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Space Standardisation and Flexibility on Healthcare Refurbishment

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ABSTRACT
One of the most common features and aims of a flexible solution is to help all stakeholders throughout the lifecycle of a healthcare facility, own or take (full or part) responsibility of reducing, mitigating or abating the redundancy impacts throughout a building's lifecycle with the integration of flexibility and standardisation into healthcare refurbishment, this can be achieved effectively with task partitioning. This paper has acknowledged that there are barriers to task partitioning. Flexibility and standardisation strategies have been implemented globally across different sectors and industries. Refurbishment is usually undertaken to improve the current state or functionality of a building in order to extend its valuable life span. Flexible designs are intended to provide future proof solutions. This requires providing the ability to adapt to unforeseen future changes at a specific place and time. Standardisation can and should be used to improve efficiency and reduce errors, it has been implemented in many manufacturing processes such as the automobile industry, but the question is how will it impact buildings especially existing healthcare spaces?

This paper is aimed at identifying the impact of space standardisation and flexibility on healthcare refurbishment, with the view to identifying best practice and prescribing possible processes for integrating and optimising space standardisation and flexibility during the refurbishment of healthcare facilities.

KEYWORDS
flexibility; space; refurbishment; standardisation; healthcare facility.

HEALTHCARE BUILDINGS AND REFURBISHMENT: INTRODUCTION

Refurbishment can include redevelopment, renovation, reorganisation, extension, expanding, contracting or modification to suit current or future functions. This paper discusses refurbishment in the context of spaces within healthcare facilities as they house critical activities and are usually subjected to constantly and rapidly changing needs, for example the introduction of new technologies and the challenges created by an ageing and growing population. It is important to appreciate that refurbishment is different from a larger scale maintenance. Refurbishment often involves providing an ability to support new activities whereas maintenance is more about maintaining the status quo. The Joint Commission Resources Inc. (2006) stated that air quality, infection control, utility requirement or interruptions, noise, vibration and emergency procedures needs to be included with any risk assessment associated with the construction or refurbishment of healthcare facilities.

PROBLEM IDENTIFICATION

There is increased recognition that new and refurbished hospitals need to be flexible and adaptable, however, there is a large number of old hospitals in the UK which fail to meet current guidelines and standards. The state of many of the older properties can make it extremely difficult for staff to perform their tasks efficiently and effectively, thus affecting the quality of treatment and patient recovery. The Department of Health (DoH) figures shows that:

- In total, 17% of the NHS estate being used is deemed to be "not up to scratch".
- 33 hospitals have at least half of their estate below standard.
- There are more than 100 other sites - mainly community hospitals and mental health units - that have 50% or more of their estate not up to scratch.
- Part of the problem is that a large chunk of the NHS estate - nearly a fifth - dates back to before the NHS started in 1948.
- NHS estates classed as not suitable, mostly had design functionality problems.
- There are unpleasant spaces with poor space layout design, (lack of toilet, storage and suitable office spaces). "Mark Masters, the hospital's director of estates and facilities, said it means staffs are left to do their best in these circumstances" (BBC, 2010).

Although such reports need to be treated with caution due to the language being used such as "not up to scratch". What does "below standard" really mean? Were there justifiable and contextual reasons for deviation from the standards? Many standards and guidance documents are written mainly to

support the design of new and refurbished facilities rather than as a tool to assess current facilities.

The need for healthcare refurbishment

The aim of refurbishment is to improve the current conditions of healthcare buildings. This can be based on the need to adapt to a rapidly changing environment, treatment, equipment, etc. With increasing concerns regarding the sustainability of existing facilities and facility whole life costs, researchers and healthcare planners are being encouraged to provide innovative means of improving these facilities. The refurbishment of healthcare buildings varies depending on the nature of the problem and the culture of responsible organisations such as NHS Trusts. Refurbishment is vital especially from a sustainability perspective; it frequently involves reconfiguring (recycling, modifying, extending, contracting and re-planning) existing spaces, meeting energy targets (carbon reduction), meeting users' needs to achieve desirable goals of healthcare facilities. Refurbishment can also be undertaken to save time and money, for example: higher fuel costs can mean that it is cheaper to refurbish a building (with double glazed windows and revolving doors) than to continue operating and maintaining it in its current state. Refurbishment is required to improve both internal and exterior elements and functions such as, indoor air quality and natural lighting. Sheth (2010a) has categorised the types of healthcare refurbishment into 3 drivers; user drivers, construction drivers and future drivers. This research has modified it as summarised in Table 1 to include space design, building structure, and facility management drivers.

Table 1: Categorisation of healthcare facility refurbishment key drivers.

Users	Space design	Building structure	Facility management	Future challenges
Infection control	Redundant spaces	Poor natural lighting	Operational cost	New treatment procedures
Improving patient privacy/dignity	Inadequate circulation	Ageing structure	Maintenance cost	New equipment
Improving quality to staff and patient	Lack of proper ventilation	Upgrading building facades	Energy consumption	Survey response
Increase in staff	Increasing communication between functional spaces	Damage to structures	Facility causing accidents	Demographic growth
User feedback	Creating natural distractions with green spaces	Structures with asbestos content	near miss (possible hazards in facility)	Competition
Introducing nursing stations closer to patients units	Improving distributed care, reduce walking	Upgrading windows (double glazing)	Change in leadership	Standardisation compliance
Patients using facility differently from how it is designed	Improving design to suit staff and elderly patients	Introducing more wash hand basins	Change in facility focus	Flexibility compliance

WHY FLEXIBILITY IN HEALTHCARE PROJECTS?

Flexibility is an alternative option, it supports buildings adapt to changes in healthcare, such as growing and ageing population, technological innovation in medical treatment and equipment. A building is able to perform effectively over the years, if it adapt to changes mentioned above. Experts' views on flexibility are listed below.

> Ruwanpura et al, (2010) stated that "Hospitals are constantly under construction with ongoing renovation and expansion to accommodate new modalities, new protocol, and new technologies".
>
> Gupta et al, (2007) stated that flexibility should be the cornerstone of the design as flexibility allows the facility to grow and expand in case of up gradation and also changes in internal functions.
>
> Improving quality, safety and flexibility of healthcare facilities are one of the 5 Evidence Based Design (EBD) principles defined by Eileen Malone, 2007 (McCullough, 2009).

Miller, (2006) quotes Mortland stating that clinical laboratories are changing frequently; that most labs accommodate new equipment or technology frequently.

Pressler, (2006) states that a good hospital design should have an adequate amount of flexible.

McCullough, (2009) noted that future flexibility is important and essential for long term viability of healthcare institutions.

Pati and Harvey, (2010) stated that healthcare facilities more than occasionally need to be adjustable to adapt changes in operation, equipment and management.

Sheth et al, (2010) suggested that storage space, flexibility and adaptability help to make healthcare facility future proof. This could help save cost and improve quality.

Lam, (2008) was of the view that healthcare facilities have life span of 30-60 years, without design flexibility, they could be functional superseded. Flexibility has a place in healthcare centres as an influencing factor that allow

hospitals to function properly over years, flexibility can be a functional declining inhibitor, that helps centres achieve their whole life cycle targets without compromising its efficiency.

LITERATURE REVIEW

Space flexibility and (changes and growth)

Lam, (2008) stated that flexibility is required due to changes or growth, which is inevitable, as hospitals are designed for a span 30-60 years and have a residual value at the end of their design life that makes refurbishment a viable and sustainable option. Also at some point in a building's life, standards and functions will change. Lam, (2008) listed flexibility drivers, this research categorised them into changes and advancement, and presented in Table 2.

Table 2: Flexibility drivers in healthcare.

Flexibility drivers	
Changes	Advancements
High density	Provision of better building performance
Special cases (epidemics)	Obsolescence and decline
Social and political issues	Advancement in medicine/equipment
Change in statutory requirements	Structural appearance

Over the years many healthcare facilities are becoming obsolescent while the life span has not reached its peak level. Due to variable demographics, cost and availability of technological hospital demands, operational and functional load requiring attention over the life span of facility, repudiating these factors in a given healthcare facility tends to reduce its life span, increase operational cost, causing early reconstruction, redevelopment and refurbishment. Adams, (2008:121) imagined that a flexible hospital could be designed today but used for an alternate operational and functional use in the future. Space for growth is one of the factors that initiates flexibility to take place in the future, Both growth and flexibility require space, but growth is considered as one of the major drivers for flexibility, it requires more space, while flexibility requires space to be organised and designed to adapt to different activities without compromising productivity or alternative to expand.

Space flexibility and forecast for uncertainties

To deal with uncertainty, the major problem is how do we forecast how healthcare facilities will operate and function in the next 10 years, 20 years or 30 years? And at what point in time will change or growth be necessary and to what extent? Another difficulty is for the healthcare facility to serve its exact purpose when the building is supposed to change in use or adapt to some specific changes. Predicting spaces that do not need to be used immediately but will be needed in the near future is another problem. When making flexible design decisions stakeholders involved should participate to achieve optimal results, as exact forecasts cannot be achieved. It is difficult to predict the future, but from past reference a clear projection can be drawn, at times healthcare facilities might need to be downsizing by offering these spaces to third parties for sub-letting. Neufville et al, (2008) reported that "it is impossible to predict future patient activity with a reasonable degree of accuracy". but Lam, (2008:43) suggested that the size of a big hospital depends on the number of beds, he also stated that in Hong Kong there is a standard of 5-6 beds per 1000 people population in a given area, this shows that the larger the population the higher number of bed required, with an estimated projection in population growth, an approximate amount of hospital beds in the near future can be specified.

Space standardisation and patient care

Designs attributed to Patient health and safety consider factors such as quality of working environment, healing environments (quality air flow, natural and artificial distractions, closeness to green environments, closeness of visitors) privacy, infection free healthcare environment. McCullough, (2009) noted that according to Eileen Malone, (2007) research was used to create healing environment using 5 Evidence Based Design (EBD) principles which included "design for maximum standardisation, future flexibility and growth". Apart from providing quality spaces that will give desirable comfort to patients, staff performance has an impact on patient care. Standardisation can help improve healthcare space to adapt to patient needs, by providing standardised procedures and guides. Standardisation can also reduce patient incidents such as falling down in the bath room, by providing handrails. A standardised space is designed so that patient can use healthcare facility with ease, it should take patient`s need and safety into consideration to improve patient care.

Space standardisation and staff performance

According to Reiling, (2007) Standardisation routine is important; it improve safety of both staff and patient. standardisation reduce the possibility of errors occurring during healthcare delivery, he also described the human brain to create patterns, which works subconsciously, standardisation helps these patterns work perfectly over time. Non standardisation leads to thinking consciously which "can lead to fatigue and human error in routine functions" also standardisation does not allow the ease to focus on imaginative problem solving. Standardisation routine or process can easily be analysed and evaluated for enhancement, hence simplification and standardisation helps ease human error. When human error is reduced in healthcare delivery, performance has been achieved. Joint Commission Resources, (2004a) states that "in the manufacturing industry, companies reduces error

rates and increase productivity by standardising and simplifying" and also that "standardisation allows for the automation and predictability of many tasks so that they are unaffected by fatigue and interruptions, enabling staff to focus on clinical issues. Standardisation can help staff adapt to healthcare delivery by providing work flow delivery processes.

Impact of growth, uncertainties, patient care and staff performance on healthcare refurbishment

Literature shows that space flexibility can facilitate healthcare facility in adapting to growth and uncertainties, while space standardisation encourage and guides the ability to achieve patient care and staff performance. All these factors listed above make up the key drivers for refurbishment. Table 3 shows the relationship between space functions stated above and healthcare refurbishment. To achieve benefits of space standardisation and space flexibility they have to be implemented first. Swayne et al, (2006:413) stated that to carry out standardisation or flexibility it is vital to take into consideration the following.

- Financial resources available
- Skills
- Policies
- Human resources
- Management talent
- Facility and equipment
- Required information

Table.3: relationship between impacts of space functions and healthcare refurbishment drivers.

Space functions	Impact	Category of refurbishment driver
Space flexibility	Growth	Future challenges
Space flexibility	Uncertainties	Future challenges
Space standardisation	Staff performance	Users
Space standardisation	Patient care	Users

RESEARCH METHODOLOGY

Literature searched involved the use of both online and offline publications to gather information on flexibility and standardisation in healthcare facilities. More than 25 papers relating to space, flexibility, standardisation and healthcare were reviewed and analysed. Keywords such as healthcare staff, patient, flexible spaces, refurbishment, standardisation in healthcare were used to find relevant publication. Literature review helped in identifying healthcare drivers for space flexibility, space standardisation and refurbishment that was used to develop a framework relating all the three functions together, categorising them into three different phases, this can be found in figure 3 below.

Primary data collection

Questionnaire was distributed to a group of professionals that included architects, healthcare planners and project managers. Respondents came from different parts of the world comprising UK, Europe, North America, Africa, the Far East and the Middle East, Figures 1 and 2 shows demographics of the questionnaire respondents. Respondents were asked to indicate whether they agree or not with certain issues regarding space standardisation and space flexibility. Ranging from "strongly agreed", "agreed", "not sure", "disagree" and "strongly disagree", these were rated from 1-5 (strongly disagree-strongly agree) respectively. Questions were distributed via e-mail

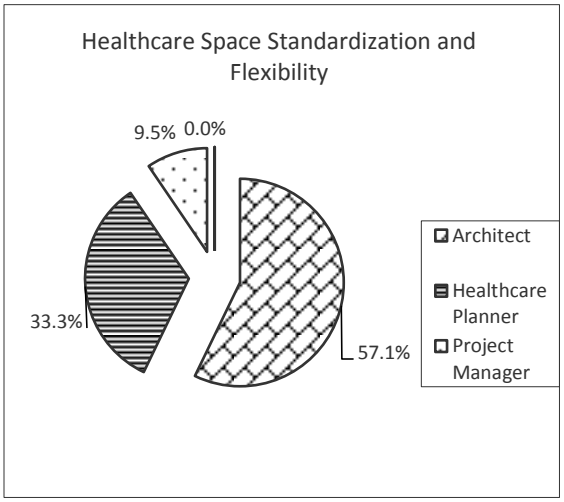


Figure.1: Professionals involved in questionnaire survey.

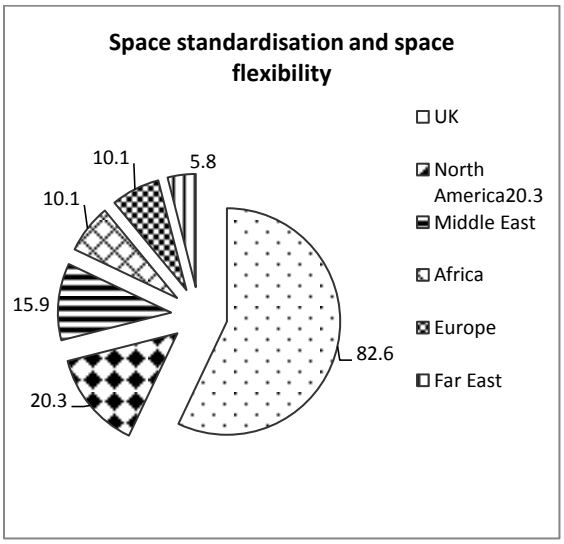


Figure 2: Location of professionals involved in questionnaire survey.

DISCUSSION ON FINDINGS

Due to the importance of both space flexibility and space standardisation on healthcare staff and patient, it is crucial they are applied during refurbishments. Sheth, (2010) categorised refurbishment into 4 levels which includes; 1) "Do nothing", 2) Interior works, 3) Exterior works, 4) Demolish. Flexibility and standardisation can take place at different phases of

refurbishment, which includes minor, average and major refurbishment, putting limitation of refurbishment into consideration, such as budgets, constraints of existing structures and functions, certain flexibility concept can be applied at specific time and places to achieve specific type of flexibilities. Figure.3 proposes a possible relationship between refurbishment and both space functions identified in this research. Effective implementation of this strategic innovation can be facilitated by the concept of task partitioning. Von Hippel (1990) stated that "An innovation project of any magnitude is divided up ("partitioned") into a number of tasks and subtasks that may then be distributed among a number of individuals, and perhaps among a number of firms". He also stated that most problems can be resolved by decomposing them to tasks and reducing the cost involved with cross boundary problem solving. Tasks for both space functions at different refurbishment phases can be assigned to different individuals or firms. Task partitioning simplifies the whole process of integration in this paper by dividing and breaking down goals into targets that are easily achievable.

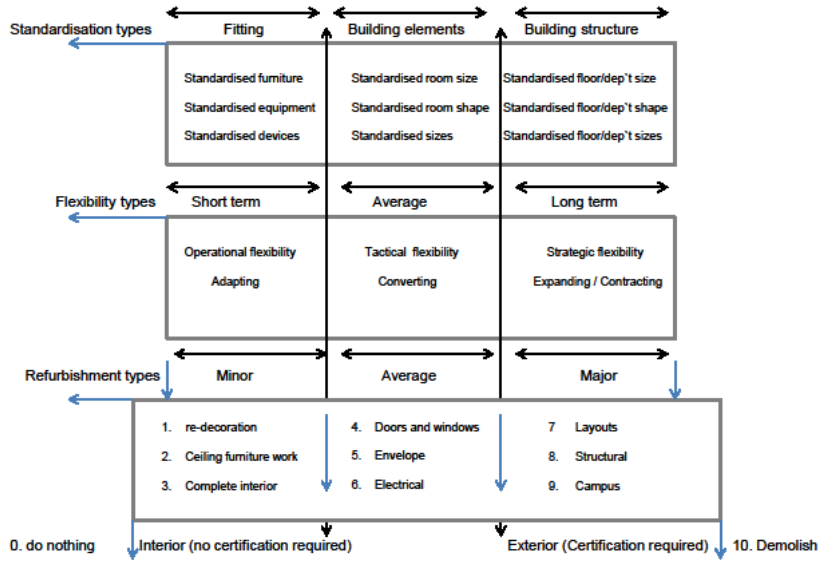


Figure 3: Proposed relationship between refurbishment and both space functions.

During the standardisation process, existing structures does affects the design brief, for instance a brief with a 100 percent single room target, might achieve 75 percent or 50 percent, this varies depending on the context, nature of existing structures and laid down standards involved in the type, location and need of projects, hence standards may vary, depending on their respective nature. Diversity in flexibility is expensive a time, as the more the space, the more the cost associated to flexible spaces. An innovative trend is to use spaces that expand and contracts back to their original size and shape after providing required services. Another major issue is how much flexibility is needed in a healthcare facility?

FINDINGS

Points to consider for space standardisation, space flexibility and refurbishment in healthcare facilities

It is vital to consider user participation in developing space standards for patient, visitors and other healthcare users. Facility users such as patients tend to use a facility different from how it is been designed to functions, there is a patient motive to always use a facility in a way they find ease and simplicity. Hence space standardisations should be simple, precise, concise and user friendly. Most respondents identified that clinical areas are more suited for space standardisation, it is still unclear if healthcare designers and planners can consider standardisation in an entire building, due to its rigidity, and the nature of existing structures.

The questionnaire used in this research showed Design brief to be the most important tool for achieving space flexibility, as other tools such as Health Building Notes, Activity DataBase gives information to choose from, while a Design Brief tells you exactly what is needed, but on the other hand it does not tell you how to achieve the brief aims, which is a major problem of depending entirely on the design brief. Questionnaire respondents also suggested healthcare designers to consider furniture flexibility and equipment flexibility while dealing with space flexibility, as space could change by converting, expanding, contract or adapting to changes when flexible process are taken place, this could affect furniture and equipment positioning and ease of use. Flexibility is considered to be expensive

due to failure to link first building cost with building lifecycle cost in the initial stage of building design, construction and facility management phase.

During refurbishment, lack of flexibility affects the building process, while hospitals are still operational, it has been noticed by the questionnaire respondent that there is always lack of alternatives spaces to move entire patient and staff while current used spaces are under construction, refurbishment in this scenario can affects healthcare delivery processes.

QUESTIONNAIRE FINDINGS AND DECISION MAKING DURING REFURBISHMENT

The questionnaire findings can improve decision making during refurbishment, by specifying where best space standardisation and flexibility are more effective and efficient, Figure 3 shows relationship between types of (refurbishment and space functions used in this research), Figure 3 can also be used as a map, to decide where and when to introduce space standardisation and space flexibility best. These findings should be considered when refurbishment is taken place, as stated before, for a successful refurbishment, a facility has to be developed, improved, re-planned to solve major problems relating to sustainability, such as energy consumption, reducing facility management cost, improve users' needs, accommodating advancements in healthcare delivery and also natural ventilation and lighting.

Findings show that it is feasible to implement flexibility in the long term. Flexibility is linked with major refurbishments in Figure.1. Flexibility, in the opinion of the respondents should be introduced at long term basis in regards to room / ward / department / building / site levels, their responses showed that in three different cases, flexibility should be applied at long term basis. This gives an opportunity to in-cooperate it into building refurbishment. When making refurbishment decisions, it is effective to plan for long term flexibility during major refurbishments. Questionnaire results from three different questions was put together to compare and analyse the best time for flexibility impact in healthcare buildings, as this will help in decision making during refurbishments. Respondents were asked to indicate whether they agree or not that it is easy to implement cost effective space flexibility at three different places, identified as A-(building /site level), B-(specific area/room level) and C-(ward/department level) in healthcare design. At A, out of 70 respondents 48 answered and 22 skipped, at B, out of 70 respondents, 48 answered and 22 skipped. At C, out of 70 respondents, 48 answered and 22 skipped. Figure 4 shows the findings from A, B and C.

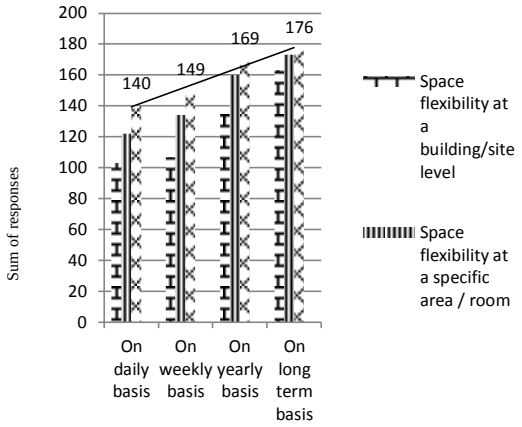


Figure 4: Questionnaire responses: Impact of space flexibility at three different places.

It is important to introduce space standardisation into refurbishment as staff efficiency and patient safety are one of the main key drivers initiating standardisation in healthcare. This was described and presented in Figure 5 below. Questionnaire respondents were asked to indicate whether they agree or not that the following are key drivers to achieving space standardisation. Out of 70 respondents, 56 answered this questions and 14 skipped. Space standardisation had a good impact on patient safety and staff efficiency according to the opinion of the respondents

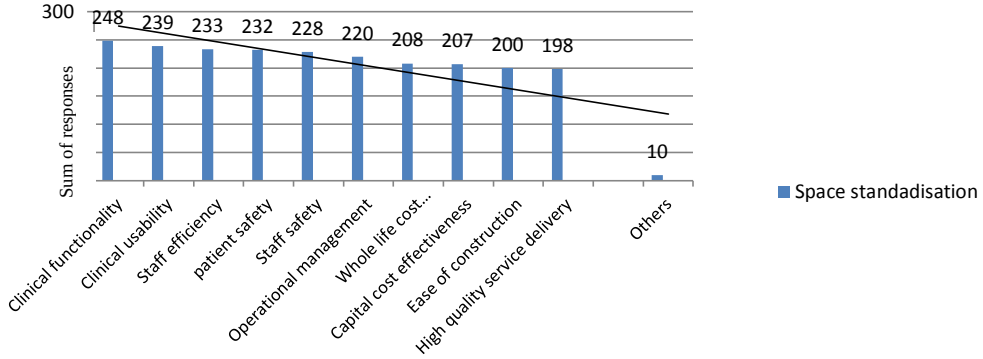


Figure.5: Questionnaire responses: Key drivers for space standardisation.

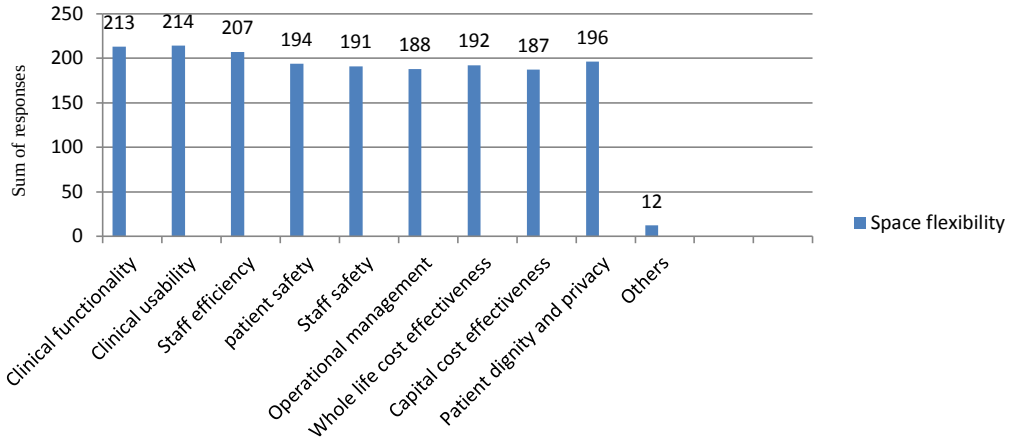


Figure 6: Questionnaire response: Key drivers for space flexibility.

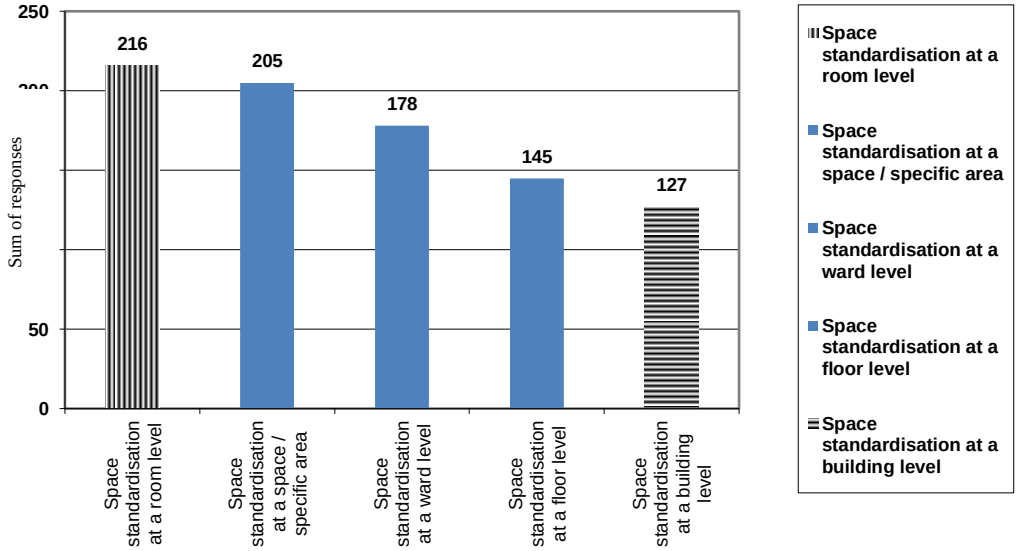


Figure 7: Questionnaire response: Best standard space/unit in healthcare buildings.

Figure 5 and Figure 6 shows key drivers for both space flexibility and space standardisation in healthcare facilities. Respondents were asked to please indicate whether they agree or not that the following are key drivers to achieving space flexibility? Out of 70 respondents 49 answered and 21 skipped. Clinical functionality and usability with staff efficiency were essentials in the design of healthcare spaces in the opinion of the respondents.

Figure 7 shows questionnaire response. Respondents were asked to choose the best type of standardised function. Out of 70 respondents 57 answered and 13 skipped. It was identified by the respondents that standardisation is easier to implement at room level. When refurbishment is taking place, rooms can be standardised to achieve optimum healthcare outcomes. Joint Commission Resources (2004) Environment of Care, (2004) stated that "standardisation of treatment areas, room layout, and medical equipment supplies provide flexibility to accommodate changing patient care needs"

CONCLUSION

Table 3 and 6 shows the relationship between refurbishment and (space standardisation and space flexibility) having similar key drivers, if both space functions are achieved, quality of refurbishment will be enhanced. Refurbishment as already stated is carried out to improve current situation of a building structure, accommodating changes and advancement in technology and method of healthcare treatment and delivery. Introducing questionnaire findings into healthcare refurbishment can help to achieve optimum results worthwhile. Questionnaire key findings were; 1) With regards to space standardisation, standardised rooms were noted to

Table4: Relationship between key drivers for refurbishment and ones for (space flexibility and space standardisation).

Refurbishment drivers category	Space flexibility drivers	Space standardisation drivers
Users	Staff safety Patient safety	Staff safety Patient safety
Space design	Patient dignity and privacy	-
Building structure	Whole life cost effectiveness	Whole life cost effectiveness Ease of construction
Facility management	Clinical usability Clinical functionality Operational management Capital cost effectiveness	Clinical usability Clinical functionality Operational management Capital cost effectiveness
Future challenges	Consistency of: Staff efficiency	High quality service delivery Staff efficiency

be the most effective standardised unit in a healthcare facility in the opinion of the questionnaire respondents, in Figure 3, standardisation can be better achieved in healthcare refurbishment, if "standardised rooms" are used at the level (average) of refurbishment, which focuses on building elements such as doors and windows, with the ability to allow conversions to take place. 2) With regards to space flexibility, applying flexibility at long term was suggested to be the most effective opportunity to achieve it in healthcare space / rooms / ward / department or any other specific unit in the opinion of questionnaire respondents, in Figure 3, flexibility can be better achieved in healthcare refurbishment, if "long term flexibility" is applied at the level (major) of refurbishment, were structural expansion and contraction is involved.

The implementation of space standardisation and space flexibility in healthcare refurbishment can be simplified by tasks partitioning, stakeholders involved in the design, construction, and facility management of healthcare facility should collaborate and divide this goal into simpler and achievable targets to facilitate integration. This research has identified a gap that further research can improve on.

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