Demand controllers (to reduce peak electrical demand), 2. Multi-load system programs (to schedule multiple chillers on and off line), 3. Multifunction programmable controllers	• They allow remote control. • The control functions include: 1. Economizer cycle, 2. Hot/cold deck temperature reset, 3. Discharge air temperature reset, 4. Chilled water reset, 5. Outside air schedule reset, 6. Start/stop optimization, 7. Air distribution optimization, 8. Chiller plant optimization and demand control.

Fig 4.21 Hierarchy of energy systems

4.20 ZONE WISE DIVISION FOR DISTRIBUTION

ZONE 1: It comprises of the guest floors from L4 to the terrace.
ZONE 2: Lobby;Level 1 kitchen and pre- function area;Spa corridor;Gym;Pool Bar;Multi function hall;Restaurant and bar.
ZONE 3: It includes the banquet rooms.
ZONE 4: It includes the rooms in floor 2 and 3.

Fig 4.22 Zone Division

- This zone division is adhered to for the initiations of alarms, sprinklers etc.
- The distribution of services (i.e.) air conditioning and hot water supply are oriented to these zone classifications.
- On a broad scale, they are separated as public areas and guest rooms.
- The further classification in the public areas is that of the guest facilities, restaurants and the banquet halls.

4.22 NARROWING DOWN TO THE CRITICAL PARAMETERS:

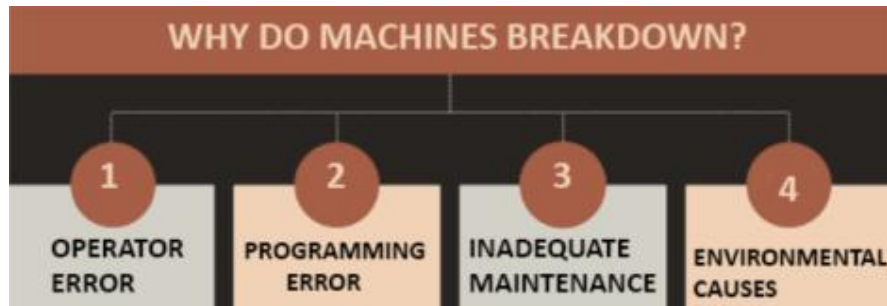


Fig 4.23 Equipment breakdown

The analysis of the critical parameters is categorized based on the zone wise location of the plant rooms and extracts of the critical equipment.

- BASEMENT 3 :
 - STP
 - WTP
- BASEMENT 2:
 - Parking
 - Grease separator
- BASEMENT 1:
 - HVAC,
 - Panel room,
 - Hot water supply
 - plant,
 - DG room,
 - Pool plant.
- GROUND FLOOR:
 - Control room

The critical equipment is tagged with two cards :

- 1. The equipment health card**
- 2. The equipment History Card**

The history card also shows when the equipment starts to deteriorate.

Table 4.5 Equipment health card layout

EQUIPMENT HEALTH CARD			
MODEL:			
DATE OF SERVICE	JOB NUMBER	PERSONNEL	REMARKS

- The health card records the list of scheduled services and maintenance activities carried out.
- It concludes by affirming the functional condition of the machine.
- The history card records the issues and defects identified in the plant/equipment.

Table 4.6 Equipment history card layout

EQUIPMENT HISTORY CARD							
LOCATION :				CAPACITY:			
EQUIPMENT:				DATE OF PURCHASE:			
MAKE:				COST OF EQUIPMENT			
MODEL:				WARRANTY STATUS:			
SERIAL NUMBER:				AMC/NON AMC:			
S.NO	DATE	JOB DESCRIPTION	MATERIALS USED	MATERIAL COST	PERSONNEL	SIGN	REMARKS
1							
2							
3							
4							
5							
6							

Both these checks are vital to ensure that the system can function seamlessly.

Table 4.7 List of critical equipment

LIST OF EQUIPMENT				
S.NO	DESCRIPTION	BRAND	QUANTITY	CAPACITY
1	TRANSFORMER	VOLTAMP	2	1250 KVA OIL TRANSFORMER
2	DG SETS	CATERPILLAR	2	1010 KVA CONSUMING 200LPH
3	CHILLER VFD	TRANE	1	357 TR
4	CHILLER NON VFD		2	357 TR
5	WATER TREATMENT PLANT		1	15 CUM/HR
6	STP		1	175 CUM/DAY
7	HP SYSTEM (ROOM AREA)	GRUNDFOSS	1	73M HEAD/3X11KW -900LPH
8	HP SYSTEM (COMMON AREA)		1	54M HEAD/3X55 KW-750 LPH
9	HEAT PUMP	AC GROUP	3	17.22 KW AND 2200 LPH
10		EXERGY	2	8.5 KW AND 1135 LPH
11	COOLING TOWER	BELL	3X2 CELL	4587 LPH - FOR THE CHILLERS,USING 43950 CFM FAN
12			1X2 CELL	33500CFM FAN - FOR THE DG
13	DG EXHAUST FAN	KRUGER	2	15 KW
14	UPS	EMERSON	4X20 KVA	3 PHASE
15	CO DETECTION SYSTEM			

PARAMETERS FOR SPRINKLER HEADS			
S.NO	FLUID COLOUR	TEMPERATURE IN C	TEMPERATURE ,IN F
1.		57	135
2.		68	155
3.		79	174
4.		93	200
5.		141	286
6.		182	360
7.		227/260	440/500

4.23 CRITICAL EQUIPMENT: FACILITY MANAGEMENT PLAN FOR COOLING TOWERS

Table 4.8 Criteria for cooling tower installation

Capacity (TR)	Space requirement per cooling tower	Weight per cooling tower
Up to 40 TR	4m x 4m	1000 Kg
50-100 TR	5m x 4m	2500 Kg
125-175 TR	6m x 4m	5000 Kg
200-300 TR	7m x 4m	6000 Kg
325-400 TR	7m x 5m	7500 Kg
425-600 TR	8m x 5m	10000 Kg

COOLING TOWER MAINTENANCE HIGHLIGHTS:

Y STRAINER	'Y' strainers shall be provided on the inlet side. - Filtration area of Y-strainer shall be minimum four times the connecting pipe size.	-
POT STRAINER	- Ease of maintenance due to removable basket type arrangement. - Does not interrupt the piping system.	recommended

- Minimize leaks in the cooling tower system -specifically the cooling water piping and basin.
- Periodic testing of the makeup water to determine the chemical composition and corresponding water treatment methodology.
- Periodic assessment to control fouling and corrosion in the system.
- Control the potential growth of microbes and other biological matter.
- Install flow meters to monitor the performance of the cooling tower.
- Schedule fan maintenance to maximize the evaporation rate.

Table 4.9 Core Checklists for cooling tower

s.no	CHECKLIST FOR COOLING TOWER
1	Location and space arrangements
2	Structural coordination
3	Colour coding and demarcation of piping lines
4	Pre-treatment of water for cooling tower
5	Vibration and noise isolation
6	Coordination to control scaling, flocculation and fouling
7	Coordination of alarm system- overflow and low level
8	Testing and certifying

S.NO	PARAMETERS TO BE MONITERED	REMARKS
1	pH	
2	Water level in sump	
3	Blow down rate	
4	Make-up water rate	
5	Temperature	
6	Residual chlorine	

DAILY	- Check system equipment for performance anomaly. - Document daily flow rates, volume of makeup and blow down water.
WEEKLY	Check the PH value and record any significant changes.
MONTHLY	- Check the water quality - Analyse rate of corrosion and fouling
ANNUALLY	- Make changes to the chemical additives used. - Replace parts damaged by corrosion. - Check the chemical levels. - Check condition of fills and drift eliminators.

S.NO	FUNCTIONAL TESTING FOR TOWER FANS	STATUS	REMARKS
1.	Tower fans do not short cycle (the minimum on time is 5 minutes and the minimum off time is 5 minutes, or as recommended)		
2.	Cooling Tower fans do not run unless associated cooling tower pump(s) are running		
3.	If installed, basin heater is not enabled when the basin water temperature is at or above the setpoint		
4.	Condenser Water Supply Sensor is reading within 3°F of measured temperature		
S.NO	FUNCTIONAL TESTING FOR COOLING TOWER PUMPS	STATUS	REMARKS
1.	Cooling tower pumps are disabled when there is no call for heat rejection		
2.	If a variable speed pumping system is installed, confirm that the VFD increases and decreases pump speed in response to changes in the system		

4.24 COORDINATION IN CASE OF COOLING TOWER FAILURE:

Failure is caused by improper functioning of pumps, fans or clogging in the pipelines that block drainage.

CASE 1: BLOCKED PIPES: strainers and valves are used. Regular pressure testing and testing of water quality help identify the source of the issue.

CASE 2: FAILURE DUE TO FANS AND MOTOR/GEARS: wireless vibration monitors are used and are connected to an alarming system. When the vibration readings show an anomaly, the alerts are sounded. Proper lubrication and periodic checks are vital.

CASE 3: FAILURE OF PUMPS: in the case of multiple pump arrangements, the stand by pump is used. The run time is shared between pumps and does not function to 100% capacity. The pumps do not function continuously.

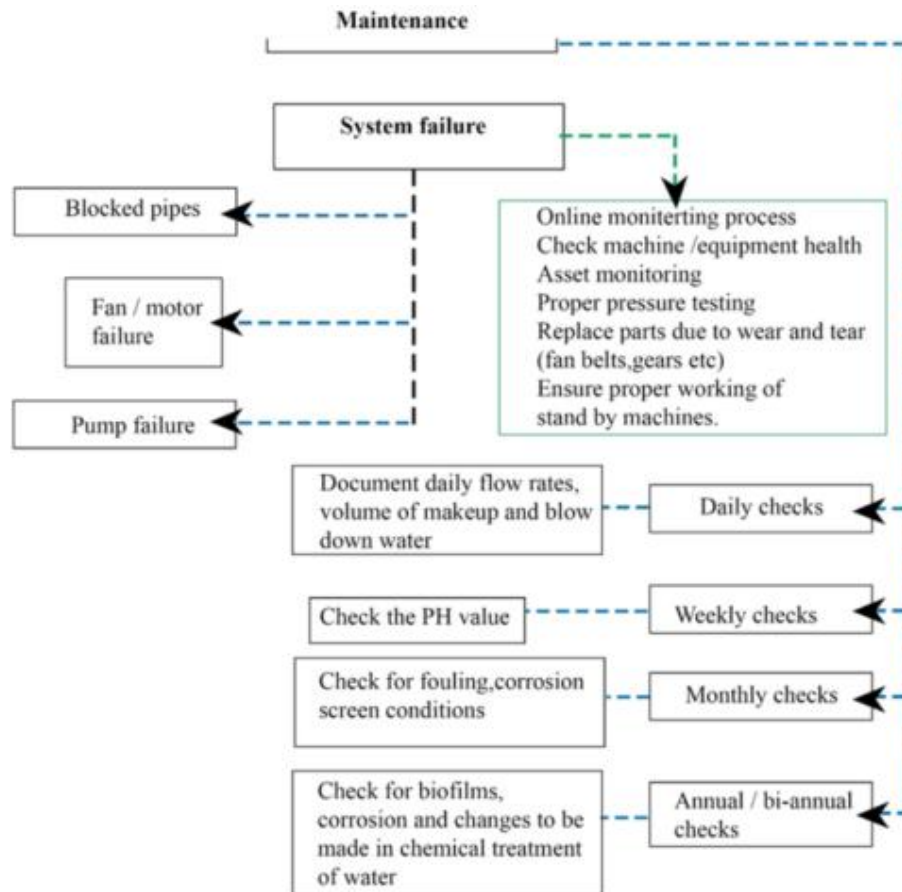


Fig 4.24 System failure flowchart

4.25 SYSTEM CHECKS AFTER THE SCHEDULED MAINTENANCE, PRIOR TO START :

- Confirm that the cooling tower is clean and that there is no debris before filling.
- Check that there is no blockage due to improper cleaning procedures.
- Confirm that the cooling tower sump is watertight when filled with water.
- Confirm automatic control valve operation and status are correct from the BMS including ON-OFF, bypass operation, EWT °C, LWT °C, LWT ° setpoint, etc.
- Confirm normal working conditions and operation of fans.

LOTO – LOCK OUT TAG OUT PROCEDURE FOR COOLING TOWERS

SHUTTING DOWN OPERATING SYSTEMS

PERSONNEL SAFETY:

Maintenance personnel are equipped with safety gear before entering the tower (Masks, goggles, boots and gloves.)

The surfaces are sprayed with mould control chemicals before cleaning process since the moisture conditions cultivate strains of bacteria.

PROCEDURE:

STEP 1: Formulate a procedure -LOTO is for circulating pumps and fans in cooling tower.

STEP 2: notify all working personnel

STEP 3: locate the areas that have to be isolated and shut down the equipment

STEP 4: Disconnect the primary and secondary energy sources.

STEP 5: Verify the lockout and ensure all equipment are in off mode.

STEP 6: Ensure that there is complete equipment lock down even during shift changes.

STEP 7: Restart equipment after maintenance and check for proper operation

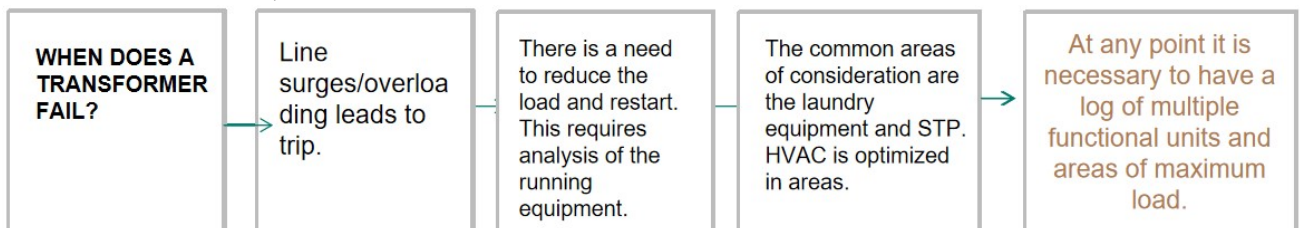
COOLING TOWER INSPECTION FOR MAINTENANCE:

Initial maintenance inspection involves a visual check of all the components for leakage, corrosion, cracks and damage of material.

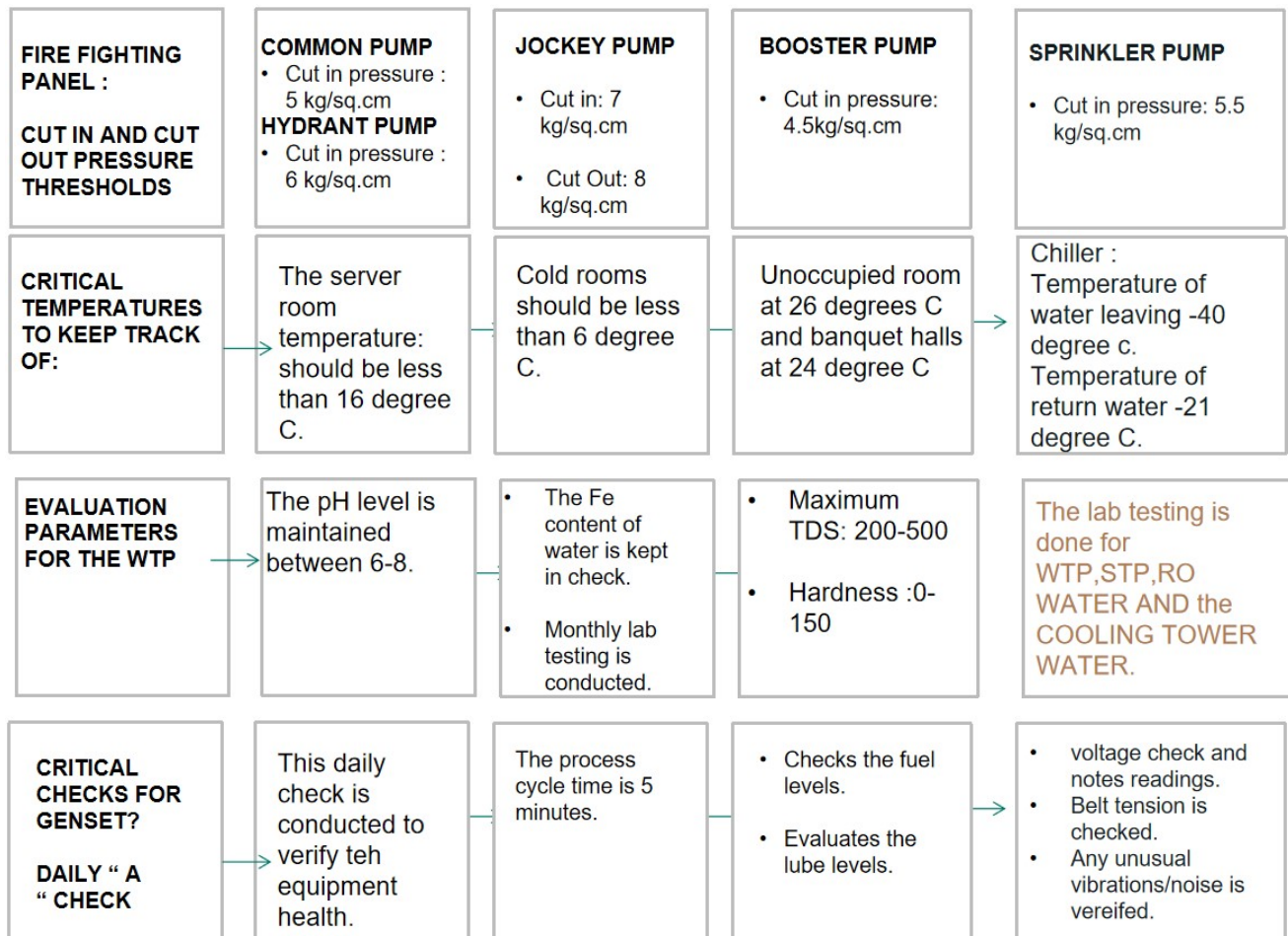
The individual components like louvers, filters, basin mats, drift eliminators, nozzles are checked for scaling and build up.

Fig 4.25 LOTO Operation procedure

4.26 CRITICAL EQUIPMENT : TRANSFORMER



- Maximum demand after 2019: 650KV
- Maximum demand before 2019: 960KV
- Regular checks: Voltage, Current, Power & Temp.



Problem	Possible Causes
Chiller Does Not Power Up	Improper line voltage or loose connection
	Incorrect phase connection (three-phase units)
	Blown circuit breaker or fuse
	Power switch in "off" position
No Pumping or Insufficient Fluid Flow	Improper or fluctuating line voltage
	Insufficient fluid in reservoir
	Pinched or restricted process line
	Closed or partially closed process valve
	Coolant fluid unsuitable for temperature requirements
	Blocked fluid filter
	Process piping too small
	Process restriction
	Pump failure
No Cooling or Insufficient Cooling	Improper or fluctuating line voltage
	Clogged air filter or condenser
	Coolant fluid unsuitable for temperature requirements
	Heat transfer properties of the coolant fluid have deteriorated
	Refrigerant leak
	High ambient temperature
	Evaporator iced up

Fig 4.26 Analysis of core critical parameters

4.27 HOW HAS THE DIVISION OF ZONES HELPED IN REMAPPING THE FACILITY PLAN?

- The relocation of the digester plant is unavoidable.
- The performance in the new location is evaluated .
- If proven unsatisfactory the alternative plan is to relocate the plant outdoors.

Two bio digester plants (250 kg each) are located in basement 3.
This is due to proximity to the waste separation and disposal area.



Problem :

Foul smell emitted is recirculated in the adjacent parking area due to insufficient ventilation .

PROS:

1. Better ventilation ,hence the smell doesn't stagnate.
2. Easy access for removal of the composted material.

CONS:

1. Longer travel distance to the plant.
2. Aesthetically unappealing.
3. Hygiene issues.
4. Possibility of a back draft to the parking in B1.

There is a necessity to relocate the plants to a better location.
The new location chosen is adjacent to the parking entry ramp in basement 1.

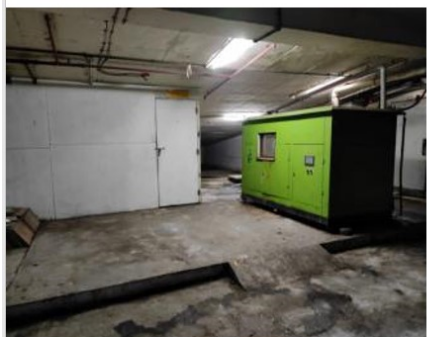
- Only one of the plants is planned to relocate to analyse the performance.
- The digester is cleared out bi monthly or weekly depending on the capacity.



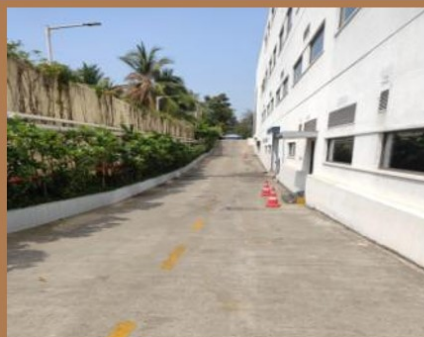
Initial location of the bio plants in B3.



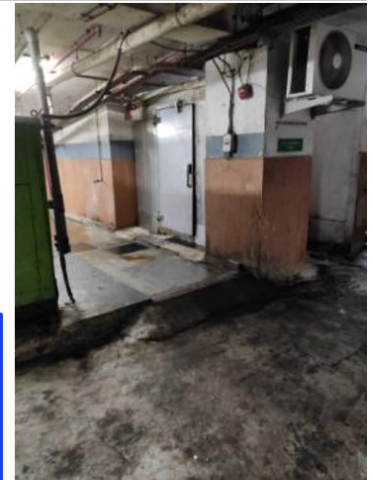
Relocated to the storage area in B1.



Trial basis relocation of a unit.



New location adjacent to the entry path.



While the new location decreases the travel distance for removal of the biomaterial, it increases the distance from the kitchen area to the site of disposal.

Fig 4.27 PDCA analysis

4.28 THE LEAN APPROACH :FOLLOWING THE PRINCIPLE OF DMAIC :

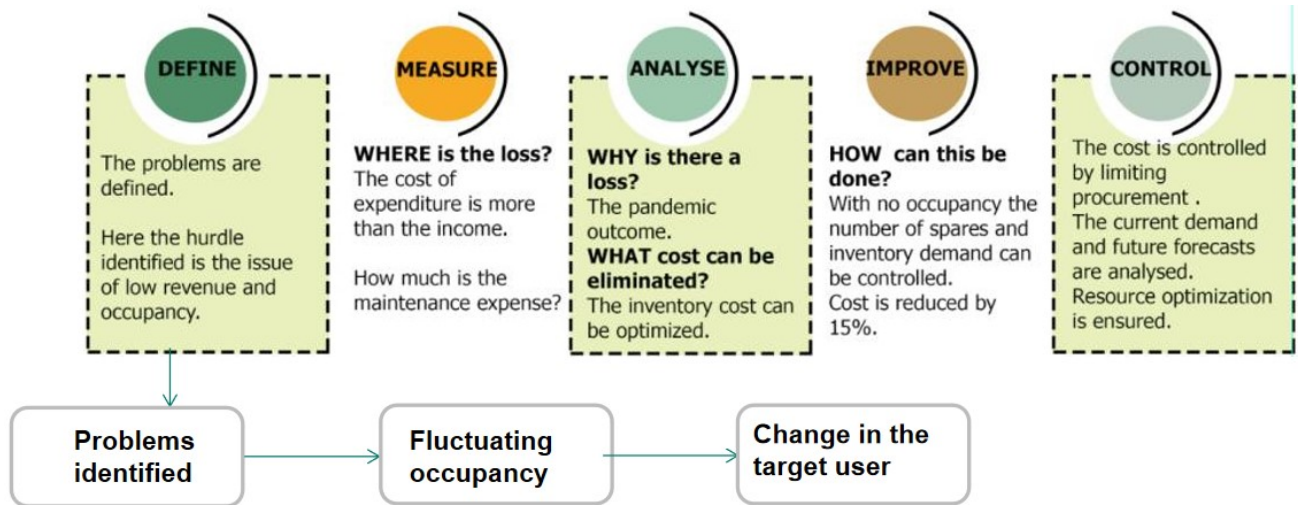


Fig 4.28 Lean approach

4.29 SCENARIO ANALYSIS:

Taking the case study example of GRT. The normal room rate is an average of 6000 Rs. During 2019-2020 the hotel was asked to house government medical professionals, where the rooms and F&B facilities inclusive were rated at Rs.2500.

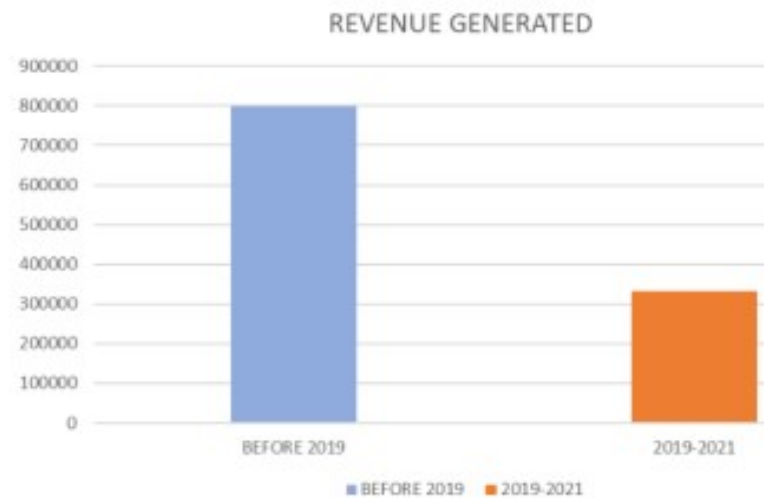


Fig 4.29 Revenue Generation (2017-2021)

- Assumption: The 133 available rooms are completely occupied.
- Average normal revenue (pre-covid): 8 Lakhs per day
- Average new normal revenue (covid): 3.3 Lakhs per day

THE OUTCOME:

- This decreased their revenue to less than half while the full work capacity of the equipment was required. This directly impacted two core factors.
- Labour
- Cost
- The obvious expense was the expense of running the equipment and plant rooms.

NEW COST OVERHEADS THAT THE SITUATION DEMANDED:

- Procurement of sanitized sprays and chemicals.
- Procurement of safety equipment.
- Procurement of fumigation equipment.
- Increased demand for laundry and linen.

The lack in the workforce was a situation change for this particular isolated scenario. Here arise the two questions:

1. How was the task force managed?
2. How to optimize the cost?

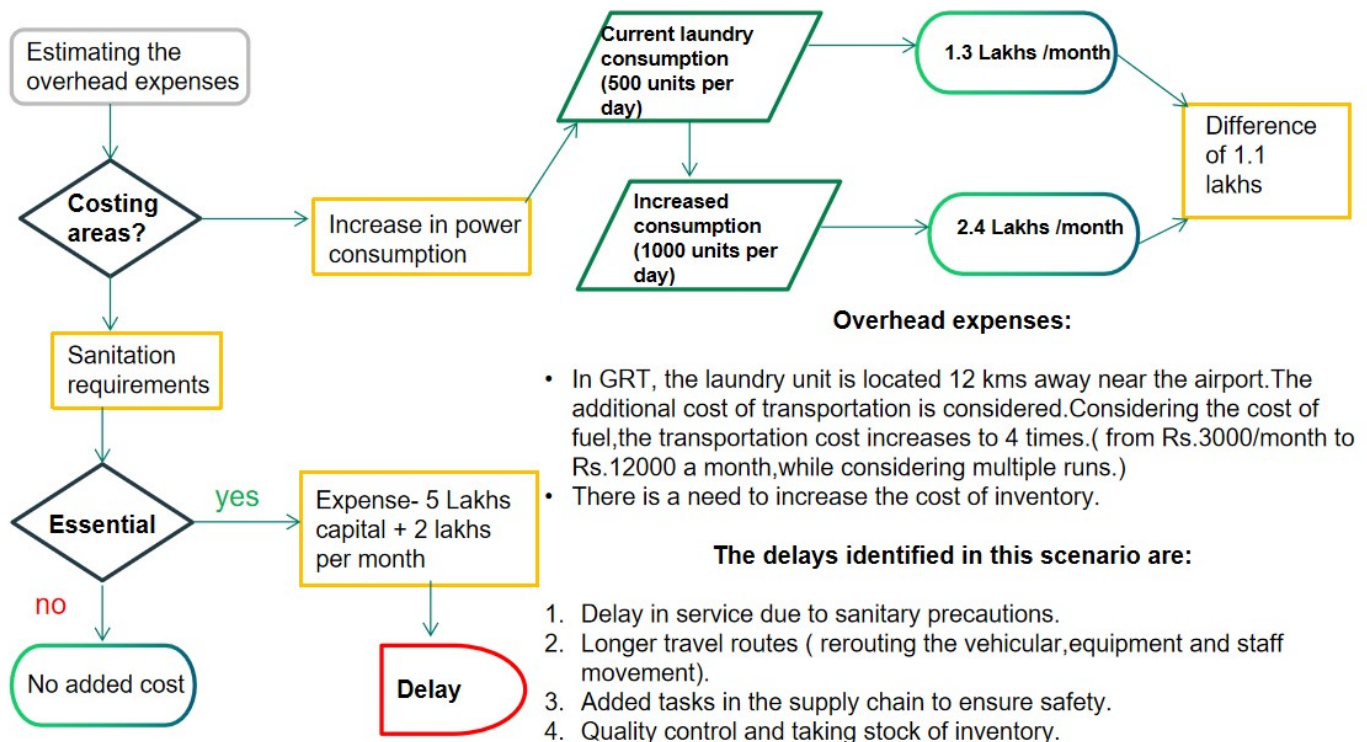


Fig 4.30 Flowchart of expenses

Overhead expenses:

In GRT, the laundry unit is located 12 kms away near the airport. The additional cost of transportation is considered. Considering the cost of fuel, the transportation cost increases to 4 times. (From Rs.3000/month to Rs.12000 a month, while considering multiple runs.) There is a need to increase the cost of inventory.

The delays identified in this scenario are:

- Delay in service due to sanitary precautions.
- Longer travel routes (rerouting the vehicular, equipment and staff movement).
- Added tasks in the supply chain to ensure safety.
- Quality control and taking stock of inventory.

4.31 INFERENCE FROM THE GRAPHICAL REPRESENTATION OF AVERAGE MONTHLY REVENUE AND EXPENSE:

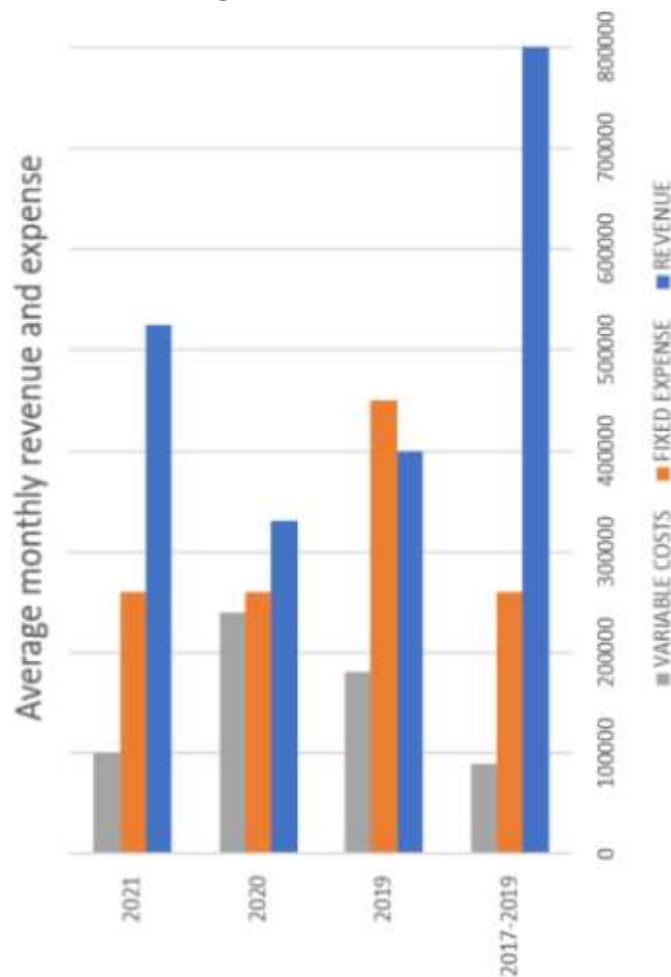


Fig 4.31 Annual revenue and expense comparison

The AMC costs remain unchanged throughout the contract period and hence are not taken into consideration.

It is also taken into account that the following calculations have taken into account only the room occupancy and not included the revenue generated from restaurants and the multiple banquet halls, spas etc.

- It is seen that in the pre-pandemic period of 2017-2019, the hotel had a significant profit in the revenue generated.
- A positive cash flow is seen.
- The year 2019 sees a loss in the hotel operations where the negative cash flow is unavoidable.
- In 2020, the revenue sees slow growth, yet is still overshadowed by unexpected overhead expenses.
- The year 2021 shows that the situation is slowly starting to stabilise. The hotel facility is back on track with a positive cash flow.
- The margin of profit however is not significant.

Table 4.10 Inventory breakdown (Feathers Hotel)

INVENTORY BREAKDOWN - FEATHERS			
S.NO	DESCRIPTION		
1	TOTAL NUMBER OF ROOMS	187	Units
2	AVERAGE OCCUPANCY	374	Numbers
3	YEARLY MAINTENANCE BUDGET	7% Of total budget	%
INVENTORY COST			
4	At peak seasons	90000	Rs
5	HLP budget	4000000	Rs
6	Fuel cost (Quarterly)	84000	Rs
7	Annual fuel cost(Approximate)	252000	Rs

Cost Breakdown:

- The majority of the budget goes into AMC services.
- Approximately 20%of the budget is spent on repairs, renovations and maintenance.
- The smaller portion is assigned for the purchase of materials, stock etc.

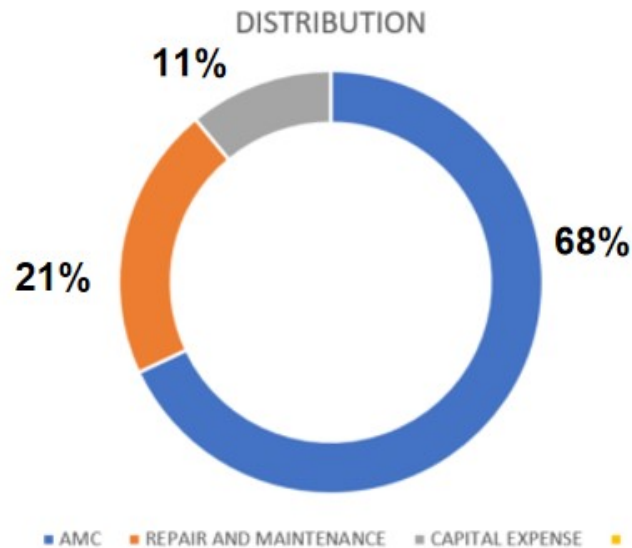


Fig 4.32 Capital distribution

4.32 PEOPLE AS A PART OF THE CRITICAL PROCESS OF MANAGING FACILITIES IDENTIFYING THE CRITICAL ASPECTS - HUMAN RESOURCES AND WORK PROCESS

STEP 1: Data Integration in a single platform.

- Manual entry allows scope for human error and is time-consuming
- It poses greater difficulty in data input, organization, prioritization and retrieval.
- A digital system minimizes the responsibility and demand on the human quotient.
- The data is clear, concise and easy to archive.

The Impact of Unplanned Downtime



Fig 4.33 Impact of machine downtime

STEP 2: Automize work prioritization

- New software identifies categories of work orders that are routed.
- E.g., A faulty HVAC unit is reported to the engineering department.
- The request is made directly to the field technician related to the specific department and the work is prioritized according to the level of skill and resource it demands.

STEP 3: Recognize the problem complexity

- During this prioritization, it is possible to identify if the issue is isolated or potentially affects a larger population.
- In the event of an emergency, the intelligent systems push this task to the top to be dealt with at the earliest.

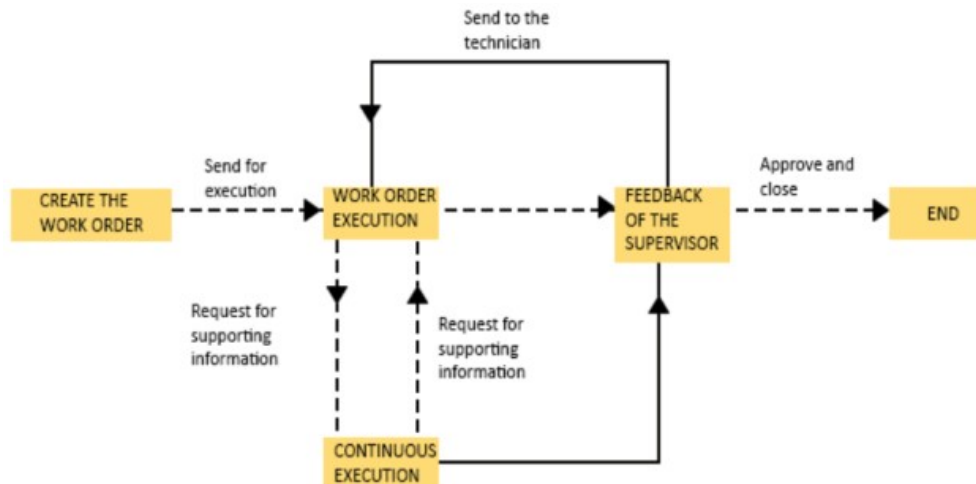


Fig 4.34 Work order process

STEP 4: Schedule repair and maintenance

STEP 5: Enhance visibility to the departments

- In a large hospitality facility that caters to multiple users at any point in time tacking maintenance activities is a complex task.
- The integrated dashboard would display the complaint, its status, the particular technician assigned for resolution, the service location etc.
- This provides a holistic view of the problem and projects an overview of the lifecycle costs associated.
- The communication links are improved, allowing coordination between onsite and in-field personnel.



Fig 4.35 Work order cycle

- Applications like mobile apps for logging, tracking, and alerts speed up the communication process for involved staff.

STEP 6: A linked database for a chain of hotels of the same brand

4.33 WORKER PRODUCTIVITY:

Analysis of the value-added and non-value-added activities

SHIFT TIMINGS:

There are 3 planned shifts:

6.30 a.m. -2.30 p.m.

2.30 p.m-9.30 p.m.

9.30 p.m.- 6.30 a.m.

STAFF RETENTION STRATEGIES:

- Performance-based incentives.
- Inter department competition.
- Weekly training sessions
- Regular meetings and feedback.

DEPARTMENT ACTION PLAN SCOPE:

- Communication
- Team spirit
- Change Management

STAFF DISTRIBUTION:

- Normal workforce: 36
- The workforce at present: 24
- Staff mix in a shift: Engineers(3);Supervisors(4);Technicians(17)

EXTRACT OF DAILY WORK LOG:

- Updating display boards.
- Scheduling activities.
- Log of critical temperatures.
- Inventory management.
- Cleaning and disposal.
- Communication.
- Visual representation.

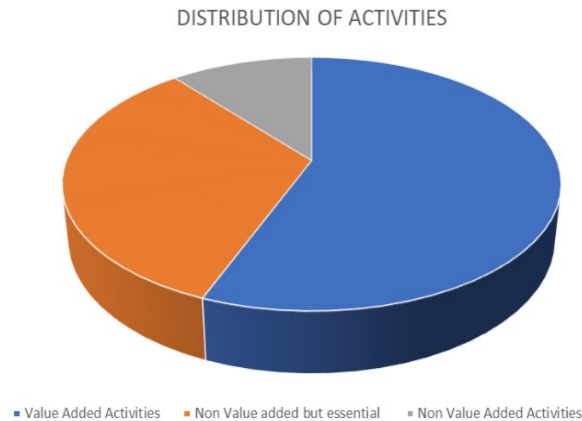


Fig 4.36 Distribution of VA,NVA and NVAN

4.34 SECURITY AS A PART OF THE ENGINEERING DEPARTMENT

This is taken as a separate topic because while the monitoring and alarming process is an integrated responsibility of the engineering department, most facilities view safety and security as a standalone department.

What are the factors compromising security(case study inference)?

Past and current experiences have etched security as an indispensable part of the facility management plan.

- 01

Aesthetics influence security in the aspects of placement of cameras and more importantly the priority given to lighting.

External lighting is often overlooked as an integral part of the facility plan.
- 02

The security system includes the different levels of security checks,the access controls and the monitoring /alarm system in place.
- 03

Crisis that creates a security lapse can be man made or natural occurrences.This can include terror attacks,disease outbreaks,theft,fire accidents,or maybe even cyber attacks.



Fig 4.37 Factors compromising security

WHAT DOES THIS ENTITLE?

- Mapping the movement of people and vehicles
- On-site
- In house
- Clear demarcation of entry and exits
- Indication of evacuation plans and floor layouts
- Extensive security checks
- Advanced PA and alarm systems
- Controlled floor access
-

4.35 INFLUENCE OF AESTHETICS ON SECURITY:

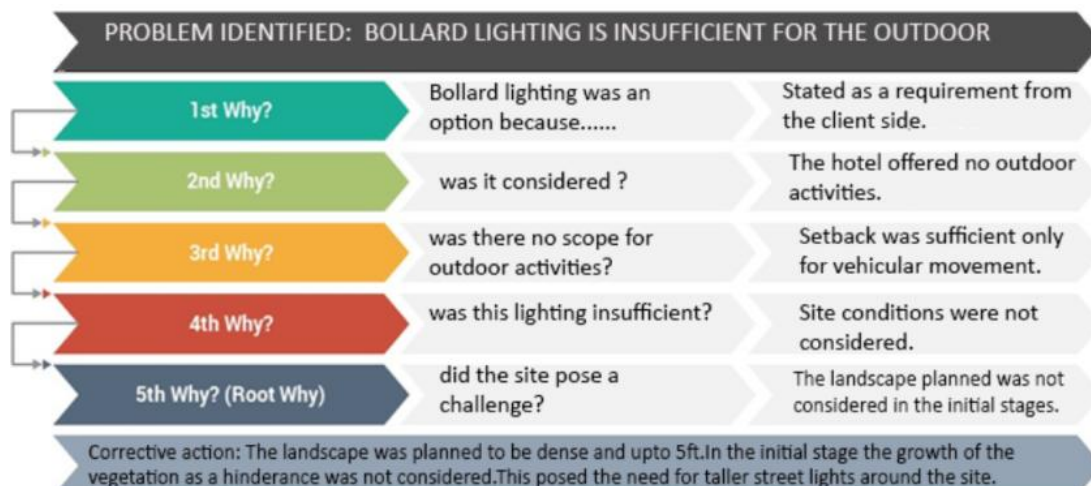


Fig 4.38 5 Why analysis to evaluate aesthetics as a risk to safety

In incidents where the security is compromised as a result of aesthetics, it is usually the lighting that plays a key role.

Below are the outdoor images of Intercontinental, Mahabalipuram.

The aesthetically placed outdoor lighting does little to illuminate the uneven path and compromises security.



Fig 4.39 Site images

4.36 SECURITY SYSTEMS AND LEVELS OF CHECK:

The perspective of security varies from different points of view and levels of interaction.

HIERARCHY OF SECURITY: PRILIMINARY LEVEL :	INTERMEDIATE LEVEL :	HIGHER LEVEL :
1. Under chasis checks 2. Baggage checks 3. Metal detectors 4. Sanitazation 5. Access control	1. Night vision cameras(outdoor) 2. Bullet cameras(Parking) 3. PTZ and Dome (interior) 4. Key card /floor access	1. Staff shift management 2. Panic alarms 3. BMS system 4. Cyber security

Fig 4.40 Hierarchy of security levels

The security systems and the levels of check are most often directly linked to response to a prior event or crisis.

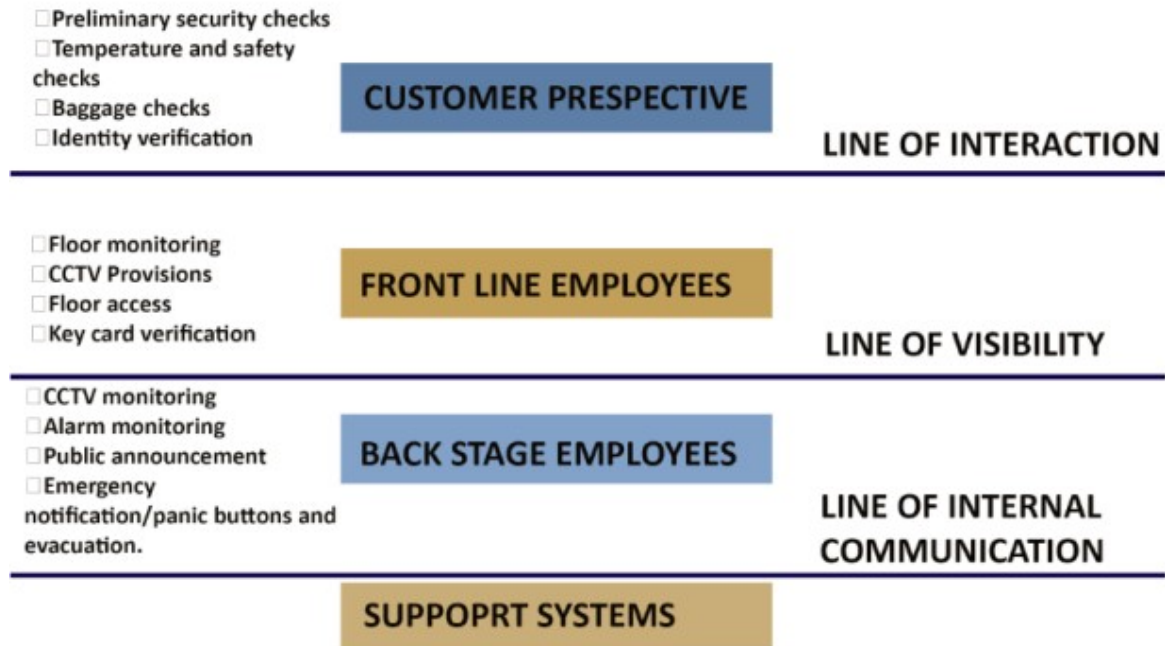


Fig 4.41 Perspectives of security

How has facility management plan in security evolved over the years? (Response to a crisis)

4.37 SCENARIO ANALYSIS:

The Taj Terror Attack in 2008:

- The analysis during the aftermath of the event predicted that the emergency operations initiated by the staff played a key role in reducing the casualties.
- It involved quick mapping of all possible escape routes and risks involved.

THE NEEDS POSED BY THE AFTERMATH:

- 2008 to August 2010-Major reconstruction and renovation work in progress.
- Cost of reconstruction - INR1.75bn
- Work scope-Restoration and repair of the public spaces, ballroom, furniture, artwork and restaurants.

STRENGTH: 1.It is a reputed brand functioning for 100+ years. 2.Priority is given to branding and image. 3.It is an iconic building. 4.Location of the hotel is an added advantage. 5.It is a luxury hotel that boasts of a celebrity status.	WEAKNESS: 1.High profile clientele are the target users. 2.Brand dilution . 3.Customer perception and expectations. 4.Stigma of past events.
OPPORTUNITIES: 1.Potential for international ventures.. 2.Growth in the Indian “Luxury market”	THREATS: 1.Client and employee retention. 2.Rebuilding after 2008. 3.Competition from new brands. 4.Economic scenario.

Fig 4.42 SWAT analysis for cast study

CONSEQUENCE- THE SCOPE OF FACILITY MANAGEMENT

1. The need to rebuild the brand image.
2. Retention of customers and employees
3. Revamp the security measures and protocols.
4. Stringent policies and monitoring system.
5. Staff training for quick response.

Analyzing the threats and opportunities:

Table 4.11 Action plan for safety and security

S.NO	ACTION PLAN	CAUSE	BRANDING AND IMAGE BUILDING
1	IDENTIFY THE CRITICAL AREAS	SAFETY AND SECURITY	
2	IMPLEMENT ACCESS CONTROL		
3	INCREASED SECURITY CAMERAS		
4	FLOOR WISE PROFESSIONAL SECURITY TEAM		
5	MONITORING LIFTS,ENTRIES AND EXITS		
6	TRAINED CANINE UNIT		
7	GUEST PREFERENCE SHEETS	SERVICE QUALITY	
8	COMPLAINT MANAGEMET SYSTEMS		
9	FIDELO- PROPERTY MANAGEMENT SYSTEM		
10	WOW CARD		
11	GRE COURTESU CALL		
12	GSTS (GUEST SATISFACTION TRACKING SYSTEM)	CLIENT RETENTION	
13	CUSTOMER RETENTION PROGRAMS		
14	TRAINING PROGRAMS	STAFF RETENTION	
15	STAFF WORKSHOPS		

4.38 CURRENT STAGE OF INFERENCE:

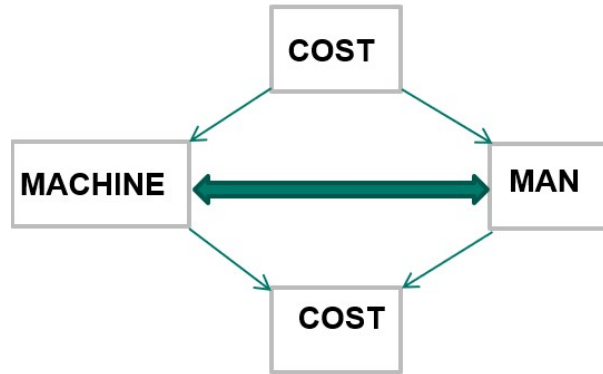


Fig 4.43 Chain-link established

- The financial capacity influences equipment maintenance and workforce distribution.
- The performance of machines depends on labour skill and management.
- The number and educational qualifications of the workforce depend on the type of equipment present and the expertise to handle them.
- Man, and machine determine the final quality of service or it can be said that it determines the revenue (client retention and satisfaction)
- This controls revenue vs expense.
-

MOVING FORWARD:

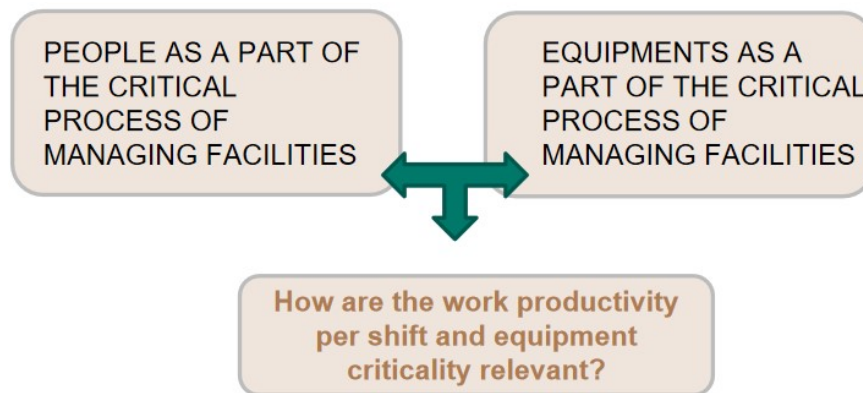


Fig 4.44 The critical elements of FM and dependency

- a) How is the gap analysis done for the facility and its management procedures?
- b) Evolution of planning and management needs.
- c) Real-time risk matrix to classify the source of the gaps in performance
- d) The current process and the areas of lapse.
- e) Manual vs digital reporting.

5.RECOMMENDATIONS AND CONCLUSION

5.1 HOW IS THE WORK PRODUCTIVITY PER SHIFT AND EQUIPMENT CRITICALITY RELEVANT?

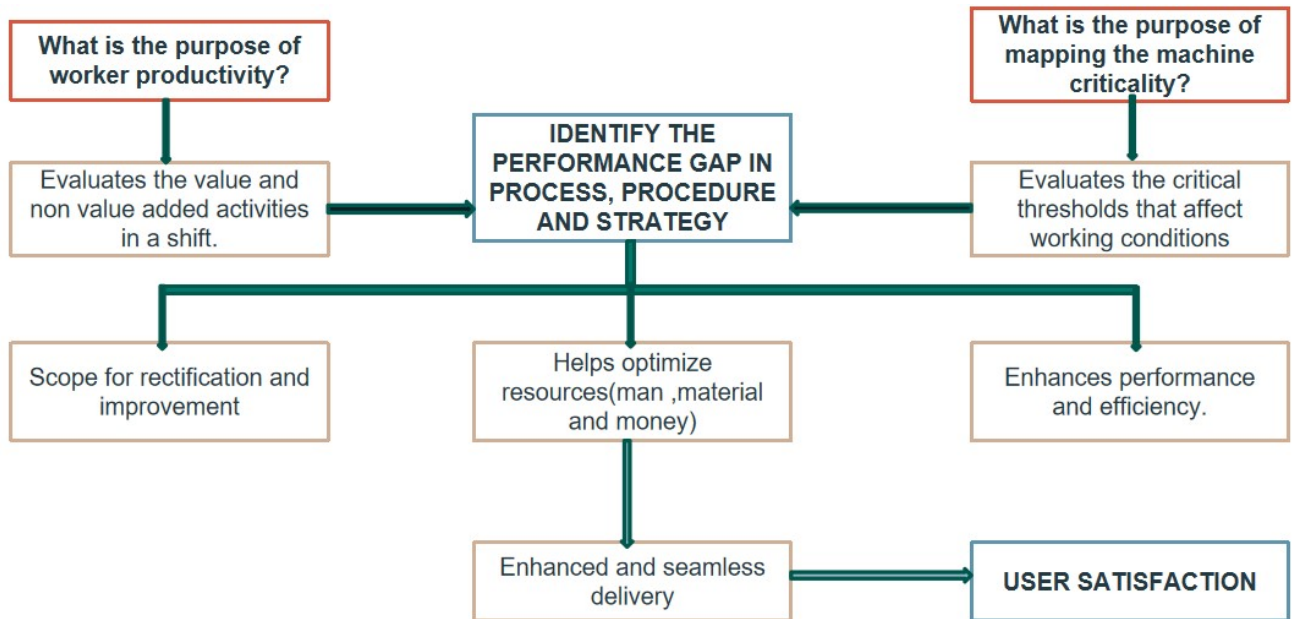


Fig 5.1 Flowchart mapping the performance gap

5.2 THE GAP ANALYSIS – STAGE 1: Nadler Tushman Congruence Model

WHAT IS IDENTIFIED AS THE PROBLEM ROOT CAUSE?

The inability to view the “BIG PICTURE”- Given the sheer number of personnel involved in the hotel facility, a large part of the service-related issues is attributed to poor communication, lack of understanding of the scenario and a gap ineffective communication.

WHAT DOES THE CONGRUENCE MODEL DO?

- It gives the framework of the organization and helps to identify exactly where the fault lies.
- It identifies 4 critical attributes -WORK, CULTURE, PEOPLE and STRUCTURE.
- The compatibility between these determines the final output quality.
- Highlights the inter dependency between the 4 isolated elements.
- Gives an overview of the day-to-day functions of the organization.
- Analysis from different aspects of what the work is as well as how it is done.

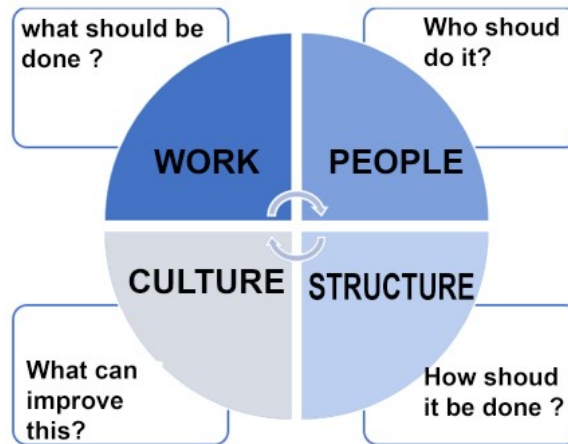


Fig 5.2 Nadler Tushman Congruence Model

EMPHASIS :

Promoting higher organizational performance by syncing involved parties.

FOCUS:

Eliminate friction between the different drivers.(i.e., stakeholders-both internal and external)

INPUT:

- A series of questions and logical maps help provide inputs based on real-time observation.
- This can be considered an aspect of work sampling.
- The inputs for the congruence model are elaborated as follows:

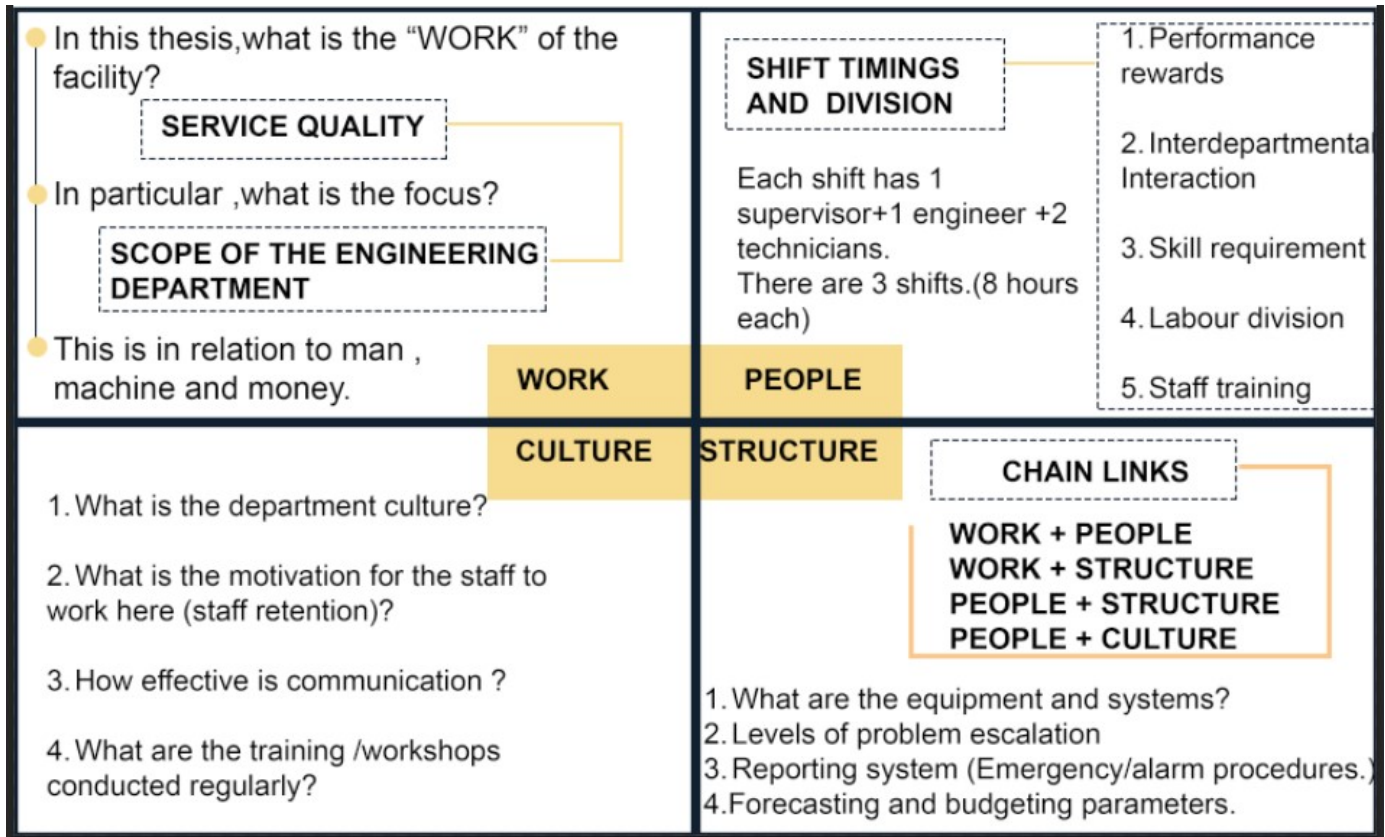


Fig 5.3 Solver inputs for the congruence model

OUTPUT:

- The SERVQUAL – service quality rating (usually online) from the end-user.
- Clear definition of the departments, work scope and overlapping responsibilities.
- Estimation of the financial needs.
- Identifies the GAPS-Ten such service gaps are identified in the whole process.
- Staff and client retention efficiency.
- Resource optimization procedure.
- Quick decision making.

5.3 THE GAP ANALYSIS –STAGE 2:

The Process of Evolution Analysis

The evaluation uses a 5-point scale of relative importance :(HIGH -5 points; RELATIVELY HIGH-4 points; AVERAGE- 3 points; LOW-2 points; VERY LOW – 1 point)

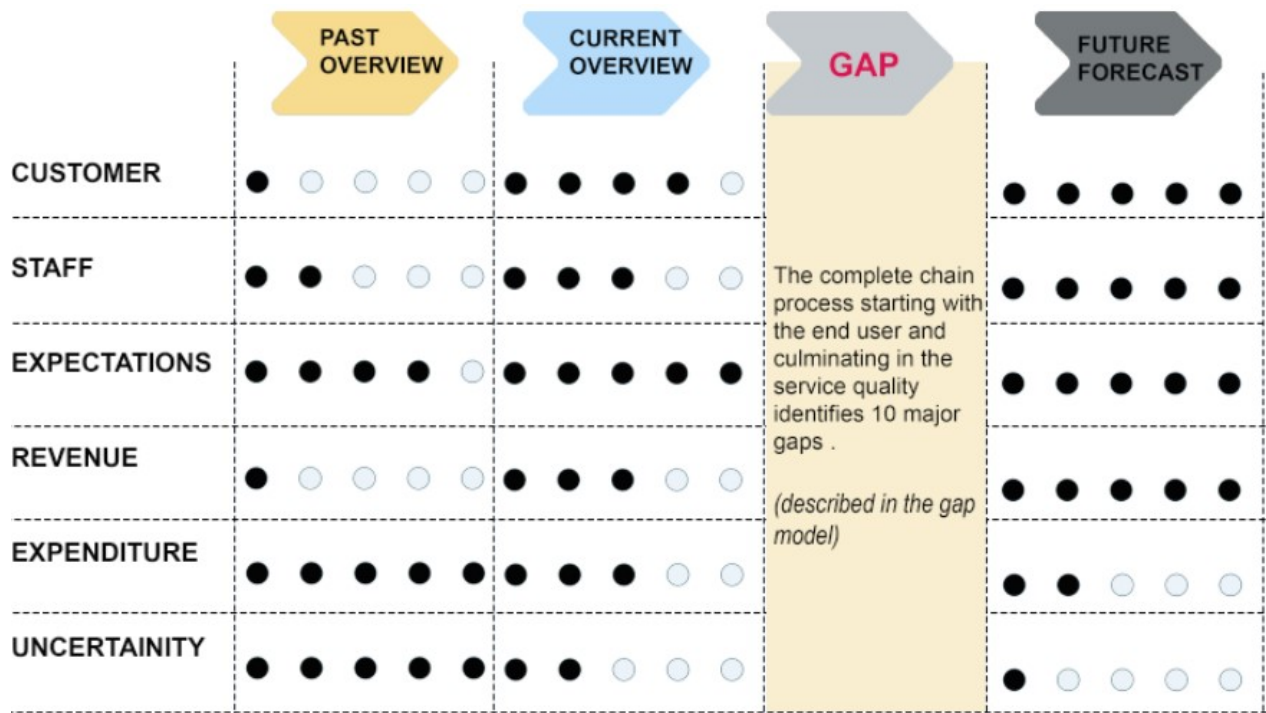


Fig 5.4 Risk matrix for evolution of parameters

5.4 THE GAP ANALYSIS –STAGE 3: REAL-TIME RISK MATRIX TO CLASSIFY THE SOURCE OF THE GAPS IN PERFORMANCE

Table 5.1 Risk analysis for hotels in Chennai

GENERAL				FEEDBACK ON TWENTY FIVESTAR HOTELS IN CHENNAI																		
	S.NO	WHAT WE HAVE IDENTIFIED	WHAT IT ENTITLES	CROWNE PLAZZA	HILTON	NOVOTEL	ITC CHOLA	LEELA PALACE	GRT GRAND	FEATHERS	TURYAA	PARK HYATT	THE PARK	RAINTREE	HABLIS	ACCORD	VIVANTA	TAJ COROMA	INTERCONTINENT	TAJ CONNEM	LE MEREDIA	RADISSON BLU
SCORING	1	Perception of needs	What does the client want	1	2	1	4	2	1	4	1	1	1	1	1	3	1	1	3	1	3	1
5-HIGH	2	Awareness of the situation	What is the procedure	1	3	2	1	1	1	1	1	1	1	2	1	1	2	1	1	2	3	1
4-RELATIVELY HIGH	3	Deviations from the prescribed standards	What was promised vs what was there	2	1	2	1	2	2	5	3	2	1	3	2	4	4	1	1	5	5	2
3-AVERAGE	4	Method of delivery	How satisfactory was it?	3	3	1	2	1	3	4	1	2	1	3	3	5	2	3	4	4	5	5
2-LOW	5	Communication difficulties	How long does it take to address the issue/get the work done.	5	3	3	2	5	1	5	2	4	5	3	5	5	3	5	4	2	2	5
1-VERY LOW	6	The experience of user	Depends on the quality of service	2	3	1	2	3	1	3	2	2	1	1	2	4	2	2	2	4	3	2



Fig 5.5 Analysis of service quality

- The bar diagram tabulates the overall service quality over the past 4 years for the mentioned hotels across Chennai.
- From the data analyzed we can determine exactly which area is responsible for poor performance.
- Once this is established, we incorporate the same into the facility management process to derive alternative strategies.

5.5 HIERARCHY OF RISKS IDENTIFIED:

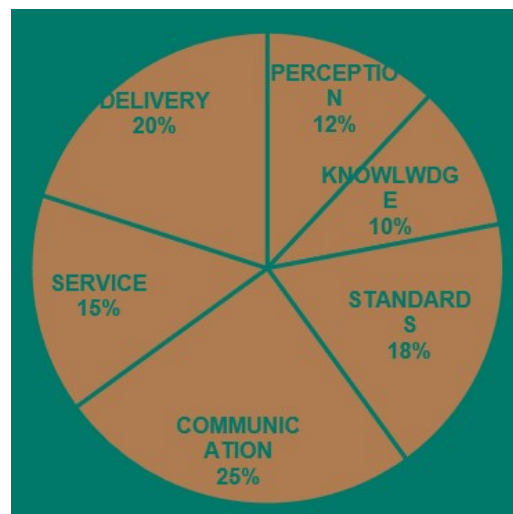


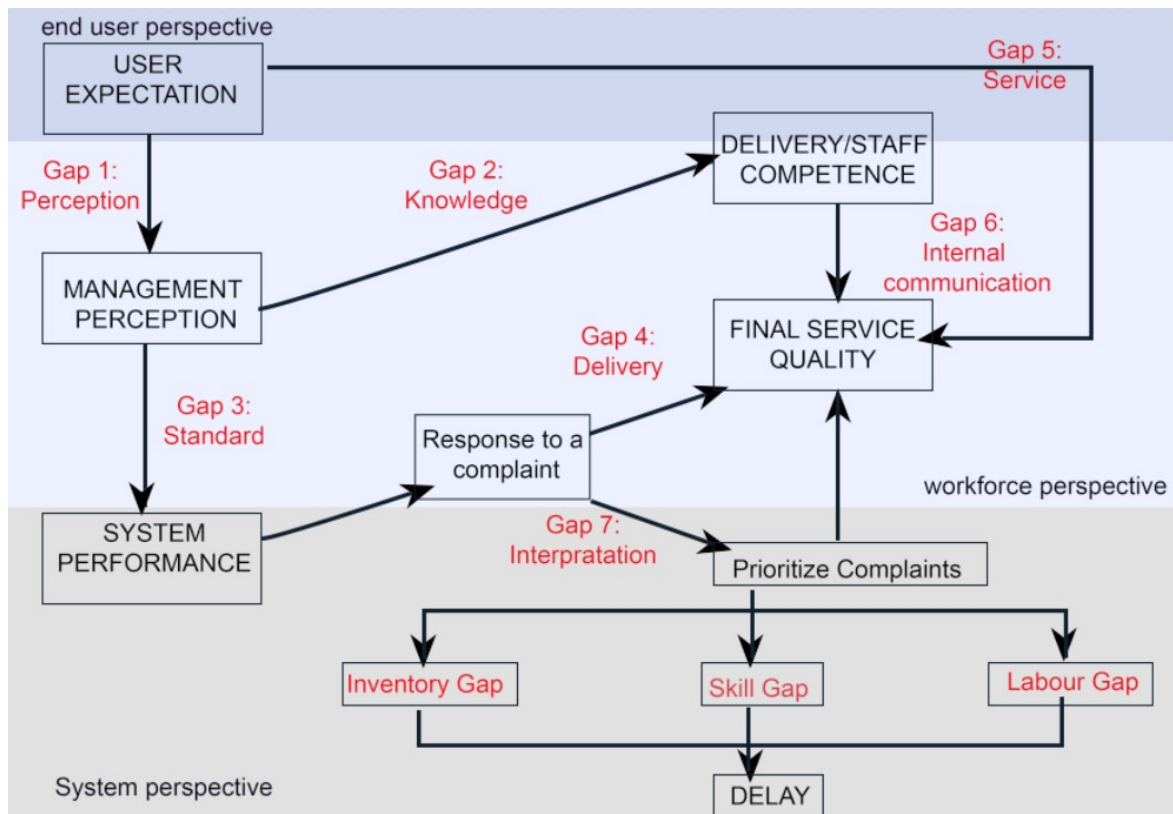
Fig 5.6 Hierarchy of gaps

- Communication Gap – 25%
- Delivery Gap – 20%

- Standards Gap – 18%
- Service Gap – 15%
- Perception Gap – 12%
- Knowledge Gap – 10%

The Gap Model

- The Gap Model is split into 3 different perspectives: the end-user, the labour force and the system integration.
- In each perspective, the occurrence of gaps is mapped and sorted.
- We see that there is no overlapping gap in the whole process.
- Identifying where the change has to be incorporated into the current system.



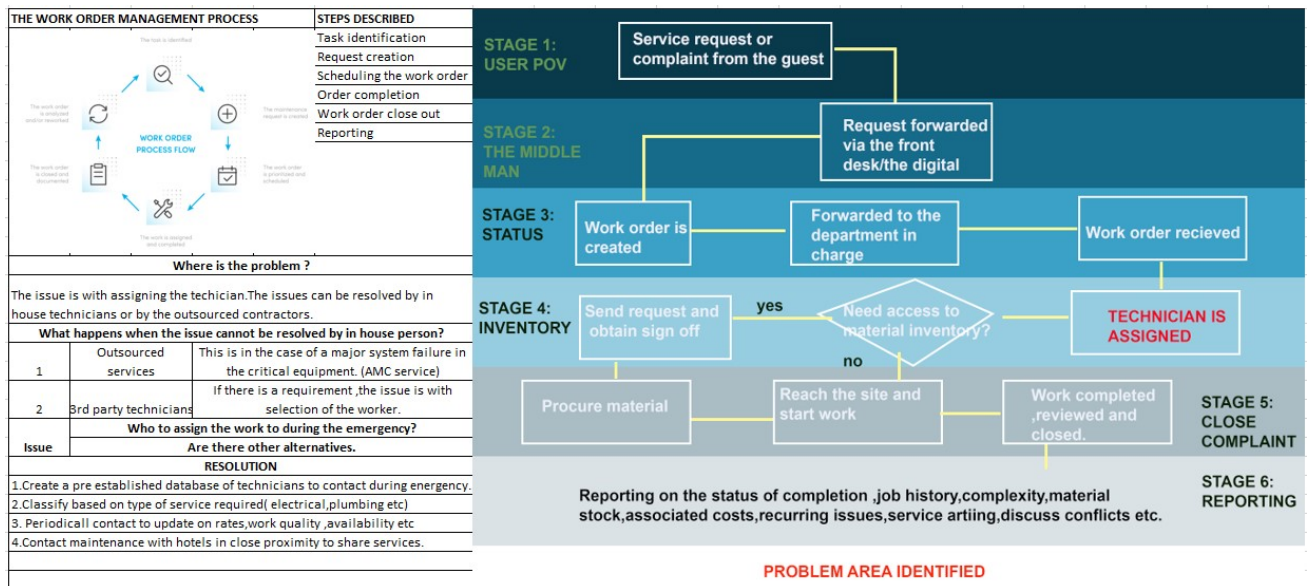


Fig 5.7 Perspective of performance gaps

5.6 PROPOSAL 1: THE NEED FOR A SWITCH TO DIGITAL SYSTEMS

- The hotels use CMMS software, but a lack of knowledge on navigation has led to several useful features being left unused.
- The readings (temperature, threshold limits levels, stock in use etc.) of equipment are still recorded manually.
- This doesn't impact short term monitoring, but in the long run, it makes data analysis cumbersome.

This gives us the next set of questions:

- **Where is manual recording needed?**
- **How else can the documentation be improved?**

In places like the job card /history card of the equipment, manual recording works better. It eliminates the need to log into the system every time to retrieve data. The decision is taken on the spot during inspection –should there be a necessity.

5.7 IMPORTANCE OF VISUAL MANAGEMENT:

- Graphical representations of the system process become important especially when the brand has a chain of hotels.
- This is because there would be the periodic transfer of personnel between facilities and an influx of trainees.
- It would help in an at a glance understanding of the parameters.



Fig 5.8 Visual management



CURRENT CMMS SYSTEM-WIN HMS

	MAINTENANCE System's main module which includes the Plant (coding, technical specification and maintenance plans of maintenance assets), the Work Orders (work orders management), the Materials (definition of the material coding standard and constitution of the master articles) and the Analysis (automatic parameters), Reports (tables, lists and charts) and Key performance indicators (created by the user).
	COSTS AND BUDGET CONTROL Additional module which allows the registration of the several types of cost documents used by the organization (invoices, delivery notes, etc.), organizing the allocated cost items (supply records, man-hours, materials and other services). In addition, it allows the definition of maintenance budgets for a given period and an account to cost center ratio, allowing the budget execution to be evaluated at any moment.
	STORES Additional module for centralized management of multiple stores, which allows the stock control of the materials and their movements (inventories, store entries, store outputs, returns to suppliers, returns to store, transfers between stores).
	PURCHASE ORDERS Additional module for the purchase orders management of materials and/or services to suppliers. Purchase orders go through the following states: prepared, issued, partially received and fully received. There is also the ability to perform proposal requests to several suppliers.
	WORK REQUESTS Peripheral and independent module, which works outside the main interface, allowing the realization and monitoring of maintenance requests. Simultaneous access to this module is unlimited.
	STORE REQUESTS Peripheral and independent module, which works outside the main interface, allowing the realization and monitoring of store requests. Simultaneous access to this module is unlimited.
	PURCHASE REQUESTS Peripheral and independent module, which works outside the main interface, allowing the realization and monitoring of purchase requests. Simultaneous access to this module is unlimited.
	AUTOMATIC MAN HOUR RECORDS Independent application that allows you to register man hour in real time, indicating only the employee ID and the work order code. Simultaneous access to this application is unlimited.

Fig 5.9 Overview of the CMMS System in use

WHERE DOES THIS PROCESS GO WRONG?

Table 5.2 Revised data sheet for digital systems

WHAT THE CURRENT DATA SHEET PROPOSES				IMAGE
CODE		ITEM TYPE		
EQUIPMENT		DESCRIPTION		
COORDINATION SYSTEM				
COST OF PROCUREMENT				
AMC DATE				
SUPPLIER				
EXPECTED LIFE				
DOCUMENT ATTACHMENTS				
INSTALLATION				
TECHNICAL SPECIFICATIONS				
OPERATING UNITS				
QUANTITY				
CAPACITY				
RUNNING HOURS				
MAINTENANCE AND MANAGEMENT				
WHAT IT SHOULD INCLUDE				
Associated failures and start up procedures				
History of repairs				
Cost of repairs				
If this equipment fails -what is the standby				
If the equipment operated on rotation-what are the scheduled running hours?				
What are the essential spares to be maintained?				
Alertnative materials to be kept as spare.				

2. WORK ORDER MANAGEMENT

In the current systems the classification for the work orders is the following status:

- Scheduled
- In Progress
- Terminated
- Closed
- Not Performed

It records any resource used –man-hours, materials or external support facilities.

DRAWBACKS:

There is a pre-determined due date for complaint closure.

- How is this time frame determined?
- Is this time frame feasible?
- How is the work prioritized?
- What are the levels of escalation?

5.8 DRAWBACKS IN THIS EXISTING SYSTEM:

Problem identification: Step 2-Reporting



Fig 5.10 Communication flow

- The front desk is not equipped with the technical expertise and may miss vital information.
- Once the complaint is received the technicians are dispatched and reach the room.
- In instances upon evaluation, they might not have the required parts to rectify the situation at hand.
- This adds travel time to log into the inventory and check out materials needed.
- This could exceed the 30-minute time frame.

PROBLEM IDENTIFICATION ,TRACKING AND RESOLUTION:

1.) COMMON COMPLAINTS:

The summary of common complaints includes improper functioning of A.C,water leakage and issues with the electronic devices/equipment.

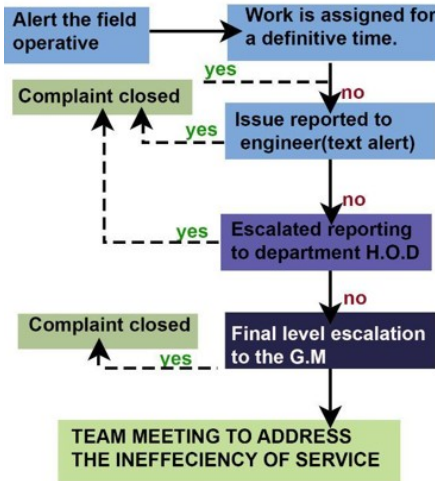
2.) REPORTING :

The complaint is forwarded to the engineering team via the digital interface.(system alerts)

3.) OPTIMUM RESPONSE TIME:

The issue is given a resolution time frame of 30 mins.

4.) COURSE OF ACTION: THE FOUR STAGE ESCALATION



THE RESOLUTION FRAMEWORK:

TYPES OF ISSUES

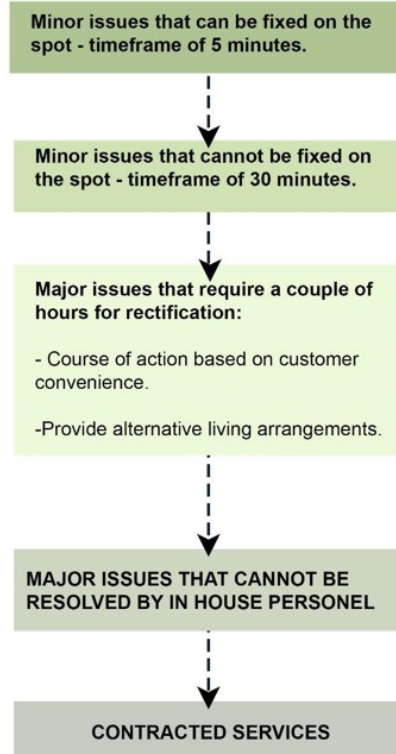


Fig 5.11 The resolution framework

- There is a need for direct communication between the technical team and end-user to determine the situation, make necessary preparations and optimize time.
- There is a need for proper direction to the department in charge.
- This entry in the CMMS System requires the staff's evaluation of the complexity of the situation.
- A standard template will not be effective in addressing the situation.
- During this process, other factors to take into consideration are the skill of technicians, peak seasons and occupancy as well as the occupancy timings.

COMPLAINT PRIORITIZATION			
SERVICE COMPLAINTS	Guest request has not been addressed	CLASSIFICATION	
	Response from the staff is delayed	1	Urgent- does not require repair
	A service promised has not been delivered.	2	Urgent repairs -electrical
ATTIDUNIAL COMPLAINTS	Staff is unaware of the procedure	3	Urgent repairs- mechanical
	Staff attitude is unwelcoming	4	Urgent repairs -Plumbing
	Staff lacks skill and sensitivity in resolving issues.	5	Directly affects user
MECHANICAL COMPLAINTS	Air conditioning issues	6	Needs repair-does not affect user
	Issues with fan,light ,other electrical equipment.	7	Can be done later
	Issue with hot water supply	8	Urgent -needs external support
	Plumbing issues	9	Not urgent -needs external support
	Key card issues	10	Noted for future review
ROOM RELATED	Improper sanitation	11	Unresolvable
	Issues with room allotment		
	Maintenance issues		
	Noise complaints		
WHAT HAS TO BE CONSIDERED			
There are several variables to be considered in complaint management,hence a common template cannot be issued.An apt evaluation is done based on the following variables and updated in the work order frame.			
1	What is the attitude/mood of the customer?		
2	How severe is the issue (cannot be rectified easily)?		
3	Is it a functional issue or aesthetic issue?		
4	How long will the repair take?		
5	Is there a need to offer alternative accomodation?		

Fig 5.12 A3 Solver for complaint Prioritization

- Delays in decision making are a major reason for the decline in service quality.
- This can be renovations, replacements or even scheduled repairs that cannot move forward without a go-ahead from the higher management authority.
- Recurring delays are due to a lack of awareness, evaluation, experience and financial constraints.
- Ultimately it has a larger impact on the facility and cost.

DELAYS IN DECISION MAKING DUE TO MANAGEMENT BUREAUCRACY				
SCEANRIO: Management and maintenance of facility plumbing			FACILITY	FEATHERS HOTEL
			ESTABLISHED	2016
Has there been any major repair since inception?	yes	no	GENERAL: The facility is a fairly recent construction (under a decade)	
Have there been recurring issues with leakage and blocked pipes?	yes	no		
POTENTIAL RISKS			REASON FOR RISK	
1	Age of the building		The risks can be a result of the quality of material,the method of installation ,and the composition of water.The salinity and pH values of the water play a key role in promoting corrosion in pipe lines.	
2	Corrosion			
3	Scaling and obstructions			
4	Biological growth			
5	Water quality			
6	Poor flow to sprinklers during emergency			
SEVERITY OF THE ISSUE			In isolated cases the repair is minor and localised.	
			Major issues- in case of an outbreak of fire.	
STANDARD OPERATING PROCEDURE			1	The fire tanks(200kld) are always at 100%
			2	The fire panel cut in and cut out pressures activate
			3	The motor propels water to the area of requirement based on the zone division after the alarm sounds.
			4	Sprinklers put out the fire.
WHAT HAPPENS IF THERE IS AN OBSTRUCTION TO THE WATER SUPPLY?			1	Uncontrolled fire outbreak
			2	Loss of life
			3	Loss of property
			4	Financial loss to the tune of crores
HOW CAN THIS BE MITIGATED?				
1	Follow NFPA guidelines for maintenance		4	Flushing the pipes to remove blockage
2	Visual evaluation using scopes		5	Chemical treatment
3	Set up pot strainers for regular physical checks		6	Pre-emptive red flag approach

Fig 5.13 Delays in decision making due to bureaucracy

5.9 PRE-EMPTIVE ASSESSMENT

Table 5.3 Red flag assessment for plumbing failure

PREEMPTIVE RED FLAG ASSESSMENT FOR PLUMBING FAILURE	
S.NO	DESCRIPTION
1	Water supply to the fire pumps is not at 100%
2	Presence of foreign matter found in the contents during lab testing.
3	Debris/foreign material blocking the pipes, check valves and sprinkler heads.
4	Excessive rusting and scaling in the pipes.
5	Severe fluctuations in the composition (chemical content) of water
6	Improper flushing and cleaning mechanism of pipe connections.
7	Leakage, cracks or broken connections remain unchecked.
8	The drainage does not occur efficiently.
9	The downtime of any equipment lasts for a long duration.
10	The fire tanks are not filled sufficiently /lack of supply.
11	There are unassessed pinhole leaks.
12	There is a visible increase in the travel time of water during regular testing as against the initial base condition.
13	The water treatment methodology is not checked regularly.
14	There are any calibration errors in the gauges and scales leading to false alarms.

- This is done when a problem is brought to attention, but the course of action is undetermined.
- When it becomes evident that the decision-making process is not progressing, a pre-emptive assessment helps manage the system.
- When the issue is not mitigated even after this assessment, it becomes imperative to fasten the decision process.
- Any further delays would adversely impact the system performance and compromise occupant safety.
- This is an evaluation escalation clause that helps gauge to what point a certain repair can be put off.

REFERENCES:

- 1.) Elbishari, E & Al Hazza, Muataz & Adesta, Erry & Rahman, Salihah. (2018). An integrated approach for facilities planning by ELECTRE method. IOP Conference Series: Materials Science and Engineering. 290. 012021. 10.1088/1757-899X/290/1/012021.
- 2.) Fraser, K. (2014). Facilities management: The strategic selection of a maintenance system. Journal of Facilities Management, 12(1), 18-37. doi:10.1108/jfm-02-2013-0010
- 3.) Pérez-Gosende, P., Mula, J., & Díaz-Madroñero, M. (2021). Facility Layout Planning. an extended literature review. *International Journal of Production Research*, 59(12), 3777-3816. doi:10.1080/00207543.2021.1897176

Articles:

<https://hippocmms.iofficecorp.com/blog/hotel-maintenance-management-with-cmms>, last accessed on 10th, October, 2021.