CONTEMPORARY SUSTAINABLE DEVELOPMENT PROBLEMS OF CONSTRUCTION INDUSTRY: CASE OF LATVIA

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Abstract—Sustainable construction industry development is important for every country, and its importance increases together with increase of population in the world. The aim of the research is to analyze sustainable construction industry development key problems, focusing on environmental component. Comparison, data analysis, induction and logical access methods have been used in the research. The practical research focuses on case of Latvia. Research investigates environmental, social and ecological aspects of the item. Research results demonstrate high importance of energy efficiency in sustainable construction development, as well as future research direction has been identified.

Index terms- Environment, Construction, Energy efficiency, Sustainability

I. INTRODUCTION

Construction activities are very important for society and for environmental development. Importance of construction industry is especially important nowadays because of process of urbanization. About 50% of the world population is living in urban areas, and it is projected to increase to 6.3 billion by 2050 [1], at the same time ecosystem is linked to human wellbeing in very complex way and decisions affecting ecology are not made often by ecological experts [2]. Construction process, energy saving activities and resource management has a great role in sustainable development for every country, society and environment in general.

The aim of the research is to analyze the sustainability key aspects of construction, focusing on environmental aspects. Comparison, data analysis, induction and logical access methods have been used in the research. It is important for each market participant and for strategy of a country to take into account factor that sustainability is a key to achieving competitiveness, but sustainability cannot be achieved without leadership, because it has a strategic meaning and requires the attention and support of top management [3]. C.N.Madu and C.-H. Kuei [3] define sustainability management as follows:

- sustainability = continuity of economic development, environmental protection, and social equity; and
- management = enabling conditions for sustainability

Sustainability is the term chosen to bridge the gulf between development and environment [4]. Concept of sustainable development includes [5]:
- resource conservation;
- ecological conservation;
- promoting goals of economic development;
- public health;
- community planning;
- energy policy.

Sustainable development is strongly interconnected with construction industry. Construction industry gains bigger and bigger role because of increase of population in the world. The most rapid increase of population was observed in the last 50 years. Thomas Robert Malthus in Essay on the Principle of Population [6] considered that population increases in geometrical progression, and when unchecked, goes on doubling itself every twenty-five years. This factor stimulates new object construction and building renovation activities. Currently the stock built before 1921 forms an important part of many European cities, and is one of the basis for cultural and social identification of the citizens with their environment, but building age as an important indicator for energy consumption [7]. Nowadays according to UNEP [8], buildings use approximately 40% of global energy, 25% of global water, 40% of global resources and emit about 1/3 of greenhouse gas emissions, at the same time contributing 10% from total GDP and employs 111 million people. Sustainable Buildings Steering Committee highlights buildings impact in such areas [9]:

- energy efficiency and greenhouse gas emissions;
- water;
- materials (consumption, scarcity, life-cycle and waste generation);
- biodiversity;
- social issues (indoor environment);
- economic considerations

All the mentioned aspects show that construction industry has very high economic, social and environmental importance. Research investigates these aspects in the integrated approach and shows interconnection between these parameters.
II. THEORETICAL ASPECT OVERVIEW

The concept of sustainability is complex and affects many areas. The different features of the sustainable development concept are [10]:

- a relationship between the environmental, social and economic aspects;
- a transverse and systemic approach;
- harmonization between short term and long term, based on the precautionary principle;
- a motto of “think global, act local”;
- solidarity between rich and poor countries, with an inter-generational component;
- a new form of governance for strengthening democracy.

However, all these aspects are complex and, for example, some scientists discovered [11] that the concept of social sustainability has been under-theorised or often oversimplified, because each author or policy maker derives own definition according to study perspective or discipline-specific criteria.

Economic, social and environmental impacts are integrated. Jenny Pope, David Annandale and Angus Morrison-Saunders (2004) defined integrated approach to sustainability assessment (see Figure 1).

Sustainability of construction influence variety of aspects and can be analyzed in different areas, such as:

- sustainability of land use policies;
- sustainable construction and sustainable maintenance and facility management;
- sustainable real estate market development.

Sustainable real estate market development and sustainable construction has strong influence on macroeconomic development. Armon Rezai, Lance Taylor, and Reinhard Mechler [13] considered that ecological economics has developed significantly over the last twenty years, but there was not paid sufficient attention to this question at the macroeconomic level - this has been identified before and Keynesian economics suggested as a potent vehicle to establish economic system's thinking, but yet few concrete ideas have been put forward. For example, more efficient land use can result in higher GDP that is important for overall country development.

Sustainable construction itself has high importance for all society. One of the important aspects of sustainable construction is construction quality. Quality in construction includes [14]:

- continuous improvement;
- evidence-based decisions;
- respect for people;
- fault detection and prevention;
- fit for purpose;
- process flexibility and speed;
- focus on results;
- waste minimization;
- external orientation;
- response to change.

Construction process in country is strongly connected with amount of investment in the industry. For sustainability assessment it is important to define amount of investment into environment and ecological buildings. Environmental investing, environmental management and environmental management system definitions are shown in Table 1.

### Table 1. Environmental investing, management and management system definitions [15,p.459](table made by authors)

<table>
<thead>
<tr>
<th>Environmental investing</th>
<th>Environmental management</th>
<th>Environmental management system</th>
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<tbody>
<tr>
<td>is practiced by funds which seek to invest in companies providing environmental technologies and services. Environmental companies are defined in terms of the products and services they provide or the proportion of turnover from a particular product or service. A sound environmental performance track record is not a necessary criterion for investment.</td>
<td></td>
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<td>is management that enables an organization to establish an environmental policy and objectives, comply with them and demonstrate them to the outside world. The policy must be relevant to the organization’s activities, products and services and their environmental effects. It must be also understood, implemented and maintained at all staff levels.</td>
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<td>covers the organizational structure, responsibilities, ways and means of implementing environmental management. It ensures that the activities of an organization, and their effects, conform with environmental policy and associated objectives and targets. It includes the preparation and implementation of a document system of procedures and instructions providing the basis for a program of continuous environmental improvement.</td>
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During a GEO regional consultation held in September 2010, UNEP reported for Europe five key challenges and priority issues for Europe, in no particular order [16]:

- climate change;
- air quality;
- freshwater;
- chemicals and waste;
- and biodiversity.

It was proved that energy conservation in the real estate sector can possess significant possibilities for viable climate mitigation actions, and the payback period of investments in energy efficiency in Finland ranged from 0.1 to 8.2 years [17].
Home prices are influenced by local economic growth variable and follow growth prospects of an urban economy [18]. Increasingly urban green space is seen as an integral part of cities having high importance and providing a range of services to the people and the wildlife living in urban areas [19]. Extensive green roofs have opportunity to be used as mitigation tool for compensation off urban habitat loss, but there is a lack of information about how closely these systems emulate ground-based habitats [20]. The amount of gas and oil processing capacity required to meet demand during the next 20 years is about more than twice the amount realised during the last decades, and Engineering and Construction contractors play the main role in the development and implementation of Large Engineering and Construction Projects for these facilities [21]. Construction and demolition waste has become an important issue due to the volume of construction activity being increasing globally, stakeholders in contingent valuation method can be identified as: public or private clients, designers (e.g. architects and engineers), consultants, main contractors, sub-contractors and material vendors, construction and demolition recyclers, regulators, environmentalists, and the general public [22].

The strategic environmental analysis should be systematic and includes 10 methodological steps that are shown at Table 2 and can provide guidance to market participants.

| Steps 7-8: Environmental opportunity analysis: | - definition of the main environmental opportunities;  
- identification of the main underlying factors and the actors to realise and benefit from these opportunities. |
| Steps 9-10: Formulation of a sustainable development policy plan with action fields and follow-up strategy: | - synthesis of the key factors and actors related to the environmental problems and opportunities;  
- definition of environmental action fields;  
- definition of sustainable development action fields by integrating priority issues from social and economic dimensions;  
- formulation of a policy and coherent action plan for sustainable development based on the strengths and weaknesses of the relevant institutions and existing development policies;  
- formulation of a follow-up strategy, including definition of coordination responsibilities, establishment of a monitoring system with relevant indicators, procedures for regular adjustments to policy using relevant strategic environmental analysis steps, institutional strengthening and capacity building. |

Table 2. 10 methodological steps in Strategic Environmental Analysis (SEAn): The AIDEnvironment Approach [23]

<table>
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<tr>
<th>Steps</th>
<th>Activities</th>
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</table>
| Steps 1-4: Society - environment context analysis and impact assessment: | - identification of the main environmental functions (production and regulation);  
- defining stakeholders dependent upon these functions;  
- assessment of current trends within the functions revealed by environmental indicators;  
- assessment of consequences (impacts) of trends on stakeholders;  
- future generations and natural values, using environmental impact chains and a trend-impact matrix;  
- defining the norms, standards and thresholds involved. |
| Steps 5-6: Environmental problem analysis: | - definition of the main environmental problems, based on the impacts of trends and a risk analysis;  
- identification of the key factors and related actors causing the problem using the action-in-context approach (underlying factors will be mainly socio-cultural, economic and/or institutional). |

All these aspects are important and vital for sustainable construction management and for sustainable development of environment and society as well.

III. PRACTICAL RESEARCH

There are different green building assessment certification systems in the world, such as:

- LEED Canada;
- LEED USA;
- LEED Emirates;
- BREEAM;
- CASBEE;
- Green Star Australia;
- NABERS Australia;
- The Three Star System, China;
- BCA Green Mark Scheme, Singapore and other.

Green real estate development is one of possible measuring and evaluation opportunities that are implemented to reduce negative impacts of construction sector and the building industry on the environment, society, and economy, however, several minuses of green real estate development can be found, such as [24]:

- difficulties in achievement of green building standard in the operational (post- occupancy) stage;  
- while the most sustainable green real estate development designs are made at the early decision-making stages, for example, CAD system does not
support sustainable design very well in energy and performance analysis;

- there is a lack of information of green building development and management from the developers’ perspective, although they take part in the whole process of green real estate development process;

- and most of the leading GB evaluation systems, such as LEED and BREEAM have been developed to suit regional climatic and geographical conditions, but no one system is best suited worldwide.

Commercial real estate energy efficiency including retrofit projects are increasing at a rapid rate in USA, and in 2009, for the first time of US Green Building Council buildings rating, the amount of space certified by the LEED for Existing Buildings: Operations & Maintenance (LEED EBOM) rating system outpaced the amount of space certified by the LEED for New Construction (LEED NC) rating system [25]. Energy consumption areas in residential and commercial real estate sectors are shown in Table 3.

Table 3. Energy consumption in real estate sector [table made by authors, based on [25]]

<table>
<thead>
<tr>
<th>Residential</th>
<th>Commercial</th>
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<tbody>
<tr>
<td>Computers, Cooking, Refrigeration, Cooling, Water heat, Lights, Heating</td>
<td>Office equipment</td>
</tr>
<tr>
<td>Electronics</td>
<td>Wash</td>
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<tr>
<td>Other</td>
<td>Other</td>
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The combination of energy efficiency solutions and profit is a problem for many investors. In USA heating has the biggest share in residential real estate sector, but lights – in commercial real estate sector, and, at the same time, a high interconnection between energy decrease and rent increase followed by increase in net operating income [25]. Capital gains are classified into the following three categories depending upon the holding period of the disposed real estate [26]:

- super short-term gain: holding period of two years or less;
- short-term gain: holding period of five years or less, but more than two years;
- long-term gain: holding period of more than five years.

In investment yield analysis in general such components are recommended to be analyzed [26] - investment outlay, time period of construction process, operating revenues and expenses, refinancing proceeds, property sale.

BREEAM, LEED and DGNB certifications are popular green building assessment systems in Europe. Assessment criteria for all certification systems show high importance of sustainability in general and energy efficiency in particular in buildings. Criteria of BREEAM, LEED and DGNB certification for new construction are shown in Table 4.

Table 4. BREEAM, LEED and DGNB certifications for new construction [Authors construction based on 27;28;29]

<table>
<thead>
<tr>
<th>Environment Quality</th>
<th>Economic Quality</th>
<th>Technical Quality</th>
<th>Site Quality</th>
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In DGNB assessment 1215 certificates and pre-certificates were issued before 13 January 2016, and projects have gold, silver and bronze levels [30]. Currently in Estonia there are 12 Breeam and 5 Leed, in Latvia 8 Breeam and 1 Leed, in Lithuania 6 Breeam and 3 Leed certifications and pre-
certifications [31]. Felicity apartments project in Riga is first residential building in Baltic States that is certified with BREEAM. In 2014 Hanner group bought a land for commercial class A office building construction in Riga, it is planned to work on BREEAM certification [32]. Sustainable construction and energy efficiency in buildings are affected by variety of factors. Energy efficiency motivating and contractionary factors are represented on Table 5.

### Table 5. Energy efficiency motivating and contractionary factors [authors’ construction based on 25; 33; 34]

<table>
<thead>
<tr>
<th>Motivating factors</th>
<th>Contractionary factors</th>
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<tr>
<td>• Financial consideration</td>
<td>• Lack of awareness and leadership particularly related to challenges in making the business case;</td>
</tr>
<tr>
<td>• Marketing advantage</td>
<td>• Work force capacity and the need for proper skills and collaboration along the value chain to implement the right solutions;</td>
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<tr>
<td>• Market differentiator</td>
<td>• Lack of adequate financing models;</td>
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<tr>
<td>• Indicator of competent asset management and paradigm shift [25]</td>
<td>• Lack of consistent and long-term policy frameworks (national and sub-national), including regulations and incentive schemes [33];</td>
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<td></td>
<td>• Difficulty getting started;</td>
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<td></td>
<td>• Limited capital and competition for resources;</td>
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<td></td>
<td>• Shortage of actionable information tailored to grocery stores;</td>
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<td></td>
<td>• Failure to consider all benefits over project life;</td>
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<td></td>
<td>• Lack of specific integrated design methods adapted to grocery store retrofits;</td>
</tr>
<tr>
<td></td>
<td>• Need for reliable data to support business case;</td>
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<tr>
<td></td>
<td>• Desire to minimize risk [34];</td>
</tr>
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</table>

Financial factor can be as well in contractionary and in motivating factors, depending on situation. In additional, international investors can face following risks [26]:

1. language capability of the investor or the investor’s property adviser and requirements of the foreign property situation;
2. legal knowledge of the foreign property environment;
3. political knowledge and foreign contacts for continual investment surveillance;
4. foreign property management availability, quality, cost, and probable performance – on-site and off-site;
5. knowledge of the business and social culture of the foreign country as it impacts the property performance;
6. foreign exchange risk in the receipt and payment of host country and other foreign currencies.

Financial considerations are important in each investment project. Quality of construction and used heating systems results in maintenance costs and have social and environmental importance. Owner-occupied housing price index in Latvia is shown in Figure 2 and increased of owner-occupied housing expenditures by 24.64 points from 2010 is observed.

At the same time there is inequality in housing stock management cost between different regions of Latvia. Highest average monthly housing stock management cost in Latvia is in Riga region (see Figure 3).

Investments in construction and its allocation makes a future view of the city. At Figure 4 offered recommendations for sustainable development of cities.

Building sector makes a step forward to reduction of energy use in buildings, 11 leading companies from the buildings sector support WBCSD plan to reduce the projected energy use in buildings by 50% till 2030 - AkzoNobel, Arcadis, ENGIE, Infosys, Lafarge Holcim, Rexel, Schneider Electric, SGS, Siemens, Skanska and United Technologies [36]. Development of energy prices is important in this context. Electricity and gas prices for domestic consumers are shown in Figure 5 and 6. Stable growth of energy prices in European Union and Baltic states from 2010 can be observed, while changes in gas prices are more pronounces and from 2014 reduction can be observed, these factors
influence maintenance costs, so chosen heating and lighting systems are crucial for residential and commercial building construction.

- reduce transportation, transmission and conversion losses;
- make available renewable energy over the lifetime of the building;
- are highly scalable, widely available, and have high replication potential for future Net-zero energy buildings.

Efficient use of energy resources is crucial for sustainable construction industry development.

CONCLUSION

Construction industry has very high economic, social and environmental importance and employs millions of people worldwide. Increase of population and urbanization process also stimulates new construction and renovation. Sustainable construction industry problems and demotivating factors are analyzed in the research as well. The lack of motivation is the main problem of sustainable construction development, that results in inefficient energy systems, high maintenance costs and has high socio-economic importance. Chosen heating and lighting systems are crucial for residential and commercial building construction, and there is a need for efficient resource consumption system development for different groups of market participants. Research investigates an integrated approach, elaborated motivation model is a future research direction for investments in sustainable construction projects.

REFERENCES


