Green Hospital Together with a Lean Healthcare System

Hatice Camgöz Akdağ, Tuğçe Beldek

Abstract Green hospitals and Lean Healthcare Systems are both dealing with increasing efficiency and effectivness by decreasing waste/non-value added activities and cost in healthcare institutions. When both of the issues are used and applied, it can be seen that green hospitals will encourage more effective and efficient usage of energy, water and material currently used, ensure the prevention of any kind of waste, perform environmentally sensible and eco-friendly building design and be environmentally friendly in the process of service provision. In addition, lean heathcare will decrease waste, costs, non-value added activities, increase patient, doctor, nurse and staff satisfaction, decrease waiting times, increase performance and finally increase revenues. The aim of this study is to give information about the concept of green hospital with a lean healthcare system.It demonstrates the applicability of the concept of green hospitals in the healthcare sector together with lean management. The study examines the contribution of these two concepts to healthcare institutions as well as to the environment. For this purpose, in this study, the concept of green, green healthcare, lean management and lean healthcare is defined. The implementation of environmentally friendly green strategies, together with lean strategies to healthcare within the framework of social responsibility and in this respect extended employees, patient and community awareness can be suggested to both public, university and private hospital managers for developing and improving the sustainable lean healthcare systems.

Keywords Green Hospital, Green Building • Lean Management • Lean Healthcare • Sustainability

H. Camgöz Akdağ (✉)

Management Engineering Department, Management Faculty, Istanbul Technical University, Istanbul, Turkey

e-mail: camgozakdag@itu.edu.tr

T. Beldek

Management Engineering Department, Management Faculty, Istanbul Technical University, Istanbul, Turkey

e-mail: beldek@itu.edu.tr

Introduction

Today growing industries are causing pollution that affect our lives directly. It gives harm to our health and is a big threat for the next generation. In this case green products and services are becoming more popular. Production systems are being customer focused to meet their requirements on time, with high quality. Even in construction industry, it is important to manage every step, beginning with the building design to the demolition. The consideration must not just be with the aesthetics or the usage of the building the resource efficiency must also be reached. As a solution, green building design reduces usage of raw materials at the initial stage, which will result in a higher percentage of recyclable materials for a sustainable structure. If the design phase considered, architectures and civil engineers are the only ones who has a role in making a building "green".

Another important topic is to provide customer needs on time and in a turely manner. This goal can be reached by some calculations in a production line but it is more difficult for a service sector. Especially in healthcare systems, it is more important to give a high quality service to the patients. When the human life is considered, it is vital to start the treatment quickly. Waiting is the biggest problem at the hospital, which increases the risk of exacerbation of the disease. Even at the beginning of the healthcare system, patients try to get appointment from the hospital and they wait for long time periods, sometimes for months, to see the doctor.

These kind of delays leads to the integration of lean management and healthcare systems. Lean management aims to eliminate actions which do not add any value to the process that are defined as "waste". Elimination of non-value added steps, shortens the lead time of the process which means to reach customer more quickly. The current state of the hospitals' departments can be provided by some lean management tools.

It will be more efficient to integrate green principles with lean thinking to a hospital. With the useage of "green" materials and making the building sustainable with its every kind of energy usage, eliminating "waste" types at a medical service line will completely fit each other to satisfy patient on time with a high quality of treatment. In this study lean management and its principles will be defined and then green building definition will be extended to green hospital design. As a result the integration of lean in healthcare systems and green hospitals will be discussed.

Lean Management

Lean Manufacturing, which is also named as "Toyota Production System (TPS)" was a new process-driven production system for the industry, founded by Japanese leaders (Abdulmalek et al., 2007). The main aim of lean manufacturing is to get rid

of the "waste" while increasing the quality of the product (Sundar et al., 2014). Waste types can be classified in eight different ways: producing more than the need, inventory, defects, waiting, transportation, extra motions, non-value added activities and the unused human ability. These waste cost nearly 95% of the whole production cost which is mentioned by Taiichi Ohno who is one of the leaders of TPS (Kilpatrick, 2003). Lean principles mainly aims to make a sustainable production line while eliminating non-value added activities. This line has to work with customer orders which means a pull system (Sundar et al., 2014).

In August 1997, a non-profit organization "Lean Enterprise Institute, Inc." was founded by James P. Womack. He aimed to explain lean thinking in accordance with the Toyota system which is being used by many different sectors spread wide (URL-1). The Lean Enterprise Institute website gives detailed information about lean principles which is summarized in Figure 1.

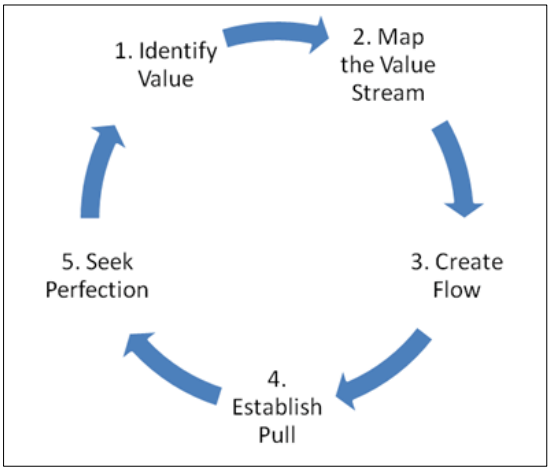

Figure 1. Lean Principles
(https://www.lean.org/WhatsLean/Principles.cfm, retrieved 05.03.2018)

Not only in manufacturing but also service industry uses lean principles in spite of application of mentioned ones are certainly different. The difference is that many service area works with pull system, which means the customers' needs trigger the production of the service. If the system has problems in terms of the process, then waiting periods will be longer (Maleyeff, 2006).

Lean in Healthcare

In a production line, lean manufacturing aims to create a high quality product and an on-time shipment to the customer. In Canada, these lean principles are concerned for healthcare systems because of the excess patient amount (Ng et al., 2010). Recovery of the patient is the total of the value created in the medical service. For this reason, as mentioned for production line, also in healthcare sector,

the process has to be customer-based, that means patient-based at a hospital (Kujala et al., 2006).

In a healthcare system, to reach a "perfect" medical experience, delays, waiting times in a queue, unnecessary repeating actions, and false applications should be eliminated or at least minimized. When lean principles are adapted to health care systems to create value, some issues have to be considered such as patients, taxpayers and service providers' equality and the legal issues for costing while reaching the required pleasant level for patients. Even tough every process in a production line is known by its standards, in a service line especially at a hospital, patients' road is not clear due to different examination results. This uncertainty causes more complicated systems to be analyzed (Young et al., 2004).

Waste definition differs from sector to sector so that when health care systems are considered, mostly documentation causes "waste". Also the whole process flows and the hardware of the hospital can yield non-value added activities (Campbell, 2009).

Green Building Design

Like any other industries, green production is very popular today at construction sites. At the design phase, architectures are considering different types of shapes and materials to provide energy saving. Green building design provides savings in different scopes: nearly 30% energy, 35% carbon, 30-50% water usage, 50-90% waste cost savings will be reached (Council, 2001). The main reasons of constructing green buildings at U.S. are given in Figure 2.

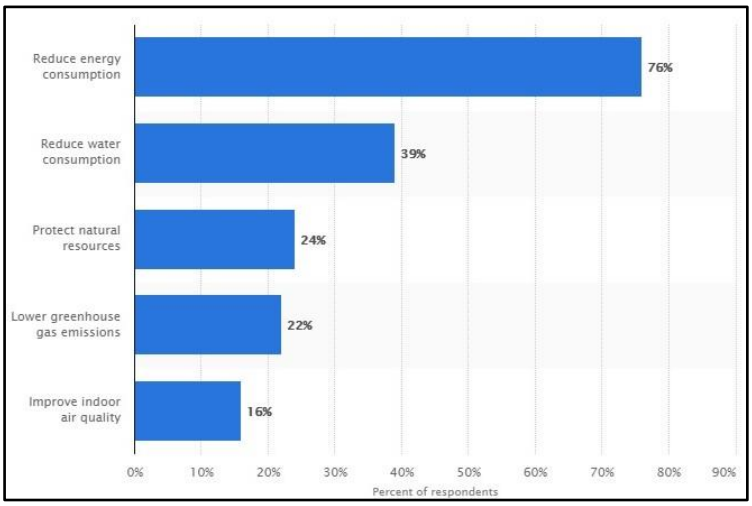

Figure 2. Main reasons to construct green buildings at U.S. by 2015
(https://www.statista.com/statistics/616594/top-environmental-reasons-driving-green-building-activity-future-in-the-us/, retrieved 21.03.2018)

There are different definitions of green building in literature. A green building is better designed than a traditional building in case of its effect to the environment. Another definition is the building that provides an important development and innovation within its environment. Green building is not only the consumer but also a manufacturer of energy and water. During its life cycle, it presents the most healthy environment while using water, energy and land sources efficiently (Terekli et al., 2013). The growth of the green building market at U.S. is shown in Figure 3.

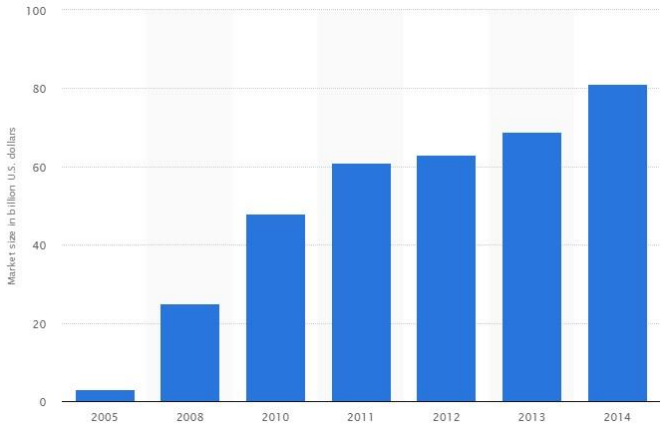

Figure 2. Growth of green building market at U.S. (in billion U.S. dollars) (https://www.statista.com/statistics/248060/value-of-us-green-building-market/, retrieved 21.03.2018)

Green hospital and its key elements

Green building operations is vital for both environment and people. The growing trend of environmental awareness and practice in management (especially supply chain) systems has had its effect on many sectors, including healthcare and hospitals. Having touched upon Green supply chain and Green management in general, turning towards Green practices in hospitals, starting with the, again US focused, ―Hospitals 2020 initiative, which aims ―to accelerate the development, use, and diffusion of environmentally preferable products, practices, and construction of Green buildings in hospitals and medical practices worldwidel. The seven key elements include hospitals‘ food, water, and (alternative) energy consumption, waste production, and related factors of building design, energy efficiency, andtransportation in and around the hospital. World Health Organizations seven key elements for green hospital are as follows (URL-2):

1. With efficiency measures, reducing cost and energy consumption
2. Building to reduce resource and energy demand and being sensitive to climate conditions
3. Producing/consuming clean, renewable energy

4. Make personnel and people coming to the hospital prefer walking and cycling
5. Sustainability of producing/consuming green food for personnel and patients
6. Reducing waste and using alternative disposal techniques
7. Finding safe alternatives to save water instead of bottled ones

Integration of Lean Management and Green Hospital

The Green Hospital is defined as a hospital that has taken the initiative to do the one or more of the following: choose an environmentally friendly site, utilizes sustainable and efficient designs, uses green building materials and products, thinks green during construction and keeps the greening process going. A Green Hospital is constructed around a facility that recycles, reuses materials, reduces waste, and produces cleaner air (URL-3). In 2002, the American Society for Healthcare Engineering (ASHE) published the Green Healthcare Construction Guidance Statement, the first sustainable design guidance document emphasizing a health based approach (ASHE, 2002). The Green Guide for Health Care, the healthcare industry's first best-practices, voluntary green building tool, modeled with permission after the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system, was initiated in 2002, followed by periodic updates and the registering of pilot projects to bolster participation (Anderson et al., 2004). While emphasizing the importance of integrated design, the Green Guide is organized in two sections— construction and operations—to facilitate its use. Using the Green Guide for Health Care as a foundational reference document, the LEED for Healthcare Application Guide development process began in 2004. With its release anticipated in 2007, LEED-Healthcare will represent the first third-party green building certification tool customized for the healthcare sector. The rapid market uptake of these tools and resources is manifested today in more than 40 million square feet of green healthcare facilities, representing about 180 healthcare projects. These include more than 100 Green Guide pilots, six LEED certified projects, and about eighty LEED-registered projects. By embracing a life-cycle view of human health and environmental stewardship as strategic definers of success, this new generation of healthcare tools—and the buildings they guide—is poised to accelerate the adoption of health-based green building standards in other sectors (Guenther, 2016). Hospitals and healthcare represent an essential societal function, with a fundamental mission to care for and heal the sick. In many respects, healthcare institutions are held to a higher ethical standard than virtually any other enterprise, as to do good, not merely to do well (URL-4).

A network "Global Green and Healthy Hospitals" gives ten goals to reach required sustainable health care systems (URL-5):

1. Give importance to the environmental health,
2. Find substitutional materials instead of harmful ones,
3. Minimize healthcare waste, and or dispose them in a proper way,

4. Use renewable energy systems,
5. Use potable water and minimize the water consumption,
6. Develop new transportation systems for both patients and personnel
7. Provide healthy food
8. Manage medical products in a safely manner
9. Support green building design and construction
10. Purchase sustainable materials

It is hard to implement a new system in a whole project. For this reason architectures should think of the green building principles at the beginning of the design phase. Both green building design and lean principles will result with the economic and social benefits (Camgöz-Akdağ et al., 2016). Lean management will decrease patient waiting times, queue length and especially it will provide a standardized application in the whole medical treatment system. An example is shown in Figure 3 to implement lean and green together for a hospital supply chain system.

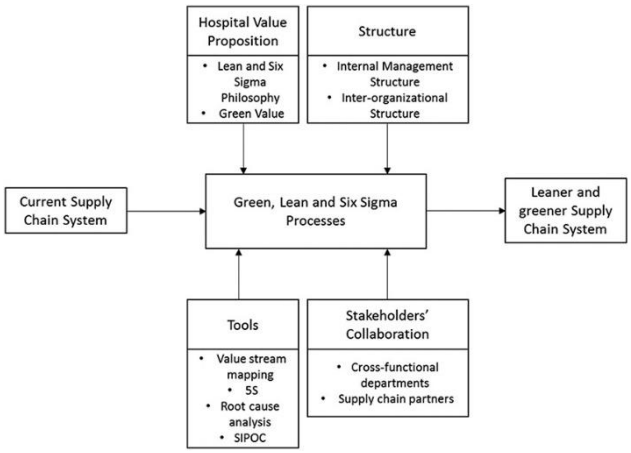

Figure 3. Integration of lean and green to a hospital supply chain system (https://www.tandfonline.com/doi/full/10.1080/16258312.2018.1426339?scroll=top&needAccess=true, retrieved 23.03.2018)

Integration of lean principles both with the goals of green building leads to a more efficient healthcare system for patients. This integration includes all internal management structure to ease the adaption in every steps of the medical care (Zhu et al, 2018).

Conclusion

In conclusion, it is obvious that green and lean thinking are very integrated in definition. They have so many common topics to make the related system sustainable.

With green principles the whole construction of the hospital will be considered to be environment-friendly. “Green” building will provide energy, water and any kind of consumption efficiency. When thinking about a hospital, it is vital to use safe systems for patients in terms of “healthy environment”. With lean princples are applied, the process of every kind of medical experience inside the hospital will create value for the patients health. Useless and unnecessary steps will be eliminated and the lead time of leaving the hospital will be minimized.

Both green and lean principles are patient oriented so their moral will also raise while getting the treatment during their way inside the hospital. It is clear that green building completion with lean management principles will result with a healthy and sustainable environment.

References

Abdulmalek, F. A., & Rajgopal, J. (2007). Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A process sector case study. International Journal of production economics, 107(1), 223-236.

Anderson J, Jansz A, Steele K, Thistlethwaite P, Bishop G. and Black A.[2004] Green Guide to composites an environmental profiling system for composite materials and products.

Camgöz-Akdağ, H., Beldek, T., Aldemir, G., & Hoşkara, E. (2016). Green Supply Chain Management in Green Hospital Operations. The IIOAB Journal, Vol. 7, Suppl 1, 467–472.

Campbell, R. J. (2009). Thinking lean in healthcare. Journal of AHIMA, 80(6), 40-43.

Council, U. G. B. (2001). Leadership in energy and environmental design (LEED).

Guenther R.(2016) Values-Driven Design and Construction: Enriching Community Benefits through Green Hospitals, FAIA, Gail Vittori, and Cynthia Atwood, Sept, 2016.

Kilpatrick, J. (2003). Lean principles. Utah Manufacturing Extension Partnership, 68, 1-5.

Kujala, J., Lillrank, P., Kronström, V., & Peltokorpi, A. (2006). Time-based management of patient processes. Journal of Health Organization and Management, 20(6), 512-524.

Maleyeff, J. (2006). Exploration of internal service systems using lean principles. Management Decision, 44(5), 674-689.

Ng, D., Vail, G., Thomas, S., & Schmidt, N. (2010). Applying the Lean principles of the Toyota Production System to reduce wait times in the emergency department. Canadian Journal of Emergency Medicine, 12(1), 50-57.

Sundar, R., Balaji, A. N., & Kumar, R. S. (2014). A review on lean manufacturing implementation techniques. Procedia Engineering, 97, 1875-1885.

Terekli, G., Özkan, O., & Bayın, G. (2013). Çevre dostu hastaneler: Hastaneden yeşil hastaneye.

URL-1 Lean Enterprise Instituite. (2000). James P. Womack, Retrieved from: https://www.lean.org/WhoWeAre/LeanPerson.cfm?LeanPersonId=1.

URL-2 World Health Organization and Health Care Without Harm. Healthy Hospitals-Healthy Planet Healthy People: Addressing Climate Change in Health Care Setting. England: World Health Organization (cited 2016 October 01). Available from: http://www.who.int/globalchange/publications/climatefo otprint_ report.pdf?ua=1

URL-3 http://hospital2020.org/Agreenhospital.html

Young, T., Brailsford, S., Connell, C., Davies, R., Harper, P., & Klein, J. H. (2004). Using industrial processes to improve patient care. BMJ: British Medical Journal, 328(7432), 162.

URL-4 Power Quality Utilization Guide, Hospitals, Rob van Heur, Laborelec, January 2008 extracted from : http://www.certh.gr/dat/EE195A7D/file.pdf

URL-5 GGHH Agenda and its Sustainability Goals (2015). Retrieved from: https://www.green-hospitals.net/sustainability-goals/

Zhu, Q., Johnson, S., & Sarkis, J. (2018, January). Lean six sigma and environmental sustainability: a hospital perspective. In Supply Chain Forum: An International Journal (pp. 1-17). Taylor & Francis.