

The role and importance of standards in cost optimization and increased productivity and quality in constructing health centers

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Abstract. Standardization of building process in medical sectors has provided the ground for specialization levels, ensuring the future buildings will have better quality. The life span of Health Centers in Iran is only one quarter of same building in other countries, which leads to extra cost for both structure and non-structure (hospital facilities & equipment) and So far, there are no approved regulations to make health care spaces. The aims of this research are reducing the cost of building, facilities and equipment and increasing productivity implies the provision of standard spaces in which the facilities are optimized by proposing Quality management model. This research has discussed the deficiency of building regulations in healthcare sector. The interviews accomplished for collecting data about defects in construction of health center and hospital. The primarily result shows that the budget estimates are not correct, design is done poorly, and studies are not accurate, so long construction time can cause a depreciation of structures. Due to the increasing need of society for healthcare spaces and their high level of construction, standard regulations should be regarded in cost optimization and increasing productivity and quality in order to maintain national assets for future generations. Finally, based on requirement a model is suggested for improving current practice definition and revision of existing laws for medical spaces. The model has been divided into ten categories namely: planning, organize, communicate, substructure, education, leading the process, control, predict variation, accessory measures and finally documentation.

1. Introduction

According to Kheni et al. [1] the construction industry plays a significant role in the economy of developing countries. It is no wonder the improvement in health and safety standards within the organizational context is an important global concern [2]. One of the most important groups of buildings is healthcare facilities, which compose a large part of national assets. These buildings must be designed and constructed in such manner so that they are able to meet special requirements against natural catastrophes, such as earthquake, during which they should also be able to maintain their stability and perform properly. Quality has become one of the essential elements in recent years due to conceptual changes (the process whereby concepts and relationships between them change over the course of an individual person's lifetime or over the course of history) in the construction industry [3]. construction safety improvement and applying regulation has proven to be a difficult task for many years [4]. Planners always pay attention to the quality of each of the above factors, and quantitative



issues have been primarily emphasized. Although many factors are involved in the chain, they are discussed and criticized in their own place.

The experience of developed countries shows that those plans are successful as quantity, technology and quality proceed concomitantly and in the long-term, economic plans develop in parallel to the environmental [5, 6], cultural and social attitudes [7]. Regulate the construction of healthcare spaces, applied research is required so that its findings emerge in terms of indigenous technical regulations. In this way, we should also be aware of the experiences of other countries. If building plans of these spaces are developed based on the technical criteria, we will achieve sustainable development in this area. Only in this situation will these spaces have high quality, and developmental plans should be followed by its quality assurance [8]. However, the costs of maintaining non-standard spaces and buildings are relatively high.

From the literature, the subject of building management has received considerable attention. However, with regards to the specific issue of the factors that influence public building management projects, there is a noticeable shortage of articles. Lee et al. [9] claimed that the main objective of a maintenance management organization is to ensure an acceptable standard and level of service is provided continuously, and at minimum cost. According to Narayan [10], failure or delay when executing maintenance actions can cause further excess damage, wear and defects. Thus, additional maintenance works must be performed in order to treat problems. Lack of documentation regarding maintenance work also leads to problems and higher maintenance costs in the long term [11]. Based on Lam et al. [11] facilities for work and in order to execute maintenance tasks efficiently, a proper maintenance plan and monitoring system is essential [11].

In operation period, due to the lack of building maintenance standards, only 25 years will be used instead of 100, resulting in a reduction of 75 years, which is a great loss for national interests. Short-lived buildings create huge waste, thus, to eliminate this waste, this study accomplished survey and proposed regulation toward extending building life expectancy. Unlike many researches that assess the time overruns or cost overruns of project [12], this research focused on the short life span of building and supports quality management model to optimize the cost during the maintenance of building. Schellenberg [13] assessed the effectiveness of facility-based Integrated Management of Childhood Illness (IMCI). The result shows that Costs of children's health care with IMCI were similar to or lower than those for case-management without IMCI. Li et al, [14] studied about poor ventilation system and layout traps disease. Although, none of above research applying or proposing any regulation regarding the hospital building construction. It can be compared that construction cost of hospitals was approximately 7% investment of private sector in housing, 70% government marginal consumption in housing and urban facilities and 24% marginal consumption in Healthcare sector in 2010 in Iran. The above figures indicate the need for attention to the issue of standardization in healthcare spaces. Obviously, the construction standards should be expected to achieve the following: to reduce waste, to improve quality, to deliver benefits along with higher durability and safety.

2. Risk Management of Health Facilities as National Capital

The current situation shows that of 130 hospitals in Tehran, 50% are over 30 years old and out of date. In most of them, technical criteria have not been regarded and these buildings are vulnerable to earthquakes. What we confront the risk of available buildings results from disregarding the available and normal standards that hospitals are included. Since the quality of constructing hospitals and clinics in other urban and rural areas is even lower than that in Tehran, seismic resistance of healthcare centers can be optimistically generalized to the entire country and can be found to their high vulnerability. In other words, the high level of investment in construction of healthcare spaces entails that development plans need to be formulated in such manner that they are subjected to minimum damage. Meanwhile, ratio of non-structural element cost to total building cost is more than that of other uses. For example, in residential and healthcare building, non-structural elements are 60% of total cost while in hospitals their cost is 85% - 90% of the total cost [15]. This indicates the importance of element maintenance. In the seismic rehabilitation of hospitals, non-structural elements must be protected so that they can function with no structural damage to their service. Experience shows that even secondary effects resulting from damage to non-structural elements can make conditions more

critical. Risk factors affecting these assets include the gradual depreciation of buildings, destruction by natural disaster, new special requirements, and low-level knowledge of construction managers [16]. In order to reduce hazards from the first and second factors, buildings are required to be constructed according to the technical standards and attention must be paid to maintenance especially during service time.

3. Research Method

This research has discussed the deficiency of building regulations in healthcare sector - one of the most important groups of buildings in each country - and offered an appropriate model for quality management and construction legalization role through information obtained from technical department of medical science university with respect to hospital quality. The research process has included visiting about seven constructed and hospitals under construction in particular regions of the country, how to implement and monitor them, examine existing maps and how to maintain them, as well as exploring the experiences of developed countries in the world through scientific resources collected as guidelines and regulations and findings of experienced scientists and researchers. Second step will be collecting data about defects in construction of health center and hospital. The final step is to ensure the subsequent collection of appropriate knowledge and information from the empirical interviews (Table 1) and focus group achieved. The interview accomplished by 24 of most involving people on hospital building as both engineering and staff who incorporate by facility and activity in that issues

4. Result and Discussion

4.1. Current Situation

Based on observation of current research, two trends should be considered in managing of medical buildings department in terms of their effect upon the destruction trend of these buildings. First, the use of more durable materials of the buildings generates considerable strength and naturally they also prolong the useful life. Second, growing urbanization implies the need for more health care spaces that they need to be regarded appropriate regulations while reducing their risk. This means medical buildings can approach their counterparts in developed countries to a greater extent, thereby leading to greater satisfaction of expectations.

Table 1. Information of Interviewees

Interviewees	Designation of respondents	Experience in current position	Educational level
1	Project manager	> 15 years	Master's degree
2	Associate Professor	10~12years	Master's degree
3	Safety engineer	> 15 years	Master's degree
4	Associate Professor	> 15 years	Master's degree
5	Financial manager	6-10 years	Master's degree
7	Consultant engineering	> 15 years	Master's degree
6	Managing director	> 15 years	PhD's degree
7	Operating room personnel	6-10 years	Master's degree
8	Hospital staff	10~12years	Doctoral degree

However, in the construction industry and health care spaces, a wide range of occupations are involved with different levels of knowledge and skills. Conventional design and construction of hospitals in the world include eight stages as follows: financing and funding, planning and studies, design, construction, operation and maintenance, restoration and reuse or destruction while in some countries such as Iran this process is reduced to only six.

4.2. Reviewing Existing Laws and Legalization Background of the Building Sector

So far, there are no approved regulations to make health care spaces, but other rules of construction can assist to a large extent in this way. Available technical regulations for conventional construction are communicated through a set of articles approved by high council of urbanism and architecture as well as institute of standard and industrial research, management and planning organization (for public construction in terms of civil projects) and national building regulations. Examining national standards for the construction industry, which are approximately 500 cases, shows that they cannot cover quality of construction products sufficiently. This is despite the fact that about half of them pertain to early in the 21st century. In some cases, experience has shown that suggested features are not suitable for accepting quality of construction materials. Although references to develop the standards are of internationally valid standards, they are not entirely compatible with country's situation [16].

A set of building regulations communicated and enforced by management and planning organization for developmental plans can improve to some extent the quality of public construction as compared to private one. This includes public construction and has been neglected due to the economic considerations in conventional construction processes, though in both cases, construction stockholders may be the same (construction and private projects). Application experience of the provisions of the National Building Regulations (20-fold) is evolving in conventional constructions by the approval of law engineering and building control in 1995. This set of regulations generates requirements in the construction industry from the technical and legal point of view. It is natural that their proper use can improve the quality of construction developments in the country. The important point is that the scientific support of the provisions of regulations, practices and standards are based on the technology, expertise, facilities and conditions in the country. One of the main problems is the lack of these standards such that their formulation must be seriously placed in short-term agenda [18].

These principles include as follows in different aspects: relationship between employer and developer, relation among designer, developer and supervisor, understanding and proper application of available materials in the area, calculation of building structure, and optimal use of natural factors such as wind, sun and so forth in building design [17]. But in recent decade, engineering occupation has been transformed in all different fields resulting in inconsistency in different engineering departments. However, engineers and experts do have up-to-date knowledge in their occupation.

5. The Practical Model for The Development of Regulations

The purpose of project quality management is to achieve the conditions of products or services that meet or exceed the customer's requirements and expectations. Additionally, quality management (QM) offers opportunities for improvement in operations and maintenance.

For most important cases, a model is suggested entitled "Construction Quality Management for medical spaces" in Table 2, which includes 10 items. The model has been suggested for more coordination, proper communication definition and revision of existing laws. It would be useful to ensure proper construction by regarding "building codes" and "construction quality control". The main purpose of these building codes is to protect public health, safety and general welfare as they relate to the construction and occupancy of buildings and structures. In Table 2 is shown the gap that currently needs to be filled by construction industry on health center.

Table 2. Quality management model and regulation of the construction of Healthcare spaces

	Method	Descriptions
1	Planning	Ministry of health and medical education is responsible for healthcare construction and its legalization. The ministry offers plans based on the previous experience and future needs. This plan includes criteria for the following cases: <ol style="list-style-type: none"> 1. Meeting people's growing requirements considering population growth 2. Long-term policy for providing suitable spaces 3. Prioritization short and long term research based on past experiences in all fields and formulate new regulations in terms of approved plans. 4. To establish basis for legalization of the formulated regulations
2	Organize	Executive and regulatory agencies should be organized and their laws reviewed so that criteria deviation cannot be inconceivable and this itself needs article 4's substructure.
3	Communicate	The above operations should be criticized by experts and committees should complete them.
4	Substructure	To realize the above operation, necessary substructure is provided in collaboration with the Ministry of Housing and Urban Planning and coordination must be made with the management and planning organization
5	healthcare	The operation should be taught in healthcare departments
6	Leading the process	A committee in the Ministry of Health should be responsible for leading the process and running the plans
7	Control	A committee in public and general facilities should be responsible for operation's inspection
8	Predict variation	In expected time intervals, probable variation should be determined, processed by organizations in article 1 and put into circle.
9	Accessory measures	Private sector can assist in each possible stage and if necessary can provide its assets
10	Documentation	Each sector, whether private or public, might document its measures in order to recognize the limitations and a practical decision must be made for improving operations.

6. Conclusions

So far, numerous efforts have been made in preparation of models and standards corresponding to the healthcare centers which are inconsistently offered by administrative systems while standard is discussed in the case of device and equipment in another level. The current research has been trying to represent a model and standards corresponding to healthcare toward increasing the life span of building, which consequently leads to decreasing the building maintenance cost. The role of standardization in reducing the cost of building, facilities and equipment and increasing productivity implies the provision of standard spaces in which the facilities are optimized. In this case, the following issues seem necessary: matching available physical situation of healthcare centers to medical plans in terms of capacities and physical planning, examining vulnerability and resistance of building based on valid building codes, formulation of coordinated regulations in these spaces based on building codes in other countries and matching it available conditions, resources, traditions and national culture and applying modern technology.

In this case, the following results can be obtained: reducing the cost of building, facilities and equipment, increasing productivity in education and treatment quality, determining strategies that make possible the system's future behaviors through its present situation without fundamental changes over time, reducing depreciation and maintenance costs over time, providing space management in the

health sector. Therefore, quality management model and regulating the construction of healthcare spaces has been proposed to obtain the above objectives.

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