



OPTIMIZING FACILITY SUSTAINABILITY: A CASE STUDY ON THE COST-REDUCTION IMPACT OF PLANNING SECONDARY FACILITIES

Hospital Administration

Dr. Shubhankur Bhardwaj*

Hospital Administrator, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, U.P. *Corresponding Author

Prof. Hem Chandra

Vice Chancellor, H.N.B. Uttarakhand Medical Education University, Dehradun.

ABSTRACT

The Planning of secondary facilities can potentially reduce the cost of repair or replacement by promoting a proactive and preventive maintenance approach. However, the effectiveness of these efforts depends on the specific details of the planning, the quality of implementation, and ongoing adherence to maintenance best practices. A case study specific to the facility in question would provide a more detailed and tailored analysis of the impact of secondary facilities on repair or replacement costs.

KEYWORDS

Planning, facilities, AHU, HVAC, Secondary, Hospital, Opportunity Loss.

INTRODUCTION

Heating, ventilating and air conditioning (HVAC) is the technology that provides environmental comfort inside of a hospital. which includes improving the indoor air quality maintaining diseases from transmission, conserving energy that also leads to controlling energy cost, Providing life safety, low maintenance requirement and meeting safety standard. Hospital buildings are one of the few types of building that run at full scale twenty-four hours a day. Hospital needs to maintain temperature, air quality, air flow and humidity. Different part of hospital area has different ventilation needs. According to studies patients are proven to show slower recovery in uncontrolled environment opposed to controlled environment. As we know nothing stays for lifelong whether it's a machine, infrastructure or technology everything demands change with time.

Sanjay Gandhi Postgraduate Institute of Medical Science (SGPGIMS) established in 1983 is located in Lucknow, Uttar Pradesh. SGPGIMS is an 1105 bedded tertiary care teaching & training hospital. According to Hospital Statistics there were 94957 New Registrations, 49569 Admissions, and 45904 Discharges in the year 2016. The annual Bed Occupancy was about 82.2%. Ward is that part of hospital which provides patient care services to the admitted patient. Ward is for those patients who need treatment under healthcare personals supervision. Patients are admitted for short and long-term depending on severity of their disease. Once the patient is admitted then ward becomes the temporary house for them. The Endo Surgery ward has 24 general and 6 private Beds. The current case study is based on the information collected during the site inspection of ward, during the renovation of facilities with the following objectives:

Objectives Of The Study:

1. To identify the prime secondary facilities which require replacement in ward.
2. To study the advantage of replacing modern technology over earlier one.
3. To identify the need and circumstances which lead to total replacement of secondary facilities.
4. To calculate the total cost incurred in replacement cum renovation of the ward.
5. To recommend planning of inpatient area in a cost-effective manner based on the above findings.

Methodology

Study Setting: Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, U.P.

Study Area: Ward

Study Type: Observational and Prospective study

Tools And Technique:

- Data collected from the various engineering divisions
- Identification of the facilities which required replacement was carried out by the Engineering department

- Need for adopting modern technology was studied and its advantages over earlier one was discussed with the engineering department over earlier one.
- The need for the total replacement of the secondary facilities was studied from the survey reports of the engineering department of the institute.

Observations:

1. To identify the prime secondary facilities required for a surgery ward

Through air conditioning there is control on temperature, humidity, cleanliness and movement of air in such a manner which result in early patient recovery and prolongs life of equipment they function satisfactorily with the desired accuracy.

The air conditioning plant can be either direct expansion system or a chilled water system. In both the cases the cooling of air takes place in a part of the plant called Air Handling Unit (AHU).

AHU is an assembly of air conditioning components {such as fans (air blowers), cooling coils, air filters, humidifiers, and dampers} integrated into a self-contained package and often installed as a single unit, which is connected to system of metal ductwork that distributes the conditioned air¹.

The main function of AHU is cooling of circulatory air and air ducts conveys the air to and from the AHU.²

In many large and centrally air-conditioned hospitals, HVAC systems may consume 40% of the electricity and Lighting is a major electricity consumer next only to HVAC (AHU) system.³ Air Conditioning and Ventilation system in hospitals is required for:

- Maintaining the requisite indoor temperature, air distribution and humidity levels for thermal comfort.
- Maintaining indoor air quality, particularly in areas requiring prevention of infection

2. To identify the need and circumstances which lead to total replacement of secondary facilities

Prime facility which requires replacement is the AHU (Air handling Unit) because the machine is 20 years old and the technology which it was using has become obsolete, deterioration of internal component and the metal coils of AHU machine are choked and spare parts are not easily available in market thus causing maintenance problem. The AHU duct was combined for the both A and B wing of wards. It had no return duct instead it had a common inlet and outlet connected to common AHU. Replacement of the old technology by newer one is planned but in planning of primary facility because of old hospital structure it is not possible to replace facility without displacing of other secondary facilities which primarily do not require any replacement and renovation, like Electric conduct, Civil, Mechanical, Medical gas pipeline, fire safety Alarms.

Prime secondary facility which requires replacement: AHU (Air Handling Unit)

- The present Air Handling unit (AHU) machine is 20 years old and the technology has become obsolete, deterioration of internal component and the metal coils of AHU machine are choked and spare parts are not easily available in market thus causing maintenance problem.
- The efficiency of AHU was also reduced due to continuous use for last 20 years which also adding up financial burden on institute.
- The present AHU duct was combined for the both A and B wing of wards. It had no return duct instead it had a common inlet and outlet connected to common AHU.
- Warm air was not available in private rooms as they were not connected to AHU, instead they had their separate indoor air conditioner and heater was given during winters for maintaining the room temperature.
- HVAC (Heating Ventilation Air-conditioning) of ward is regulated manually no central controlling was incorporated.

Initially only AC system is required to be replaced but once all the associated structures are displaced users requested to change all associated setting of all secondary facilities.

The Replacement of older technology of the AHU by modern technology had add on advantage over the old one they are summarized below:

- The older AHU was manually operated which is being replaced with automated operating system thereby reducing the manpower for operation and smooth functioning of the AHU.
- Advanced Technology in AHU reduces the carbonization of coils which reduces the recurrent deterioration of internal components and downtime can be reduced.
- A and B wings air ducts are now separate, now the AHU can be regulated separately and are now according to fire safety norms.
- Duct has been replaced with well insulated coverings which reduced the heat loss thus conserving the energy.
- Fresh air is mixing up now 20% outer air to maintain the ventilation
- Cooling load of ward requirement can be regulated centrally previously it was regulated at ward level
- Better coil drainage

The circumstances which lead to the total replacement of secondary facilities as a whole while replacing the prime secondary structure i.e., the AHU of the Surgery ward-

1. Lack of proper planning initially while construction
2. Technology up-gradation
3. Energy conservation
4. Fire Safety norms
5. Precautionary measures to reduce hospital acquired infections
6. Ambience atmosphere and psychological effect

Smooth functioning the department- reducing chances of frequent breakdown of the AC system of the Surgery ward.

The secondary facilities for their replacement during the process of installation of new AHU are mentioned under the headings of Fire Safety, civil, lighting, telecom.

Fire Safety

While replacing the old AHU the fire safety system of the Surgery ward also required to be replaced under the following circumstances:

The lack of proper planning, the fire safety water pipe lines was crossing the old AHU air duct leading to hindrance while replacing and the conventional fire alarm and smoke detector was based on old technology. In case of any fire hazards specific site location was difficult for the fire safety guards.

- Newer fire and smoke detector were installed with added Addressable system in which, fire area and particular point of fire can be detected by sensor in central fire safety office and location can be traced, and time to reach the area is also reduced.
- Water sprinkler is installed with heat detector.

Civil Work

There were cracks and crevices on the tiles and the height of daddoing was insufficient which leads to dust accumulation and thereby increasing chances of hospital acquired infections. The false ceiling is replaced with 2 by 2 grids Steel Sheet, which makes it convenient to open during repairing activities in future.

Lighting:

Improper planning and the technology up-gradation, makes it mandatory to replace the lighting of the Surgery ward. False Ceiling lights in ward, nursing station, and corridor of ward is replaced by LED Light. The advantage of LED lights is reduced light pollution, low maintenance, reduction in electric power consumption this will reduce the monthly electricity charges.

Telecom

The telephone wires behind the false ceiling were damaged so they were replaced which led to expenditure

Need For Replacement Of Prime Secondary Facilities:

After comprehensive site inspection, the infrastructure and physical facilities available at present made significance to be undertaken lies in its effort to surface the importance and need of replacement of the old AHU technology due to initial planning process other secondary facilities were also ceased because of this these facilities was also changed for Example Fire safety alarms, worn-out infrastructure of the ward to cope up with the changing technology, a need to renovate and introduction of the modern technology in the ward was felt to provide a healthy, homely and safe environment to patients and staff, efficiency of the staff will be enhanced indirectly if comfortable environment is provided.

3. The Expenses Incurred In The Replacement Of Prime Secondary Facilities Of Ward Were Obtained From The Respective Engineering Departments Which Are As Shown In The Table 1.

Table 01: Expenses Incurred For Replacement Of Prime Secondary Facilities

Sl. No	Department	Total expense incurred (Rs.)
1	Civil	3686225/-
2	Electrical	1700000/-
3	Mechanical	220051+51626=271,677/-
4	AHU	3500000/-
5	Fire	1250000/-
6	Telecom	1172/-
Total	10,409,073/-	

The total expense incurred for renovation of primary and secondary physical services was found to be **Rs 10,409,073/-**.

Hospital Charges Loss (Opportunity Loss)-

There was loss of room charges also due to non-occupancy of the private rooms for these 94 days of renovation of ward.

Hospital Charges	Amount per day per room (Rs.)
1. Admission charges	100.00 (one time/ admission)
2. Private room charges	1500.00
TOTAL	1600.00
For Six Rooms	1600x6= 9,600
For 94 days (for Six Rooms)	9600x94= 9,02400

The loss incurred by hospital through non-occupancy of private rooms is **Rs. 9, 02400/-** for 94 days.

4 To recommend planning aspects of secondary facilities installed, services to have independent network so as to minimize the cost of repair and replacement in future.

In this context, the survey of ward was done with the team of the institute and team consists of hospital administrator, engineers from various divisions, sister in charge and head of department. The survey team suggested replacing the existing AHU of the Surgery ward. The existing AHU needs replacement due to the following reasons-i). The AHU is 20 years old; the technology is out of date and ii). Due to fire safety issues, the A and B block needs separate individual AHU. The Survey team found that the old secondary facility was not properly planned, it was lacking isolated plan for fire safety pipelines, fire alarms system, fire detectors, telephone cables, and medical gas pipelines.

The survey team involved multi-disciplinary engineering team and they plan the work as per the latest national and international norms.

The various planning aspects are-

1. To replace the existing false ceiling with 2 feet by 2 feet grid steel, which will help in easy removal in future repairing work,
2. The existing light to be replaced by the LED lights, which will conserve energy.
3. The tiles of the walls and floors planned to be replaced which are having cracks and crevices,
4. The medical gas pipelines and the pendants in the patient care area also planned to be replaced as they were damaged while replacing the AHU and the wall tiles.
5. Planned to have AC return duct above the false ceiling, which will reduce the heat load above the false ceiling.

While planning to install the new AHU 'the main problem was the air condition duct, which is fitted above the false ceiling and covering the entire ceiling by his tributaries duct. For changing the duct system entire false ceiling has to remove which involves the civil work, and when removing the false ceiling fire alarm has to remove which leads to involvement fire safety department (Jal Nigam) and when renovating the ward false ceiling light also has to remove and replaced for this work involvement of electrical department is also required. Side by side renovation of wall also decided and proposal for new glazed tiles replacement is planned. Medical gas pendants are fitted on patient bed side on wall, on renovation of wall gas manifold is also relocated due to which medical gas plant service provider is also get involved. The plan incorporates the best practices in healthcare facility design including patient friendly infrastructure and internationally accepted safety protocols.

Engineering Team:

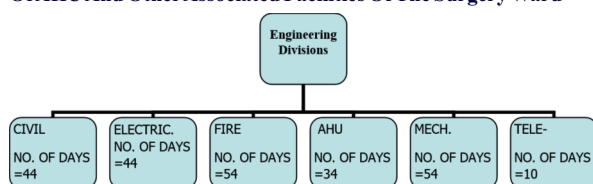
The composite coordination of all the engineering divisions (Civil, Electrical, Mechanical, Fire, Telecom, Air- Conditioning etc.) came together and worked in well coordinated manner by keeping the safe hospital concept in the planning of ward renovation so that work will finish in the targeted time line.

Time Frame

The after commencement of work in month of April the renovated ward was handed over in July total of four months.

The work was followed up by Residents of Hospital Administration Department on regular basis and the expected date of work completion by various engineering division involved in the renovation is displayed in table 02.

Following PERT Design Depicts The Various Engineering Division Involved And Time Taken To Complete The Replacement Of AHU And Other Associated Facilities Of The Surgery Ward



Mechanism of Change:

To introduce the advance technology by replacing the older air handling unit which is the primary facility displacement of other associated facility was also taken into consideration because the plenum space was fitted with the tributaries of AHU duct, sprinkler pipe line, medical gas pipelines, electric cable, telephone cable etc. for the primary facility all the associated facility was also replaced and for this the entire engineering department has to work and following line of action for replacement and renovations is done in the following manner:

Civil Engineering Division (Air handling unit, glazed tiles, flooring)

↓
Electrical Division (ceiling light, electric wiring)

↓
Fire services (Fire Alarm)

↓
Mechanical Department (Gas pendent fixing)

Maintenance:

The maintenance of the renovation work was done by the various engineering divisions summarized in table no 02.

Table 02: Showing Services And Agency Involved In Ward Renovation

Sl. No	Services	Division of engineering department/ Agency
1	Air handling unit	Nirman Nigam Agency(Civil Engineering)
2	Fire detector	Jal Nigam (Fire Department)
3	Civil work	Civil Engineering
4	Gas manifold	Mechanical Engineering
5	Electrical work	Electric Engineering

Commencement:

After completion of all the renovation work the surgery ward was inspected by head of department, sister in-charge, hospital administrator and head of engineering department and ward was commenced in July for functioning.

RESULTS AND DISCUSSION:

Scaling up the infrastructure in the ward to cope with modern technology and the administrative approaches taken to provide continuous uninterrupted patient care during the period of replacement. But during the replacement of AHU and associated secondary facilities the patient care provided by private ward was discontinued for the period 3.5 months and it can be easily inferred from table the loss incurred by hospital through non-occupancy of rooms was Rs. 9,02,400/-Rs. for 94 days. the actual cost of replacement of AHU (Prime secondary facility) was 35,00,000/-Rs. and the cost incurred in replacing the other secondary facility was 6,909,073/-Rs. and gross total including non occupancy of private room and engineering work done was 11,311,473/- Rs. The expenditure for the prime facilities is more compare to the other secondary facility which was replaced. The running cost of AHU will be decreased by replacing with newer technology this was the one of the reasons for replacement even the electric consumption will also decrease which in turn reduces the financial burden on institute. If the secondary facilities were not replaced the expenditure will be less.

CONCLUSION:

HVAC systems are crucial mechanicals system in building especially in healthcare buildings because healthcare buildings are first and for most places of healing and the people within required a thermally comfortable environment to recover and function well. With today's need for a more environmental conscious approach, it is imperative to give architectual design key emphasis and to incorporate new and greener technology, it is necessary to run an individual assessment for each building.

Planning is therefore essential in this case we can see that the replacement of AHU (PRIME FACALITY) along with secondary facility was need of time for internationally accepted patient safety protocol and for satisfaction. The hike in gross cost incurred for replacement was because of replacement of secondary facility which could be avoided if proper planning was done before implementing. If planning was in accordance with cost factor in mind, then the focus will on primary facility only which can be done by minor replacement of AHU only. So, engineering infrastructure set up should always be kept in mind.

REFERENCES:

1. McGraw-Hill Dictionary of Scientific & Technical Terms, 6E, by The McGraw-Hill Companies, Inc.
2. Modern trends in planning and designing of hospitals principles and practice by Shakti Kumar Gupta, Chapter 1 & 2
3. Chandra H, Jamaluddin K. Hospital Administration at a Glance. 1st ed. Lucknow: Bharat Book centre; 2010. Chapter 19,34
4. Sanjay Gandhi Post Graduate Institute of Medical Sciences Lucknow; Hospital Statistics for the year 2017
5. Energy Efficiency in Hospitals Best Practice Guide.