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GREEN SUPPLY CHAIN MANAGEMENT IN GREEN HOSPITAL OPERATIONS

Hatice Camgöz-Akdağ^{1*}, Tuğçe Beldek¹, Gökhan Aldemir¹, Ercan Hoşkara²

¹Department of Management Engineering, Istanbul Technical University, Istanbul, TURKEY

²Department of Architecture, Eastern Mediterranean University, Famagusta, NORTH CYPRUS

ABSTRACT

Green buildings also known as green construction or sustainable building are environmentally responsible and resource-efficient throughout a building's life-cycle. Today the environmental issues and the concern for sustainability is encouraging 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 construction. This requires close cooperation of the design team, the architects, the engineers, and the client at all project stages. Green Supply Chain Management (GSCM) reduces energy usage and waste, so it prevents any problem that will occur in human health and environment. Hospitals ensure a gapless sanitary care for the population in this network and they have a significant social, economic and environmental responsibility. In the last few years a new environmental trend in the field of bigger buildings occurred, green buildings. The aim of this paper is to explore the social-benefit reflections by combining GSCM and green hospital design, based on the literature review and EU directives for Turkey, to build and propose a model regarding Green Hospital operations using GSCM and reverse logistics.

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. Not just the aesthetics or the usage of the building is considered but also resource efficiency has to be reached. As a solution, green building design is a way to reduce usage of raw materials at the beginning and to use high percentage of recyclable materials to make sustainable structures. When the design phase is considered, only architectures and civil engineers will have role to make the building "green". But as a whole construction industry, suppliers and other subcontractors are also in the whole supply chain. For this reason, to make the whole production line sustainable, green supply chain models will be useful to connect every step to each other with every kind of actors in the supply chain.

As a new topic, GSCM makes sustainable systems with the help of waste management directives. Both European Union and Turkey published regulations to manage construction and demolition waste. First aim is to reduce the raw material in the source and if it cannot be reduced, than the second aim is to recover those materials as much as it can be. To be able to reduce the raw material such as the materials that are directly used in the structure, water and energy resources it can be designed as green building at the beginning. It is possible to take green building certification with the required properties that will be given more detailed in the following sections.

LITERATURE REVIEW

Green supply chain management

Supply chain management definition changes day by day according to its broadening scope [1]. SCM includes logistics and trade while operating both customers and suppliers [2]. Supply chain is a cycle that starts from suppliers and ends at customers as the product or service flow [3]. Another definition is that supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer [4].

Supply chain traditionally starts from the cradle to the grave, which means from raw material state till the end product reaching the customer. However today environmental issues force processes to change and comes up with new operations such as recovery options. For this reason, closed loop supply chain, a new definition, allows the finished good collected from customers which are end-of-life products now, and go in to some other processes for recovering them [5]. The aim of the end-of-life recovery options are to recover material, energy and avoid landfill. This recovery is a value that if it is managed properly, high profits will be gain for both producers and customers [6].

Today companies are aware of their responsibilities about the environment depending on regulations. This leads to sustainable systems that will continue their processes without giving any harm to the environment. Environmental issues are seen at every step of supply chain that starts from getting the raw

KEY WORDS

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*Corresponding Author

Email:
 camgozakdag@itu.edu.tr
 Tel.: +90-212 293 1300
 Fax: +90-212 240 72 60

material and ends with reuse or recycle or disposal [7]. This causes a requirement for companies to have a green supply chain management (GSCM). A study in India, found that there are different pressures for different sectors to be able to adopt GSCM in their own traditional supply chains [8]. To integrate GSCM to a company five different applications can be used as environmental management systems, green purchasing and design, investment recovery and strong relations with customers [7]. In common green activities and sustainability have an intersection in practice which is 4R: reduction, redesign, reuse and remanufacture [2].

Constructions cause air, water and noise pollution and today with global warming environmental issues became very important. Even in construction design, green materials are being preferred to minimize waste and construction firms are starting to use green supply chain management to make their work sustainable. Green buildings, sustainable design and constructions, construction waste management are some of the sustainability topics that are being used by producers [9]. The best way to minimize the construction waste generation is disposal. Also material types have to be selected very carefully to get rid of recycling limitations that means recycable materials should be preferred [10].

To leave a healthy environment with high level of social, economic and environmental conditions to future generations, sustainability is important which leads to improved quality of systems [9]. Supply chain management has four specific roles in construction; improving the interface between site activities and the supply chain, improving the supply chain, transferring activities from the site to the supply chain, integration of site and supply chain. SCM helps to understand construction problems and shows a direction to solve them but practical methods for SCM should be improved to implement for specific situation of construction [10].

Green building design

Like any other industry, 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 [11]. “World Green Building Trends Smart Market Report” which was published at 2013, shows the importance of the reason for building green structures according to different locations [Fig. 1].

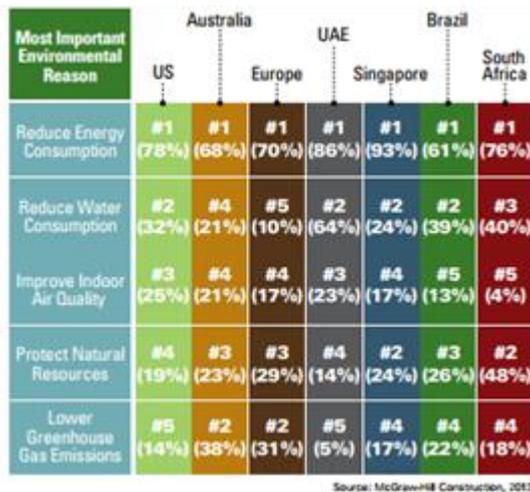


Fig. 1: Most important environmental reason for building green by locations.

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 healthiest environment while using water, energy and land sources efficiently [12].

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 worldwide”. The seven key elements include hospitals’ food, water, and (alternative) energy consumption, waste production, and related factors of building design, energy efficiency, and

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transportation in and around the hospital. World Health Organizations seven key elements for green hospital are as follows[13]:

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

Waste management principles related to Turkish and EU Council directives

Regulations about common waste management at Turkey, are improved according to waste variation. EU directives and country based guidelines are published and put into practice. In this scope, different types of waste are being stored regularly such as domestic solid waste, excavation soil, construction and demolition waste, waste batteries and accumulators, hazardous waste, herbal waste oils, medical waste, end-of-life tires, packaging waste, polychlorinated biphenyl and polychlorinated terphenyl, waste electrical and electronic equipment, waste oil, end-of-life vehicles, maintenance and repairment equipment of vehicles [14].

One of the most important principles of Turkey's waste management strategy is to prevent waste at source, otherwise reduce waste and finally if waste is unavoidable recycle it. Collecting all terms related to waste management directive under a common structure, simplifying regulations and adjusting them according to the EU waste management directive updates are being maintained by Ministry of Environment and Urban Planning.

There are two issues on recycling in the 10th development plan for years 2014-2018:

- Industries will give attention to applications such as recycling and recovery.
- Recycling performance is negatively affected by some topics such as lack of knowledge about recycling benefits which is one of the important issues in the solid waste management, lack of standardization of the recovered secondary products, deficiency of incentives and orientation system.

According to the national data about recycling; at 2003, at 46 recovery centers nearly 4 thousand people were employed and as a result of recovery operations 62 million TL added value provided. At 2011, at 898 recovery facility nearly 60 thousand people were employed and as a result of recovery operations the provided added value exceeded 1 billion TL [14][24].

"Regulation on Excavation Soil, Construction and Ruin Waste Control" is law in force that was promulgated at 18.03.2004. Following goals are given in the regulation: Reduce excavation, construction and ruin waste without giving harm to the environment at the place where they are produced, collect, store temporarily, transport, recover, use and dispose them.

Waste generation is increasing day by day at many countries due to the growth of towns and cities. Many regulations about construction and demolition waste management are developed to prevent the environment [15][23].

Directive 2008/98/EC starts with waste, recycling and recovery definitions. It also explains how waste can be classified to be a secondary material or product. The aim of the waste management is protecting the environment without giving harm to human health, animals or plants, water, air and soil.

In terms of waste management European Union has published a directive (2008/98/EC) which gives details about goals for EU countries according to different types of waste. After giving the definition of waste, to standardize waste management at EU countries, the directive mentions the objectives as follows: "In order to comply with the objectives of this Directive, and move towards a European recycling society with a high level of resource efficiency, Member States shall take the necessary measures designed to achieve the following targets:

- (a) by 2020, the preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 50 % by weight;
- (b) by 2020, the preparing for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste excluding naturally occurring material defined in category 17 05 04 in the list of waste shall be increased to a minimum of 70 % by weight." [16].

Turkey is not a member of EU but as a candidate ministries are trying to edit regulations according to the EU standards. In 2008, ministry of environment and forestry published a waste management action plan that includes 4 years for each cities in Turkey. It stated goals for cities to manage solid and hazardous waste types in order to protect environment and human health.

There is no goal like gaining 70% of materials with recycling at 2020 which is mentioned in the EU Directive, for Turkey in the related regulation. At Turkey, every year 125 million tons excavation soil is evaluated to regain. At the current situation construction and demolition waste amount is nearly 4-5 million tons per year. With the new regulation of rehabilitation of areas that are under risk of disasters for

the first 3 years, annual goal will be 40% that is 10 million tons/year and 6 million tons/year for regaining materials [14].

It is difficult to manage construction and demolition waste in EU because of strict goals which is mentioned before. A study showed that Southern Europe countries need development in their measures, and Central and Northern countries need new models to integrate waste management technologies locally, so that waste management systems will work efficiently to be able to reach those governmental goals [17].

INTEGRATING GREEN HOSPITAL DESIGN TO GSCM

To reach the waste management goals with using GSCM starts with the reduction of the raw material that is thought to be used in the structure body. It is hard to make the balance between the strength and the amount of the material at the design phase according to different material types. It is possible to use "green" materials while reducing the amount and make the structure as strong as it was with the traditional materials. There are new types of materials that can be used as substitutes. With the advantage of being light and durable, they are also recyclable so that can be connected to GSCM. If a closed loop is designed to make the system sustainable, manufacturer will be able to use waste materials in the other construction projects as second quality materials. To reach regulation goals both in Turkey and EU, waste amount has to be reduced and most of them has to be recovered at the end of the life cycle. Green hospitals will already help the reduction of the materials and will also provide energy savings. 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 [18]. 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 [19]. 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 [20].

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 [21].

Green Hospital promotes the following [22]:

- Sustainable building materials
- Products free of mercury, latex, PVC, and DEHP
- Energy and water conservation
- Tools and resources for environmentally preferable purchasing
- Greener cleaners
- Integrated pest management
- Waste Reduction and Recycling
- Green Electronics
- Managing pharmaceuticals
- Environmentally Preferable Medical Waste Treatment and Disposal
- Safer alternatives to PBDEs: products in health care settings
- Nutritious, Sustainable Foods and Food Systems

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 GSCM will result with the economic and social benefits while fitting the governmental requirements.

Developed supply chain model

A closed loop supply chain will be sustainable for construction industry that will also suit the definition of green supply chain management explained above. The following model will reduce the disposal amount of waste material with the help of recycle, repair and remanufacture operations.

A supply chain model is developed, with green building design integration, for a construction firm in Turkey [Fig. 2]. By this model, construction firm will able to sell their recovered materials to the secondary markets and get profit from them. In the previous model, firm was not able to know what is happening to their

waste after sending them to the landfill. Thus, this new model will be sustainable for the environment that materials will not left on the ground while giving harm to the environment. Also at the beginning of the design phase, raw material usage will be minimum according to green building principles. Usage of recyclable materials will be increased and energy efficiency technology will be preferred.

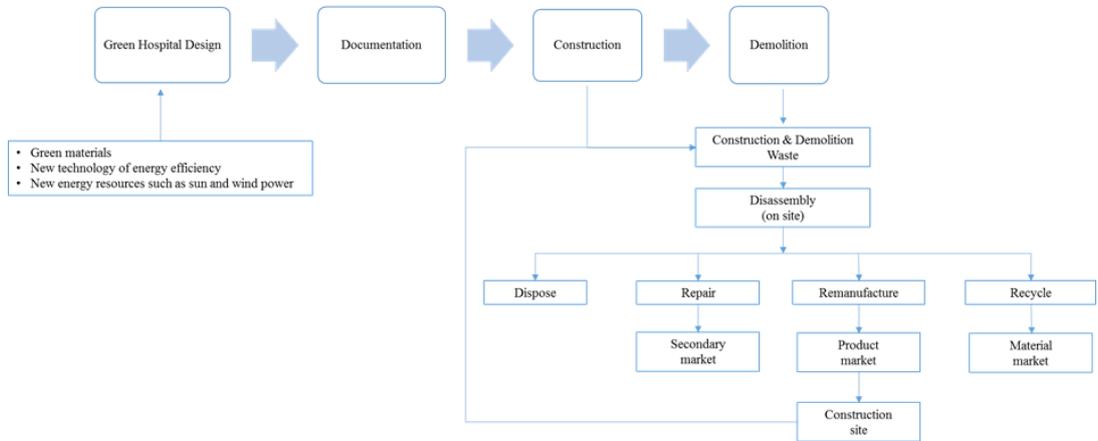


Fig. 2: Developed supply chain model with green hospital design integration.

Benefits of GSCM in green hospitals

By using green supply chain management, at the beginning of the design phase “green” requirements of a hospital is already being provided. As mentioned in the second part, green hospital requires every kind of efficient energy sources, helping people to reach easily and –usually- by walk or bicycles. With GSCM, raw materials have to less used and also be mostly recyclable. If the waste cannot be recovered with any kind of techniques, then the most proper disposing should be done. This issue is more important for green hospitals because of patients that are already in the building. This view has to be considered for also every kind of materials and food that will be consumed inside the hospital. Although GSCM model shows only the beginning and the end of the chain that green issues are implemented, the management has to be sustainable for the whole life cycle of the green hospital to keep environment and people safe.

CONCLUSIONS AND RECOMMENDATIONS

The aim of this paper is to explore the social-benefit reflections by combining GSCM and green hospital design, based on the literature review and EU directives for Turkey, to build and propose a model regarding Green Hospital operations using GSCM and reverse logistics. A green supply chain management flow chart for a green hospital was established to understand the waste management system clearly in Turkey. Based on the literature review, Green Building principles and EU directives from Turkey a model was built and propositions regarding green supply chain management and reverse logistics were formulated for a green hospital. Benefits of GSCM is considered for especially for green hospitals which is one of the popular topics in the world. To make the supply chain sustainable, in the design phase of a construction, the materials may be used less and green materials may be preferred. As mentioned in the regulations first aim has to be to reduce waste, so it may be done with using less raw material if it is possible. This development can be provided with “green building design” principles at the beginning of the construction project.

Finally it can be said that if these above mentioned improvements are applied as integrating green building design to GSCM, setting a supply chain for a hospital construction, the system will be sustainable and the construction firm will be able to minimize the cost while making profit from their own waste and the most important it will be environmentally friendly and less harmful for the human health.

CONFLICT OF INTEREST
There is no conflict of interest.

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