

Recreational, Fitness and Health Center: Facility Layout Design Case Study

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Abstract— Systems Engineers focus on a systematic development process for any project of interest, aiming to proceed from a concept to a final successful product. They consider business operation, management, and engineering technicality. Our team was giving a chance to develop and improve a real-life system, starting from the design stage by implementing regulation, improvements, and integrating new technologies. Our focus was on designing a new local Health Center that provides recreational, fitness, and health care services. Facility design and logistics are considered as something that can “make it or break it” for businesses because they affect the customer’s perception, attractiveness, comfort, and accessibility levels, which are essential business success factors. Any business type such as warehouse, customer service, or food distribution, apply different facility design techniques. Our team designed a facility layout, which meets the state, city, and American with Disabilities Act regulations, and provides the local community with a state-of-art health facility. A health club layout design considers multiple factors, such as type and number of equipment, facility location, available amenities, human factors, user safety, and use frequency. All these factors had been included to design the 50,000-ft² and 2-floors layout of the health center facility. The team presented 2D and 3D layout designs that comply with the imposed constraints and requirements while accommodating users’ needs and confront.

Keywords—facility layout; facility design; health care facility; human factors; 3D design; building design development.

I. INTRODUCTION

The main objective of being an engineer is to improve and change all the available systems, including businesses, to accommodate the new needs. Facility layout research was originated for manufacturing and production systems. Attempts to apply facility design techniques to health care facilities have been significantly limited to structural analysis and civil engineering areas. Facility layout models do not take into consideration the health care facilities. Health club design is important because of the significant impact on the quality and ability to provided service [1]. Gym layout design involves multiple concerns because it is a service-based business. Some of these concerns are related to customers’ satisfaction, such as travel distances and ease of movement, to access machines, traffic, privacy and noise control, natural light, access restrictions, and sufficient equipment space. Current approaches found in the facility layout literature are incapable of addressing these concerns.

The productivity of local communities is driven by available critical structures such as recreational and health care facilities. Health care and recreational center design require significant knowledge of the local population and their experiences and expectations of such a service provider.

Such a center allows humans to exercise, recharge, and relax in a comfortable and safe environment, which will increase the efficiency of their economically gainful activities. Recreation, leisure, sports, health, and fitness activities play an important role in communities, by improving the individuals’ health and welfare, empower individuals, and promote inclusive community development. A Health or recreation club facility's main goal is to provide people with an opportunity to be physically active while maintaining a safe and appropriate environment [2].

The world is constantly changing and that encourages a team of Systems Engineers to take upon a challenge to analyze a local health club and develop solutions to improve its performance. The health club management’s main concern was the facility design and layout, namely the arrangement of machines, storage areas, and/or work areas within the available physical structure. The team started tackling the health club’s business plan, floor plan, the targeted population, the local community needs, and financial concerns. Each station with its machines was broken down into based on its functionality and relation to the users' needs.

This paper will illustrate the development of health-club facility design. A health club should allow members to

interact with each other, exercise at different stations, provide different storage locations, and provide healthy supplements, personal trainers, and dietitians to help to achieve the members' goals. Recent research illustrated the importance of considering the spatial and structural concepts while designing a recreational facility, as it must satisfy the users [3].

Spatial planning is a fundamental aspect of a sustained health club. To encourage participation and enhanced facility performance, designers should focus on environmental, safety, health, and life quality improvement, local economic feasibility, and higher enforced standards [4].

Flynn proposed multiple ideas to improve facilities that serve an athletic program. Their first idea was to build the actual club to consist of indoor and outdoor stations as improvements on the current design. This layout includes two or three basketball courts, one Olympic sized pool, weight lifting designated area, various facilities that could include secondary sports such as archery and badminton. This idea provided details and information about each sport and its associated space need, which assisted in developing a flexible system. In addition, Flynn discussed the importance of temperature control and interior lighting for the whole building and subsections. They discussed different outside activities space needs, such as grass selection that best fit the players' optimal performance [5].

One of the other main concerns is easy accessibility to gyms in all areas. The Task Force on Community Preventive Services decreed easily accessible facilities when it came to physical activity. American adults need to exercise at least 30 minutes of physical activity a day to stay healthy, which can be achieved if gymnasiums are designed to be accessible. The authors mentioned the importance of short stairwells. Based on their survey, customers requested more equipment, knowledgeable staff, and more interactive gym by incorporating eye-catching designs and machine layout [6].

Perform Better corporation designed a gym of 3000-5000 square foot facility equipped with everything that the ideal gym should have. It included a swimming pool, weight room, cardio machines, outside fields for recreation, and other establishments for customers' convenience. They illustrate how the gym should be simple and customer-oriented because it saves money and brings customers what they need. They focused on the indoor facility design but not outdoor, as they left that to the owners of the facility to decide. They mentioned that design should be flexible and have some maneuverability to customize it to fit the customers [7-8].

McCarthy in his article discussed the main issues when trying to design a gym. He mentioned that a good balance of everything between the cardiovascular and strength-training equipment must exist for a successful health club. Many club owners do not grasp the importance of planning the facility layout and its essential role in their success. Customer safety and comfort were the top concerns in his facility design, he added enough space in between the stations to meet the demand and reduce the crowd. All owner's future remodeling includes adding equipment, however, certain quantities and percentage of the club machines should be taken into account, and for example, intermediate weights should be more to allow more customers or new members to practice. Besides, he mentioned that establishment lighting should be

taken into consideration to reduce any distraction to the users [9].

Various tips to assist in designing gym facilities had been included in the literature [10-16]. Different parts of a gym may make the biggest impact when expansion or remodeling is needed. Outdoor space differentiates the clubs based on the intended purpose of the facility. Convenient accommodations such as free Wi-Fi and various outlets will allow the customers to use their electronic devices, allowing them to stay longer and come more frequently. Constant communication between the customers and staff/owners will enhance the experience and success of the business. Flexible spaces design can transfer into other facilities, such as an unused racquetball court that can be converted to a free weight area or dance studio for group classes.

Another researcher focused on the involvement of disabled people in fitness centers. People with mobile and visual impairments are an important part of our local communities. They have similar needs to exercise. Therefore, gyms must compensate and adapt their facilities to be welcoming and more accessible to them. Gyms should give attention few major areas such as building, equipment, swimming pools, information and policies, and professional conduct. Researchers found that fitness centers are inadequate when it comes to accessibility for people with disabilities. These centers should develop an inviting environment allowing disable persons to participate with dignity and autonomy. Other papers suggested different layouts that meet the American with Disabilities Act (ADA), such as allowing extra space to move freely, prevent accidents, and facilitate the exercised. Most of the current health facilities that include gyms and other areas are lacking enough space to allow the customers to move with their disabilities [18-22].

The gym interior design must have to fit well with the human body and make it as comfortable as possible in all circumstances. The authors suggested that the health center should be geared towards providing an ecological advancement utilizing the interior design to provide the customers with both worlds of nature and mechanical experience. Therefore, people will use the facility to have their physical, psychological, and physiological sides taken care of. They highlighted the importance of paying attention to the light illuminated within the facility and the air quality such as CO₂ contents and temperature control [23-25].

Another research team discussed how gym areas affect the customer directly. They provided an example of a healing environment for people with a focus on providing healthcare and proper maintenance of facilities and sustaining high hygiene standards. The hygienic area's idea makes people feel more comfortable and allows them to go through various workout sessions. The authors stressed the importance of cleaning-up stations and their position at various locations throughout the pavilion [26].

Health centers used to be aesthetically pleasing and aimed to maintain customer safety in the facilities. The author analyzed the effect of including pleasing furniture and staff in the main lobby, to welcome and encourage customers to continue visiting the establishment. This is an important psychological aspect of the business, having professional staff would help and assist the customers will establish a

sense of comfortableness that is needed to sustain healthy customers. Placing and organizing proper space would help ease the customer's tension while they are trying to exercise. Another research team studied the service quality and customer satisfaction due to the facility layout designs; few different health club layouts were assessed. The results showed that having wide-open space attracted more customers and enhanced their interest in keeping the consistency of attending the health club. The comparison showed that customers are more comfortable working out in an area with enough space to move around [27]. Another team illustrated the layout importance to make both staff and customers conduct their jobs/tasks easier and improve the marketing of the business [28-29]. Facility layout plays a significant role in enhancing exercise success toward a healthy heart, including areas of stretching and cardio, and having a set weight area is crucial to the therapy development [30-31].

In the current competitive market, service or manufacturing businesses must provide cost-effective services or products, by reducing cost and increasing system effectiveness. Facility planning can considerably reduce business operational costs and improve service quality. The Facility Layout relates to the location of different items and components that are essential for the business such as departments, stations, machines, working and rest areas, etc., within a confined structure and the customer and material flow between these objects [32].

II. MATERIAL AND METHOD

The proposed local health center consists of 50,000 square feet, contained in a two-floor structure, the facility will be handicapped accessible and meet all local community needs. Factors such as capacity, type of machinery and facilities needed, and business plan were discussed with the owners and construction team. Our team started the development process by selecting the needed exercise areas and the associated space while assuring that enough space around machines/equipment would exist for comfort and safe access. A variety of stations will be implemented in the design to provide customers with multiple options and movable stations, which will reduce congestions. In addition, a swimming pool will be included as health improvement, rehabilitation, and relaxation section.

The lobby area will be designed to enhance customers' experience, while flexible classrooms will be integrated to allow a wide spectrum of training or private exercising sessions. The team utilized AutoDesk AutoCAD® software to design the entire facility. The design was developed to meet customer satisfaction while following the DMAIC (Define, Measure, Analyze, Improve, & Control) process aiming to reach the optimum design with the allowed budget, as shown in Figure (1) [33].

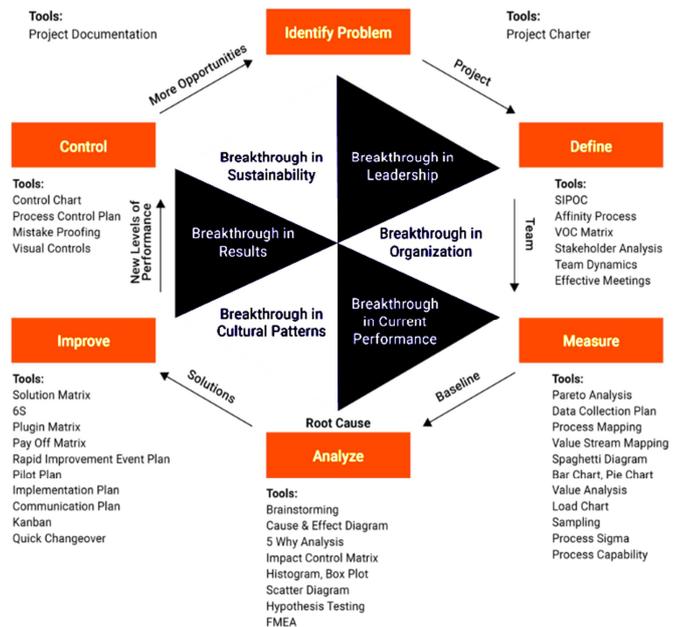
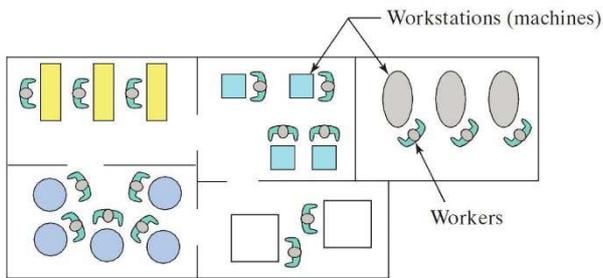


Fig. 1 DMAIC business performance improvement approach [33]

The facility layout design is an essential part of any business strategic plan; it contains the analysis to determine the best layout for machine and equipment placement to have a successful start and output delivery of the service or production processes. For the service sector, customers are the input and output of the system; it starts with the arrival of the customer and finishes with providing the service needed with high satisfaction. An efficient and effective facility layout will allow the following [32, 34-37]:

- Organized equipment within sufficient space where customers and goods can move freely,
- The environment where customers will be safe and satisfied,
- Reduced bottlenecks and traffic congestions,
- Flexibility to expand and adapt for new needs and requirements,
- The ability to increase business capacity.

Construction of new or renovation of existing health centers requires a large budget and a long time. Therefore, layout planning is a critical task as layout designs must be developed based on a well-studied strategic plan while considering the effect on customer experience and service quality; confusing layouts can add to customer' anxiety [38-46]. The team used a combination of the Process (functionality) layout, cellular manufacturing, and cellular layout. Process layout was developed to accommodate low traffic and customized services while cellular layout allows a wide variety of services in medium volume such exercising classes, this layout is known for high flexibility to move around [34]. A generalized process layout is shown in Figure (2) while the generalized cellular layout is shown in Figure (3).



Process (Functional) Layout

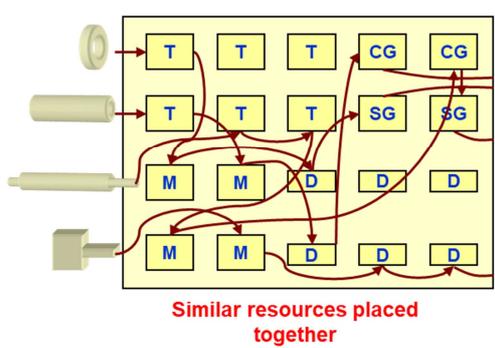
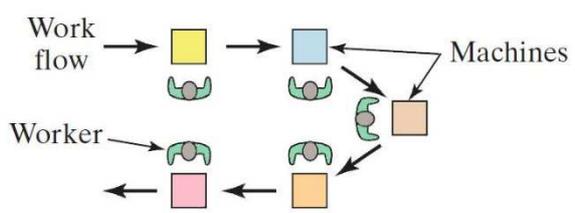


Fig. 2 Generalized process layout [34]



Group (Cellular) Layout

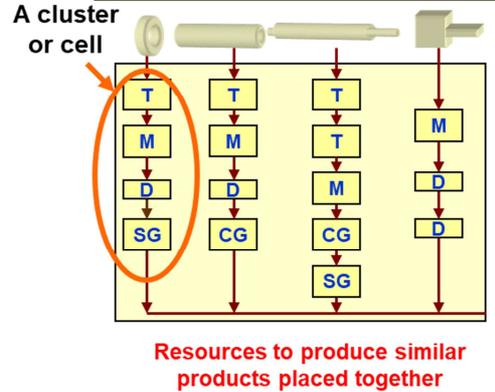


Fig. 3 Generalized Cellular layout [34]

III. RESULT AND DISCUSSION

The final design was an implementation for all the knowledge gained from the literature review, and the systems engineering concepts. The facility is designed to include a nice lobby, weight areas, cardio, and flexible classrooms that have multiple functionalities, in addition to an indoor swimming pool, a second story running track, an indoor basketball court that can be used for softball, volleyball, indoor football, and indoor soccer. These areas will be user-friendly for people that may have disabilities.

The general layout for the first and second floors with the detailed areas are shown in Table (1) and Figure (4 and 5).

TABLE I
LAYOUT AREAS DESCRIPTION

Area No.	Discription
1	Open Space for Extra Activities
2	Stairs and Elevators
3	Restrooms
4	Snack Bar
5	Front Desk
6	Treadmill Stations
7	Running Track

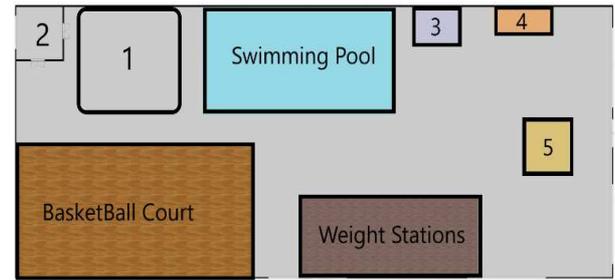


Fig. 4 First-floor layout

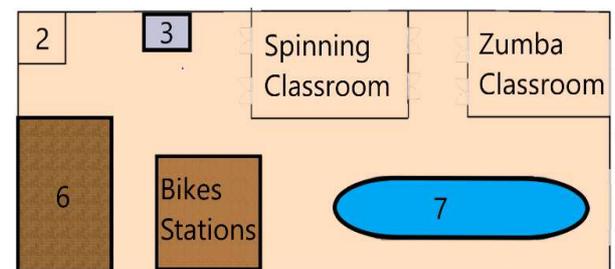


Fig. 5 Second-floor layout

The complete facility design 3D rendering is shown in Figure (6).

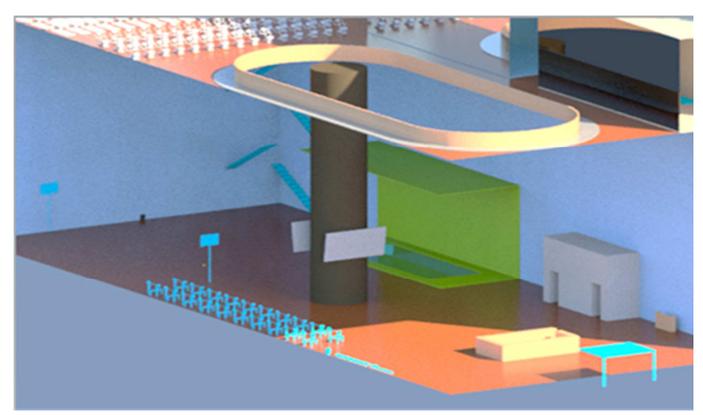


Fig. 6 The complete facility layout 3D rendering

The first-floor house the front desk/lobby where it serves as an information desk for people and healthy snacks sale point, shown in Figure (7). In addition, the first floor is shown in Figure (8) will include a basketball court, indoor swimming pool, weight lifting areas, restrooms, lookers, and entrainment open space. The swimming pool will be used for

various types of activities for all different ages and aqua therapy sessions, shown in Figure (9).

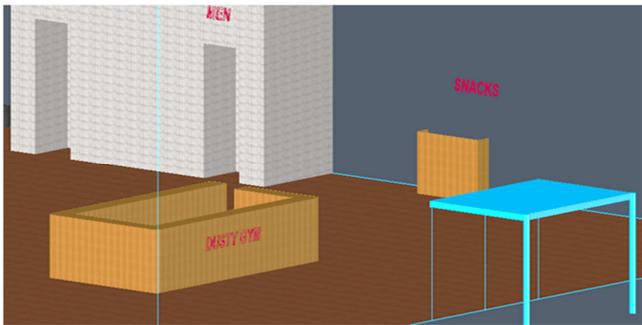


Fig. 7 The facility front desk and snack bar 3D rendering

The basketball court is a professional court-sized, which will help to make it flexible to accommodate multiple sports.

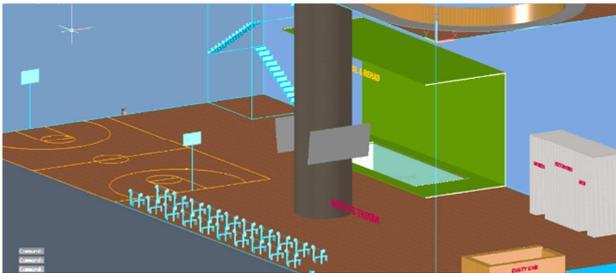


Fig. 8 the facility first-floor layout 3D rendering

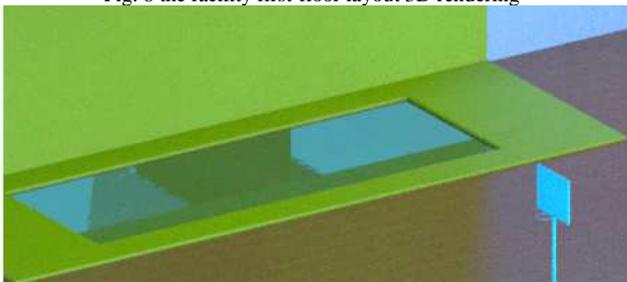


Fig. 9 The swimming pool 3D rendering

Stairs and elevators will be provided to get to and from the second-floor. One unique feature in this center is the stairs to the second floor will be designed as Cardio stairs. The treadmills and cardio bikes are located on the second floor and facing the entertainment screens, shown in Figure (10).

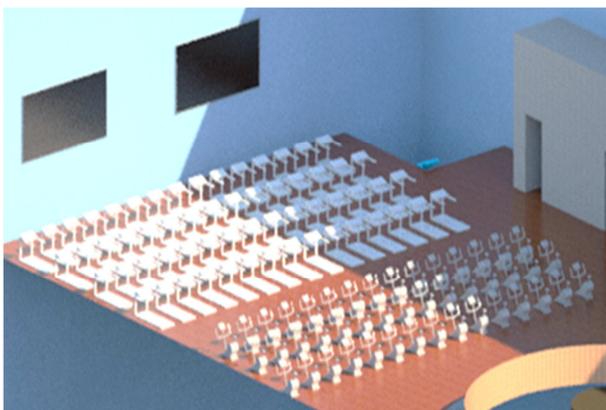


Fig. 10 The treadmills and cardio bikes in front of the entertainment center 3D rendering

The running track shown in figure (11) is located on the second floor, with an open glass center to allow more lighting to the first floor. It will help people who prefer to run in a more natural ambient without using machinery.

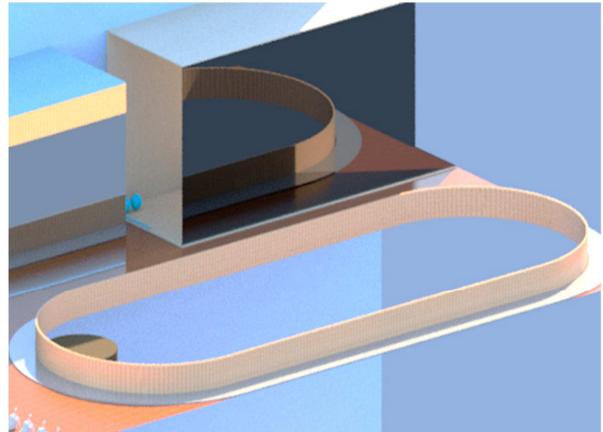


Fig. 11 The second-floor running track 3D rendering

The two semi-closed sections are located on the second floor and they will be used for “Spinning” and “Zumba” classrooms, which will be equipped with all the needed machines and tools such as exercising rubber balls, low weight dumbbells for various types of workouts. These rooms will be flexible to accommodate any new classes. They are shown in Figures (12 & 13).

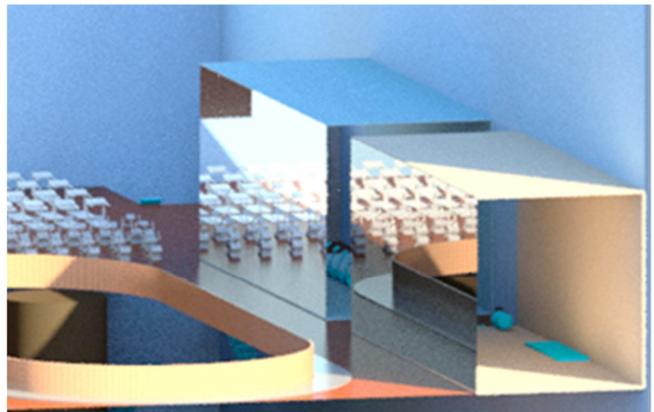


Fig. 12 The semi-closed sections “Spinning” and “Zumba” classrooms, with glass sides (front-end) 3D rendering

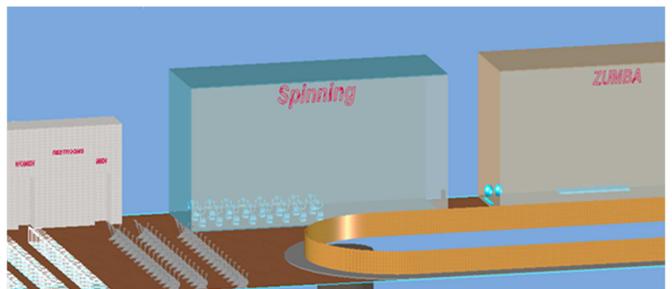


Fig. 13 3D rendering of the semi-closed sections “Spinning” and “Zumba” classrooms and restrooms (side view)

The front view of the second floor and the floor layout are shown in Figure (14).

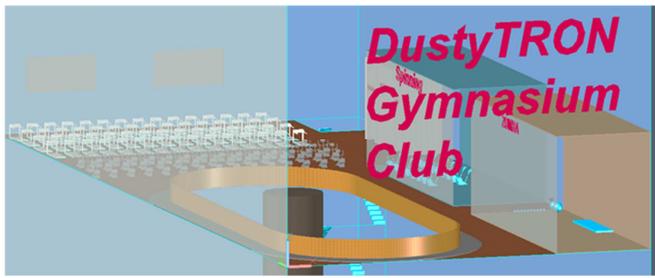


Fig. 14 3D rendering of the health club second-floor layout

IV. CONCLUSIONS

The team implemented the facility layout principles and the existing theory to design an optimum health center, of 50,000 ft², and two-floors, that can benefit the local community. The team utilizes AutoDesk AutoCAD® in the visualization of the final design that was focused on the following concerns: appealing and attractive to different sectors of customers, traffic control, accessibility, safety, and hygiene. The final design was submitted to the facility managers and it is being discussed for future implementation. Designing a health center (Gym) is still complicated. More variables come into play when designing such a facility. In the future, the team will include human factors analysis of the machines and equipment and adaptation for new trends and needs.

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