

Strategies to Implement Energy Savings in Hospital Buildings: Perception of Designers

Mohammad Hafiz Maulud¹ & Roshartini Omar^{1,2*}

¹Department of Construction Management, Faculty of Technology Management & Business,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor,
MALAYSIA.

²Center of Sustainable Infrastructure and Environmental Management (CSIEM),
Faculty of Technology Management & Business,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor,
MALAYSIA.

*Corresponding Author

DOI: <https://doi.org/10.30880/rmtb.2023.04.02.033>

Received 30 September 2023; Accepted 01 November 2023; Available online 01 December 2023

Abstract: Due to the fact that they are open around the clock, hospitals are one of the buildings that consume the most energy. The Heating, Ventilation, and Air Conditioning (HVAC) systems at hospitals are responsible for the majority of the electrical energy that is consumed there. The application of designs for reducing a building's energy consumption is not where it should be in Malaysia's buildings. Through the incorporation of energy saving designs into hospital buildings, hospitals are able to provide healthcare facilities to humanity while simultaneously lowering the amount of energy that they use. The vast majority of a human's life will be spent inside of structures of some kind. The primary purpose of this research is to investigate the degree to which designers are able to implement energy-saving measures in hospital buildings, to investigate the difficulties that designers face when trying to implement energy-saving measures in hospitals, and to investigate the strategies that designers can employ in order to improve their ability to implement energy-saving measures in hospitals. Because of this, a study was carried out to determine, from the perspective of hospital building designers, the methods that can be used to reduce energy consumption in healthcare facilities. This study concentrates on the hospitals located in Johor Bahru To collect data and information for this study, the researcher uses qualitative methods of data collection. The primary data is gathered through an interview question in a form of a Google Form. Books, articles, journals, and thesis papers that are in some way of collecting secondary data. As a result of data collection and analysis, the findings in this study revealed that many hospitals have started implementing energy savings in their buildings. The challenges that is most faced by designers are the budget of the client. Finally, designing a bigger window to introduce more natural lights and design a more efficient layout of the

hospital is the top two strategies needed to be made by designers to ensure the implementation energy savings in hospitals.

Keywords: Energy savings, hospitals, hospital building, designers.

1. Introduction

Malaysia's strong economic expansion has resulted in the design and construction of numerous new hospitals. Aside from that, many existing large referral hospitals have undergone or are undergoing extensive physical upgrades and renovations to match today's high medical standards, as well as to provide additional facilities and services for new and expanding medical services. Most hospitals have become particularly energy intensive as a result of the hot and humid climate, as well as the high expectations and requirements of medical and clinical standards (Kamaluddin *et al.*, 2016).

According to Imran *et al.* (2016), a significant increase of energy usage is caused by the major rise in hospital operational expenditure. Challengers in reducing operating costs and improving patient care are becoming more crucial than ever in the present healthcare climate, with hospitals as the primary

energy users. To find out how designers can implement energy savings in Hospital Buildings, we need to highlight and understand the challenges and obstacle first. Teke (2014) stated that an average of 1.2% increase of energy demand per year from the building sector. The most commonly retro-commissioned systems in hospitals are lighting systems, controls, HVAC equipment and building envelope.

In many countries, energy usage in buildings has long been a key research issue. Many developing countries have made various initiatives in recent years to encourage efficient energy use in buildings, including attempts to regulate energy conservation initiatives and energy efficient building design. Studies are carried out with the goal of better understanding local and worldwide energy concerns in order to reduce energy consumption (Kamaluddin *et al.*, 2016). Hospitals are responsible for a disproportionately high quantity of energy demand and emissions, owing to their continuous operation and other requirements. They consume more energy than a commercial facility. They also require reliable and high-quality electricity supplies (Kolokosta, 2012).

The implementation of energy savings designs in buildings in Malaysia is not where it needs to be. Ninety percent of a human lives will be spent in buildings (Simens, 2020). So, the energy consumptions to make us comfortable will be astronomical without the implementation of energy savings properties or designs. Buildings are estimated to account for approximately 40% of primary energy and 36% of greenhouse emissions (D'Agostino, 2018). A lot of energy is used by a building to fulfill the needs of comfort for the people inside the building.

With the advancement of energy savings technologies, every building needs to adapt and change from their old ways and start implementing these energy savings technologies. Even though there are buildings in Malaysia that applies energy savings, the energy consumption in Malaysia is still high. According to Kumar (2018) up to RM46.9 billion spent in energy in Malaysia can be saved between 2016 and 2030, if the implementation of energy efficiency initiatives done nationwide.

As a result of rapid economic growth, Malaysia become one of the biggest electric energy consumers per capital in the region, with the average usage of 4.652 kWh per capital in 2014, higher than the worldwide average of 3,132 kWh. Malaysia needs to put their efforts to lower their energy usage (Energy Watch, 2019). This will aid to improve our country energy usage and how much we spent on energy bills.

There are many ways and steps designers need to make to ensure the success of energy savings implementation in buildings in Malaysia. As a designer, during the designing phase of the buildings,

they must take energy savings methods into consideration and implement them as much as they can within the budget of the client. From choosing the building materials, building form, building design and ergonomic space planning, energy savings properties needed to be in the minds of the designers. Therefore, the objectives of this research are (i) To investigate the level of implementation of energy savings in Hospitals, (ii) To investigate the challenges among designers to implement energy savings in Hospitals and (iii) To investigate the strategies to be made by designers to enhance the implementation of energy savings in Hospitals.

The scope of this study is limited to the strategies for designers to implement energy savings in hospital buildings. This research is made to find the best answer for the research questions based on the objective of the research. Researchers have focused on several factors to facilitate the study. In this study, the researcher discusses about the implementation of energy savings in hospital building in the perception of designers. The challenges for designers to implement of energy savings in hospital buildings were also discussed. In addition, data and information will be collected through surveys and research done on the internet. Moreover, an interview with designers will also contribute to the research to aid the researcher to understand more of the strategies to implement energy savings in building by designers.

As designers in the construction industry faced many obstacles and challenges to implement energy savings in hospital buildings. This study proves the importance and benefits of implementation of energy savings in hospital buildings. It will not only be beneficial to the costs of running the hospitals, it is also beneficial to the environment and the earth. This study could somehow help other designers on the steps and ways for them to implement energy savings in hospital buildings. This research will benefit a few people such as, designers so that other designers can benefit from this research so that they can apply and manage all their challenges and obstacle when implementing energy savings in Hospital buildings. Next, the construction industry. The significance of this study could be indicated as it will help the construction industry in addressing the obstacle and challenges on implementing energy savings in Hospital buildings. Moreover, the hospital can save a lot of money spent on energy with this research. They can acknowledge the benefit and obstacles of implementing energy savings in their buildings. Lastly, this study will benefit from an academic standpoint. Through the help of this research, students can use this research as reference for their assignments or research. Moreover, students can learn more about strategies to implement energy savings in hospital buildings from the perspective of designers.

2. Literature Review

A literature review is a summary of studies related to a particular area of research. It identifies and summarizes all the relevant research conducted on a particular topic. It is important that literature review is focused. Therefore, researcher should choose a limited number of studies that are central to the topic rather than trying to collect a wide range of studies that might not be closely connected. This study aimed to focus on strategies to implement energy savings in hospital buildings from the perception of designers.

2.1 Definition of Energy

In physics, energy is the ability to perform work. It can take many many forms, including potential, kinetic, thermal, electrical, chemical, radioactive, and others. Furthermore, there is heat and work—that is, energy in the transmission of energy from one body to another. Energy is always classified according to its type once it has been transmitted. As a result, heat transmitted can be converted to thermal energy, while labour done can be converted to mechanical energy. Energy cannot be generated or destroyed; it can only be transformed from one state to another.

2.2 Energy Savings

Energy savings is improvements in energy efficiency minimise the amount of energy required to offer a service. Energy savings have been the foundation of energy efficiency's many benefits, and they're linked to a slew of additional economic, social, and environmental advantages (IEA, 2019).

2.3 Energy Use in Hospital

Hospital buildings, in comparison to other types of structures, have a particularly high impact on the environment's whole cycle. Due to their all-weather high-cost operation, complex medical equipment, and tight cleaning processes and environmental criteria, hospital buildings are energy-intensive buildings. Hospitals are the second most energy-intensive commercial buildings in the United States, with per-square-foot energy consumption twice that of office buildings (Shen *et al.*, 2018). The interest of researchers has been caught by commercial building such as Hospitals. Hospital buildings must apply a variety of energy efficiency methods because they are open 24 hours a day, resulting in high energy usage (Ludin *et al.*, 2019).

2.4 Level of Implementation of Energy Savings

According to Aziz *et al.* (2021) energy efficiency in hospital buildings has become a hot topic among experts throughout the world in recent decades. The complexity of a hospital structure, which includes multiple engineering systems as well as the nature of healthcare building operations, makes implementing energy conservation methods without affecting hospital operations extremely difficult. The majority of the techniques are engineering-based, such as improved heating, ventilation, and air conditioning (HVAC) systems, more energy-efficient lighting systems, and other features such as building orientation and operation and maintenance (O&M) management.

Table 1: Implementation of energy savings

Author (Year)	Implementation
Calcedo <i>et al.</i> (2018)	<ul style="list-style-type: none"> – Optimization of Electric Energy installations – Improvement of Air Conditioning and Heating Systems (HVAC) – Domestic Water Heating (DWH) – Optimization of Lighting System
Calcedo (2014)	<ul style="list-style-type: none"> – The Reactive Power Compensation – Improvement in Service Water Heating – Improvement in the Lighting System – Heating, Cooling and Ventilation Systems
Bakaimis (2017)	<ul style="list-style-type: none"> – Dynamic AC Control – Dynamic Lighting Control – Smart Equipment - Energy metering (Pilot) – Smart Equipment – Light-Control Sensor (Pilot)

2.5 Challenges in Implementing Energy Savings

According to Bakaimis (2017) there are several challenges to implement energy savings in Hospital buildings Such as maintaining the same degree of quality in health care services. While implementing such programmes in other sectors may be simple, doing so in the health sector necessitates a significant deal of time and attention. Secondly, recruiting and retaining employees. Changing people's habits and daily lives, particularly in a diverse hospital environment (health professionals, doctors, patients, etc.)

is a challenging endeavor that necessitates a dynamic and flexible approach to implementing cooperative projects and raising awareness. Thirdly, budgetary concerns Because of the limited budget, not all initiatives could be executed at the same time or to their full potential. As a result, budget management and allocation must be a dynamic and efficient process. Fourth, keeping a Team Together. The quantity of technical workers has dropped. In addition, individuals were compelled to perform tasks that were not directly related to their official responsibilities. As a result, it was difficult to keep a coherent team on track. Lastly, the public sector's unique qualities (lack of incentives, sloppy working conditions, lack of sanctions, lack of management by objectives, etc.) are obstacles that must be overcome.

Table 2: Challenges in implementing energy savings

Author (Year)	Challenges
Bakaimis (2017)	<ul style="list-style-type: none"> – Maintaining the quality in healthcare while implementing energy savings. – Recruiting and retraining Employees. – Budgetary concerns. – Keeping the team together. – The public sector's unique qualities (lack of incentives, sloppy working conditions, lack of sanctions, lack of management by objectives, etc.) – Individuals were compelled to perform tasks that were not directly related to their official responsibilities
Singh (2017)	<ul style="list-style-type: none"> – Reduced staffing. – Budget separation. – Energy intense equipments. – Round the clock. – Space use variations. – Need for backup. – Air quality regulations. – Complecated physical plans. – Small part of operations.
Davies (2016)	<ul style="list-style-type: none"> – Hospital funding. – Hospital management strategy. – Regulatory and legislative barriers. – The physical and operational considerations of day to day facilities management

2.6 Strategies on Implementing Energy Savings

According to Teke (2014) healthcare businesses can save money on energy by implementing a variety of strategies, for low-cost measures, hospitals can measure and track their energy usage, check the rates for gas and electricity, ascertain that all equipment is operating as intended, inefficient lighting should be replaced, check the transformer loading factor and ensure that the power factor is same, seasonal and occupancy fluctuations should be taken into account while adjusting thermostats, install energy- efficient motors and variable-speed drives (VSDs), set up an air curtain system, examine the building's thermal insulation and HVAC system, air and water systems need to be in balance, staff and patients should be educated on how their actions effect energy consumption and install a building energy management system and maintain it on a regular basis. For cost-effective investments, hospitals can

collaborate with an energy service provider to manage and optimise energy performance, set up a Combined Heat and Power (CHP) system, consider making a capital investment in high-efficiency HVAC systems, purchase things that are energy efficient, such as qualified office, electronic, and commercial kitchen equipment, using natural light as much as possible during the day by using corridors, monitoring the energy systems of a building on a continuous basis and upgrade to more energy-efficient lighting and motors.

Table 3: Strategies on implementing energy savings

Author (Year)	Strategies
Ludin <i>et al.</i> , (2019)	<ul style="list-style-type: none"> – Awareness campaign – Replacement of Existing Personal Computers with Laptops – Regular maintenance – Refrigerator replacement
Bakaimis (2017)	<ul style="list-style-type: none"> – Efficient Use of Electric Appliances/Equipment – Raising awareness – Dynamic Lighting Control – Dynamic AC Control
Teke (2014)	<ul style="list-style-type: none"> – Track and measure their energy usage – Check the rates for gas and electricity – Ascertain that all equipment is operating as intended – Check the transformer loading factor and ensure that the power factor is same – Inefficient lighting should be replaced. – Set up an air curtain system. – Purchase things that are energy efficient, such as qualified office, electronic, and commercial kitchen equipment. – Using natural light as much as possible during the day by using corridors. – Upgrade to more energy-efficient lighting and motors. – Monitoring the energy systems of a building on a continuous basis. – Consider making a capital investment in high-efficiency HVAC systems. – Set up a Combined Heat and Power (CHP) system.
Shen (2019)	<ul style="list-style-type: none"> – Air conditioning system adjustment the amount of air supply according to the indoor CO2 level. – Set up a air source heat pump unit that serves domestic hot water according to actual needs. – Use multiple channels to independently control the lighting in each public area

3. Research Methodology

The methods of data collection for research purposes were identified in research methodology. Quantitative analysis and qualitative analysis procedures were the two basic types of study approaches. The goal of researching methodology is to gather best practises from respondents who were reacting to the field by generating recommendations, point of views, and other types of reflection.

The researchers utilised qualitative approaches to acquire all of the required information from the respondents for this study. In this chapter, what will be discussed is the appropriate methodology to be used throughout this research. With the selection of appropriate research methodology, data collection work can be done quickly and easily. Various methods are used to achieve the objectives of the study. Methodology is defined as a system that includes the methods and principles used in an activity. Therefore, in order to achieve the objectives of this study, research should be conducted in accordance with the scope of the prescribed methodological methods.

3.1 Research Process

The research methodology serves as a guideline in conducting this research and aids in the important stages of the methodology step of the process carried out to achieve the research objectives. As a result, a few procedures have been organised in stages to ensure that the research is completed properly and that its objectives are met.

3.2 Data Collection

In order to gather correct data and information, data collection procedures were critical in this study. Accurate facts and information are founded on strong evidence and logic. The data collection method employed is qualitative, which is appropriate for this type of research.

a) Primary Data

Primary data was the information collected to do the research project. The data collected implemented in this research is mainly from a qualitative approach. The interview method used for data collection consists of individual interviews, group interviews, face-to-face interviews, interviews through telephone, and online interviews.

b) Secondary Data

The secondary data was obtained from conducted various references such as books, newspapers, journal articles, inline databases, and thesis papers which related to the implementation of energy savings in hospital buildings from the perception of designers. Secondary data involve the theories and definitions which are related to poor communication and design change. It also includes the facts that have been done by the researcher before. It is very important in proving the accuracy of the primary data in doing this research.

3.3 Data Analysis

For the data analysis, the interview result was analyzed by the thematic analysis method. Thematic analysis is a common method be used to analyze the qualitative data. It can come out theme through the process of identifying analyzing and reporting pattern with data. The pattern brings the information that related to research questions and represents the response pattern of the respondent.

4. Data Analysis and Discussion

This part presents case study results. The study's aims were to explore existing implementation, problems designers have in implementing energy savings, and solutions designers may use to improve implementation in hospitals. The study was done utilising a Google Form with interview questions.

Fully qualitative online surveys that prioritise qualitative research values and use qualitative data have a lot to offer qualitative researchers. However, qualitative survey research is underused and rarely explored (Virginia *et al.*, 2020). Qualitative research seeks to comprehend people's lives and social settings. Qualitative research must reveal individuals' subjective meanings, behaviours, and social situations (Fossey *et al.*, 2016).

Busetto *et al.* (2020) define qualitative research as the "study of the nature of phenomena," which includes "their quality, different manifestations, the context in which they appear or the perspectives from which they can be perceived" but excludes "their range, frequency, and place in an objectively determined chain of cause and effect." Qualitative research data is usually provided as words, not statistics.

The 37 interview questions were categorised into A, B, C, and D. A contains 5 questions. In Part A, respondents' backgrounds are queried, and in Part B, 11 questions are posed about hospital energy savings. In Part C, respondents answered 9 questions about the obstacles they faced as hospital designers. 12 questions asked designers how to apply energy savings in hospitals.

4.1 Classification of Respondents

4.1.1 Respondent Background

Respondents are hospital architects and interior designers. The researcher emailed 9 organisations that had worked on hospital building projects in Johor Bahru Google Form interview questions, but only 3 responded. 33.3% of respondents gave input. 67.3% of interviewees did not respond. For each part, respondents answered survey questions.

4.1.2 Background of Respondent

Table 4: Background of respondents

Respondent	Position	Age	Company	Years of Experience
R1	Interior Designer	31	A	3
R2	Architect	38	B	5
R3	Interior Designer, Drafter	35	C	5

The background of respondents comprises position, age, and work experience. It can establish that the respondent's data was real and that they were responsible for producing better, more accurate replies. Section A of the interview form the researcher provided contains demographic questions. Table 4.1 lists survey respondents.

4.2 Data Analysis

Following the completion of the Google Form with interview questions that the respondents were asked to answer, the data collected from those responses is then examined. The responses received from each respondent are compared with those received from other respondents.

4.2.1 The Existing Implementation of Energy Savings in Hospitals

This part of the question has been divided into several questions which are as many as eleven questions related to the existing implementation of energy savings in hospitals. Table 5 displays the respondents responses to questions about the existing implementation of energy savings in hospitals.

Table 5: Respondents responses to questions about the existing implementation of energy savings in hospitals

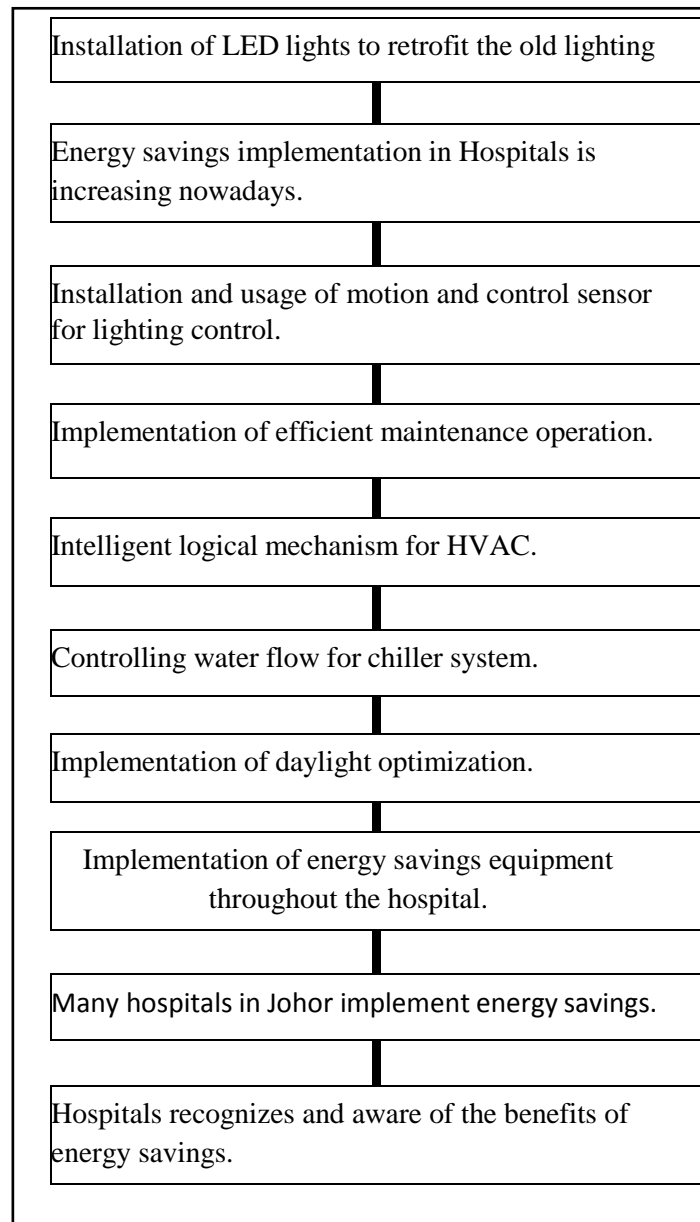
No.	Question	R1	R2	R3
1	Many hospitals in Johor implement energy savings.	Mostly new hospital apply this operation. They are more efficient about this. I bet old hospitals already start aware on this and plan to do something for energy savings.	Many hospitals probably save energy. Patients and doctors need it.	I've seen hospitals applying energy-saving designs during renovations. Many hospitals recognise the benefits of energy-saving measures.
2	Hospitals recognizes and aware of the benefits of energy savings.	Some hospitals use energy so much for patients. Hospitals save energy by designing for air and people circulation in closed areas. Old hospitals may save energy, but not as much as new ones	Of course hospitals are aware of the benefits of energy savings. Mostly people knew about earth saving energy.	Many hospitals are starting to be aware of the benefits of energy savings. They started to renovate their old buildings to be more energy savings.
3	Energy savings implementation in Hospitals is increasing nowadays.	Architect and designers always aware about this. Pertubuhan Akitek Malaysia (PAM) always focus on sustainable design and mechanism.	Mostly hospitals in Johor Bahru already aware of energy savings.	Designers have started to implement energy savings in their designs. They know it will be beneficial for many parties. For hospitals that operates 24/7/365, energy savings implementation is very important and beneficial.

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- 4 Installation and usage of motion and control sensor for lighting control. I know every hospital apply this motion and control sensor for lighting. Emergency lights and sensor are very important. Sensor can make doctors and nurse work easier. Motion and control sensor for lighting is very important for doctors and nurse. Designers studied things to make easier for patients and doctors.
- 5 Implementation of daylight optimization. This thing is very important to hospitals too. Nowadays, there are many energy saving technology and products too. Mostly architects study about this to get title building and to make it easier for clients in the future. If all hospitals applying sustainable and energy saving mechanism, that's good! I bet architects applied green building for this to get title green building and to make it easier for clients in the future. Daylight optimization is something that is implemented. But a certain area in hospitals needs electricity lightings 24/7. Some are because the location or the space were an old design.
- 6 Implementation of efficient maintenance operation. I'm sure hospitals staff aware about this benefit since they use a lot of energy saving for their patients. The maintenance operation is rare to see at old hospitals. Maybe the system is outdated or broken. All the staff are trained to efficiently do a maintenance operation. This method is still newly introduced. It may take time to be fully implemented.
- 7 Implementation of energy savings equipment throughout the hospital. Of course there are many equipment for energy savings for hospitals. They aware about this before start operate the hospitals. Existing energy savings equipment for hospitals maybe not efficient much as new one. Perhaps need to maintenance or upgrade new one. A lot of modern equipment are made with energy savings in mind. So, during an equipment upgrade, an energy saving equipment will replace it. Implementation of energy savings equipment's effects are very noticeable.

- 8** Installation intelligent logical mechanism for HVAC. Many hospitals are aware about this. That HVAC unit in shows green building modern designs are very important for considered as a logical mechanism is energysavings and normal practice. installed to replace sustainable. Many older the old outdated one. hospitals are A lot of hospital go starting to upgrade this route to keep up their HVAC with the systems too. modernism. A better HVAC will benefit everyone in the hospital either doctors, staff or patient.
- 9** Installing LED lights to retrofit the old lighting system. Nowadays LED is very easy to find. Easy to install and maintenance. But when it comes replacing the old lighting system, i think technician can handle this. There is no much difference between old lighting and LED system. But LED is last much easierto install longer, and uses less electricity than normal bulb. The price difference is too little to be noticed. LED is widely used and easily sourced now. It is brighter, last
- 10** Controlling water flow for chiller system. I'm sure everyhospital apply this energy savings method. Designers need to aware water flowfor chiller systemtoo for long term hospitals. Newer hospital does control their water flow for chiller systems. But for Old older hospitals, it may cost a lot to implement it. complicated mechanism than new one
- 11** State other existing implementation of energy savings in Hospitals. "Many Hospitals in Johor Bahru is starting to recognise the importance of implementing energy savings. Asfor the Hospital thatwe worked on, KPJDato Onn they recognise the benefits of implementing energy savings. During their "Gleneagles Medini Hospital that we worked on have incorporated using natural light as we designed using a lot of windows to allow natural light and the open feeling. We wanted the indoor and outdoor to feel connected while allowing privacy." "Installing an automated dimmer and timer for certain areas such as cafe area. Strategic space planning to make the space more flowy and open to reduce electricusage."

renovation, many energy savings equipment and measures were taken.”

Figure 1: The existing implementation of energy savings in hospitals in order of the responses received



4.2.2 Challenges Faced by Designers On Implementing Energy Savings in Hospitals

This part of the question has been divided into several questions which are as many as nine questions related to the challenges faced by designers on implementing energy savings in hospitals. Table 6 shows the respondents responses to questions about the challenges faced by designers on implementing energy savings in hospitals.

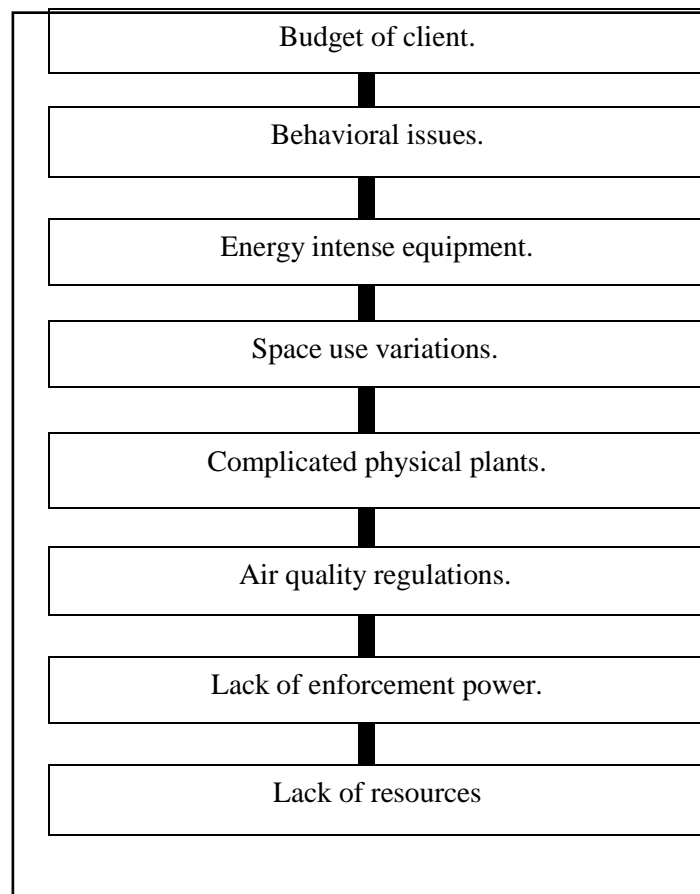
Table 6: Respondents responses to questions about the challenges faced by designers on implementing energy savings in hospitals

No	Question	R1	R2	R3
1	The budget of client.	Budget client is very sensitive. Some clients need to think for future use and maintenance. Usually the client's budget is a very challenging part for architect and designers for sustainable buildings.	Budget client is very important for architects and designers. They design based on budget and client needs.	Clients with bigger budgets are easier to persuade than clients that have a very tight budget and have many requests. Influencing client that it is beneficial for them in the long run is also a challenge.
2	Lack of enforcement power.	Of course lack of enforcement power is very challenging for architects and designers.	Lack of enforcement power is major challenges for designers to implement energy savings in hospitals.	There are enforcements done but it isn't monitored properly. So some does and some doesn't care.
3	Energy equipment. intense	There are many equipment for energy intense but as architect, we need to study for maintenance and function.	Equipment for energy saving mechanism need to be particular for hospital's needs.	Some equipment just uses a lot of energy. The ones that can be replaced should be but those that haven't had a more energy saving model, it needed to be used to cure patients.
4	Complicated plants. physical	Old building plans is very complicated but systematic. Very rigid and straight forward design. New building has a more flexible and organic design than the old building.	Complicated physical plans can make architects and designers hard to maintain and blend with sustainable mechanism.	Some layout plans are just too complicated. Designers need to be creative and smart to implement every space available to implement energy saving.
5	Space use variations.	We can see modern designs by architects usually focus on public spaces. Public	Space use is very important for hospitals. Space between private and	Designers need to always keep in mind that every space needs to flow

	spaces is very important to avoid crowds in semi-public and private areas. Designers always focus on orientation and flow for patients and doctors.	public spaces and amount of energy uses at certain spaces need to focus by designers.	and connect with each other. This will make it comfortable for patients and easier for nurses and doctors.
6	Air quality regulations.	Air quality regulations are very important for hospitals. Designers need to study detail on this part for patients.	Air quality regulations need to study for designers to design more efficient. It is very important for patients health and safety. When designing, air quality regulations is one of the aspects that designers have to take into consideration. A better air quality ensures the comfort of the building occupants.
7	Lack of resources.	I don't think lack of resources is a challenge for designers. There are many resources on the internet and PAM.	I don't think designers and architects lack of resources. I'm sure they aware bout energy savings and sustainable. Designers have abundance source of resources. It's very ridiculous if people say we don't have enough resources. Nowadays, every information is in our fingertips.
8	Behavioural issues.	Behavioural issues very sensitive to patients or guests. Basically everyone needs to be educated to avoid incident happen.	Behavioural issues also important for designers how to overcome if any incident happen. Behavioural issues are one of the challenges that is needed to be faced by designers
9	State other challenges faced by designers on implementing energy savings in Hospitals.	"Most people acknowledges the benefits of implementing energy savings, but they always go for the option that saves them money in short term. Mostly, people	"Most Hospital's equipment uses a lot of electricity. So as designers, we need to know which area can apply energy savings, and which area need to be given sufficed "Energy saving things are expensive and clients do not want them"

are not willing to electricity. Also
spend that extra incorporating
money.” energy savings in
designs without
disturbing the flow
of the hospital is
also a huge
challenge.”

Figure 2: Challenges faced by designers on implementing energy savings in hospitals in order of the responses received



4.2.3 Strategies on Implementing Energy Savings in Hospitals

This part of the question has been divided into several questions which are as many as twelve questions related to the strategies on implementing energy savings in hospitals. Table 7 displays the respondents' responses to questions about the strategies on implementing energy savings in hospitals.

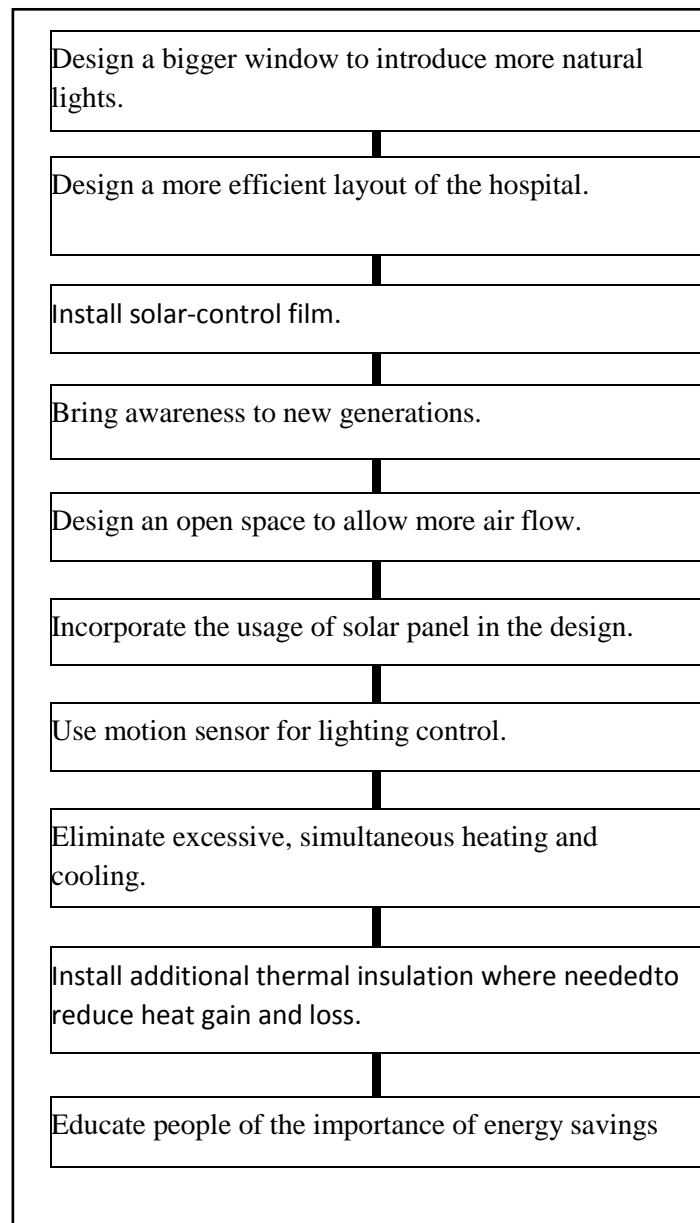
Table 7: Respondents responses to questions about the strategies on implementing energy savings in hospitals

No	Question	R1	R2	R3
1	Design a bigger window to introduce more natural lights.	Bigger window allows lighting and consumptions electric public area.	Apply bigger windows at public spaces is very good to reduce electrical energy. Designers can apply tinted windows to avoid heat energy in public spaces.	If done properly, a bigger window can provide a building a lot of much needed natural light that is more beneficial than artificial lights. Designers needs to take into consideration the direction of the sun first to avoid the hot afternoon sun.
2	Design an open space to allow more air flow.	Designers always focus on open space for get more air flow come through the building. It is very important for public spaces.	Open space maybe can apply for public spaces. Very suitable for kids and family to avoid crowds. Open spaces is good for air flow circulate in the buildings.	Proper air flow that an open space allow is something designers are doing right now. An open space will allow the building's occupants to feel more comfortable air flow.
3	Design a more efficient layout of the hospital.	More efficient layout can avoid crowd control. This thing can avoid heat and noise pollution in small spaces or crowded area.	Layout is main strategies for energy saving of the building. Architect must be study flow and orientation for hospitals and clients.	An efficient layout helps with the flow of the building occupants. It helps connects each space properly with a better layout.
4	. Incorporate the usage of solar panel in the design.	Architect and designer should be aware how design the building to match with the usage of solar panel for sustainable buildings.	The solar panel in design need to study by designers or architects for user. The amount usage solar energy apply to electrical energy.	A solar panel is a good long term investment for the user. The effects solar does show and is noticeable is installed and used strategically.
5	Provide internal or external shading devices to control solar heat gain.	I think internal and external devices of main thing how to	Of course designers need to provide internal or external	Solar heat gain can be controlled by providing internal

		control solar heat gain shading and airflow cooling consumers. system.	for or external shading devices to ensure the comfort of building's occupants.
6	Use motion sensor for lighting control.	Motion sensor for lighting control need to use for certain areas to reduce electrical consumptions.	Motion sensor for lighting control is important for doctors and patients to make things easier. installed. It wouldn't take a good technician long to retrofit a whole building.
7	Installation of solar-control film.	Solar control film is one of the technologies for sustainable buildings. Very useful for electrical and lighting systems.	Architects need to plan which area can install solar control film to get more protection from excessive light. Solar control film can block the unwanted natural lights that makes the building occupant's uncomfortable.
8	Install an additional thermal insulation where needed to reduce heat gain and loss.	A thermal insulation in Malaysia is something that is not that important as the occurrence of extreme hot or cold weathers are very rare. But some newer hospitals does have it.	Designers must know which area can reduce heat gain and loss. They can apply thermal insulation usage in their design. Even though not many designers use the implementation of additional thermal insulation to reduce heat gain and loss, most designer does incorporate it in their newer designs.
9	Eliminating excessive, simultaneous heating and cooling.	When it comes efficient layout, I'm sure designers/architect avoid design excessive and simultaneous heating and cooling spaces.	Excessive heating and cooling can be reduce by high ceiling and in out air circulation mechanism. Excessive heating and cooling needed to be eliminated. Designers need to be creative to incorporate a design that does that.
10	Educating people of the importance of energy savings.	Educate people is very important. To aware people how	Government should be aware about this and educate youngsters how It should be a natural instinct for people to want to conserve energy. It

	important saving is.	energy important savings is.	energy benefits them a lot and logical people will realise it. People should be educated about this matter form a young age.
11	Bringing awareness to new generations.	Younger generations should be aware how important energy saving and sustainable system for our future.	New generations need to aware about sustainable in every buildings. There are many advantages if new generations can apply to daily lives.
			The newer generations is what ensure future does energy savings methods into consideration when designing.
12	State other strategies needed to be made by designers to ensure the success of the implementation of energy savings in Hospitals.	Making incorporating energysavings in building anorm. Make it a "new style" or the "new trend" of design. Making energy savings devices and equipment cheaperand savings devices just more affordable.Make people realise that it's a worthy investment in the long run to spend theextra money on energy savings	Designers need to know where is the existing energy savings technology in the design and smartly use natural energy as much as possible bring problems. Try to avoid using cheap energy devices just to cut cost because it will not be worth it for the trouble it will bring later

Figure 3: Strategies needed to be made by designers to ensure the implementation energy savings in hospitals in order of the responses received



4.3 Discussion

After collecting and analysing data, the researcher found that the Part A interview data is almost equivalent to the study literature and earlier studies.

Table 8: Literature Review Relationship (Objective 1) With Respondents

Questions	Literature review	Findings
Hospitals recognizes and aware of the benefits of energy savings	<i>Aziz et al. (2021)</i>	R3: “Many hospitals are starting to be aware of the benefits of energy savings. They started to renovate their old buildings to be more energy savings.”

Implementation of efficient maintenance operations.	Franco <i>et al.</i> (2019)	R3: “All the staff are trained to efficiently do a maintenance operation. This method is still newly introduced. It may take time to be fully implemented.”
Intelligent logical mechanism for HVAC	Teke (2018)	R2: “Using intelligent HVAC unit in modern designs are considered as a normal practice. Many older hospitals are starting to upgrade their HVAC systems too.”

In Part C, respondents also described the obstacles they faced as hospital designers. Respondents discuss their challenges.

Table 9: Literature review relationship (Objective 2) with respondents

	Category	Literature study	Findings
General	Budget of client	Bakaimis (2017)	<p>R1: “Budget client is very sensitive. Some clients need to think for future use and maintenance. Usually the client's budget is a very challenging part for architect and designers for sustainable buildings.”</p> <p>R2: “Budget client is very important for architects and designers. They design based on budget and client needs.”</p> <p>R3: “Clients with bigger budgets are easier to persuade than clients that have a very tight budget and have many requests. Influencing client that it is beneficial for them in the long run is also a challenge.”</p>

Implementation	Energy equipment.	intense	Singh (2017)	R1: “There are many equipment for energy intense but as architect, we need to study for maintenance and function.”
				R2: “Equipment for energy saving mechanism need to be particular for hospital’s needs.”
				R3: “Some equipment just uses a lot of energy. The ones that can be replaced should be but those that haven’t had a more energy saving model, it needed to be used to cure patients.”
Company / Staff	Behavioural issues		Bakaimis (2017)	R1: “Behavioural issues very sensitive to patients or guests. Basically everyone needs to be educated to avoid incident happen.”
				R2: “Behavioural issues also important for designers how to overcome if any incident happen.”
				R3: “Behavioural issues are one of the challenges that is needed to be faced by designers.”

In Part D interview questions, respondents said the third purpose is to determine the method for implementing energy savings in hospital facilities. Each respondent expressed their perspective on the aforesaid method and their former strategies.

Table 10: Literature Review Relationship (Objective 3) With Respondents

Category	Literature study	Findings
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Design	Incorporate the usage of solar panel in the design	Teke (2014)	<p>R1: “I think internal and external devices one of main thing how to control solar heat gain and airflow cooling system.”</p> <p>R2: “Of course designers need to provide internal or external shading for consumers.”</p> <p>R3: “Solar heat gain can be controlled by providing internal or external shading devices to ensure the comfort of building’s occupants.”</p>
Installation	Install additional thermal insulation where needed to reduce heat gain and loss.	Shen (2019)	<p>R1: “A thermal insulation in Malaysia is something that is not that important as the occurrence of extreme hot or cold weathers are very rare. But some newer hospitals do have it.”</p> <p>R2: “Designers must know which area can reduce heat gain and loss. They can apply thermal insulation usage in their design buildings.”</p> <p>R3: “Even though not many designers use the implementation of additional thermal insulation to reduce heat gain and loss, most designer does incorporate it in their newer designs.</p>
Awareness	Educate people of the importance of energy Savings.	Ludin <i>et al.</i> (2019)	<p>R1: “Educate people is very important. To aware people how important energy savings is.”</p> <p>R2: “Government should be aware about this and educate youngsters how important energy savings is.”</p> <p>R3: “It should be a natural</p>

instinct for people to want to conserve energy. It benefits them a lot and logical people will realise it. People should be educated about this matter from a young age.”

5. Conclusion

As a conclusion, researcher can conclude that the implementation of energy savings in hospital buildings was not enough to affect the whole industry itself because of the implementation is only being done by the few hospitals. In this research, researcher will find a way and solution to make the implementation of energy savings in hospital buildings to be more recognized and known by many individuals.

This part presents study outcomes. Previous part's analysis shaped the conclusions. Several portions of the study have been concluded, including the designer's perspective on energy savings in hospital buildings. This research accomplished the stated objectives.

5.1 Research Objective 1: To investigate the existing implementation of energy savings in Hospitals

The first goal of this research is to examine hospital energy savings. The responders liked the researcher's work. A lot of hospitals where respondents worked have implemented energy savings. Most of their renovations saved energy. According to Koulamas *et al.* (2018), the engineering and scientific community acknowledges the value of energy efficiency in the building sector.

Belussi *et al.* (2019) say enhancing building energy efficiency is key to energy strategy. Reduce energy use to limit building effect. This goal is reached by minimising construction materials and components and using renewable energy. Zero-energy building (ZEB) is the consequence.

Zero-energy buildings boost energy efficiency, minimise energy demand, and use renewable energy to meet their energy needs, per Liu (2019). Using energy conservation technologies, zero-energy buildings use less energy. Passive building methods including solar heating, natural ventilation, and phase change energy storage boost building energy efficiency. Effective HVAC equipment. These solutions reduce building energy use by increasing system efficiency or reusing waste heat.

5.2 Research Objective 2: To investigate the challenges among designers to implement energy savings in Hospitals

This research also examines the problems designers face when implementing energy-saving measures in hospitals. Even though there were just three responders, the data helped the researcher discover designer issues. This section's survey questions were general, implementation, and company/staff.

Every challenge that a designer must overcome has a workable solution. The majority of respondents mention budget and behaviour as their biggest difficulties. Respondents claim designers don't confront resource and enforcement difficulties. The following is a review of the relevant literature, followed by interview data.

Bakaimis (2017) says a constrained budget prevented all activities from being implemented simultaneously or to their full potential. Maintaining quality health care services while thinking about finances is a difficulty when implementing energy savings in hospital buildings. The budgeting and

funding process must be fluid and effective. This review was supported by responses given by all three respondents.

5.3 Research Objective 3: To investigate the strategies to be made by designers to enhance the implementation of energy savings in Hospitals.

The final goal of this project is to investigate how designers might improve hospital energy efficiency. The researcher desired responder strategies. Everyone approaches problems differently. A fresh perspective will assist the researcher locate the greatest solutions. This section's survey questions covered design, installation, and awareness. According to the research, all respondents believe that building a bigger window, having a more efficient layout, adding solar-control film, and educating future generations are all very important. Ad hoc instructions and counselling on the effective use of electricity resources were provided, according to Ludin *et al.* (2019). Then, flyers were developed to remind personnel to operate the appliances effectively. Individuals and groups were given recommendations and help. Managers were given documents to help raise awareness among their workforce. Clinic personnel received extra attention, such as monthly checks. This review was supported by responses given by all three respondents.

Acknowledgement

The author would like to thank the Faculty of Technology and Business Management and all the respondents involved in this study.

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