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MODEL FOR MULTIPLE CRITERIA ANALYSIS OF INTEGRATED INTELLIGENT AND BUILT-UP AMBIENT ASSISTED LIVING ENVIRONMENT

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ABSTRACT

Creation of healthy lifestyle conditions and guarantee of indoor life quality is one of the most relevant issues related to research of indoor microclimate and our environment. Guaranteed indoor life quality would improve productivity, as well as reduce morbidity and healthcare expenditures. Intelligent assisted residential environment embraces technological, organizational and institutional innovations. New technology can help to solve the existing problems and to deal with future problems through more efficient allocation of expenditures and reduced damage to nature, as well as reduced energy

consumption. Based on experience of foreign scientists and completed research, this article describes the model for multiple criteria analysis of intelligent assisted residential built environment developed by the authors.

KEYWORDS

Built Environment, Ambient Assisted Living, Multiple Criteria Analysis, Model

1. INTRODUCTION

Today, intelligent elements are characteristic of almost any building. The concept of intelligent building was first used in the USA in 1980 [1]. Creation of optimal business environment and favourable conditions for activities, as well as reduction of maintenance expenditures—such are the main criteria in the concept of intelligent building. A building can be called intelligent when it has the means for automatic control of all systems for life activities.

2. THE CONCEPT OF INTEGRATED INTELLIGENT AND BUILT-UP AMBIENT ASSISTED LIVING ENVIRONMENT

The term of Intelligent and Built-up Ambient Assisted Living environment (IABAALE) describes a possibility to improve life quality in homes of persons from the most sensitive social groups and to reduce the need for assistance services (nursing, care homes). (IABAALE) has two goals: social advantage (improved life quality) and economic advantage (reduced expenditures of a welfare state). Thus (IABAALE) offers opportunities at various levels:

- Personal: IABAALE satisfies individual needs of stakeholder groups, for instance, safety, health, independence, mobility, participation and social relations (product examples: emergency calls, home security; personal medicine: observation of patients).
- Economic: Intelligent products and processes are: a) improved efficiency of limited resources and reduced prices of healthcare services; b) market opportunities for European industry in promising areas, new commodity markets.
- Social: Improved life quality of persons from the most sensitive social groups; additional benefits for younger generation.

In order to determine which innovations are the main for built-up ambient assisted living environment and to arrange the process effectively, it is necessary to consider relations and factors (Fig. 1). The most important factors are the following:

- factors of micro and macro environment;
- demand (consumers);
- supply (including technology variants);
- solutions and products for built-up ambient assisted living environment (demand and supply combined).

3. MACROECONOMIC FACTORS AFFECTING INTELLIGENT BUILT-UP AMBIENT ASSISTED LIVING ENVIRONMENT

The efficiency of the IABAAL model, which is being developed, foremost depends on the combined effect of variable macro level factors, such as the level of economic, political and cultural development, governmental policy (regional support programmes, control of competition, loans on easy terms, tax exemptions, commissioning of goods and services), legal and normative documents, the taxing system, the process of loan granting, interest rates, insurance systems, social policy, inflation, market, levels of unemployment, qualification of labour force, size of salaries, labour laws, environment protection, customs and traditions, availability of local resources, etc. [2].

National economic environment has a direct influence on IABAAL. It is determined by the policy of national authorities on taxes and money, capital movement, investment environment, loan granting and interest rates. Economic environment is also determined by such factors as demand, supply, competition, pricing, etc. [3]. The main economic indicators, which define development of economy, are the following: development cycles, inflation and

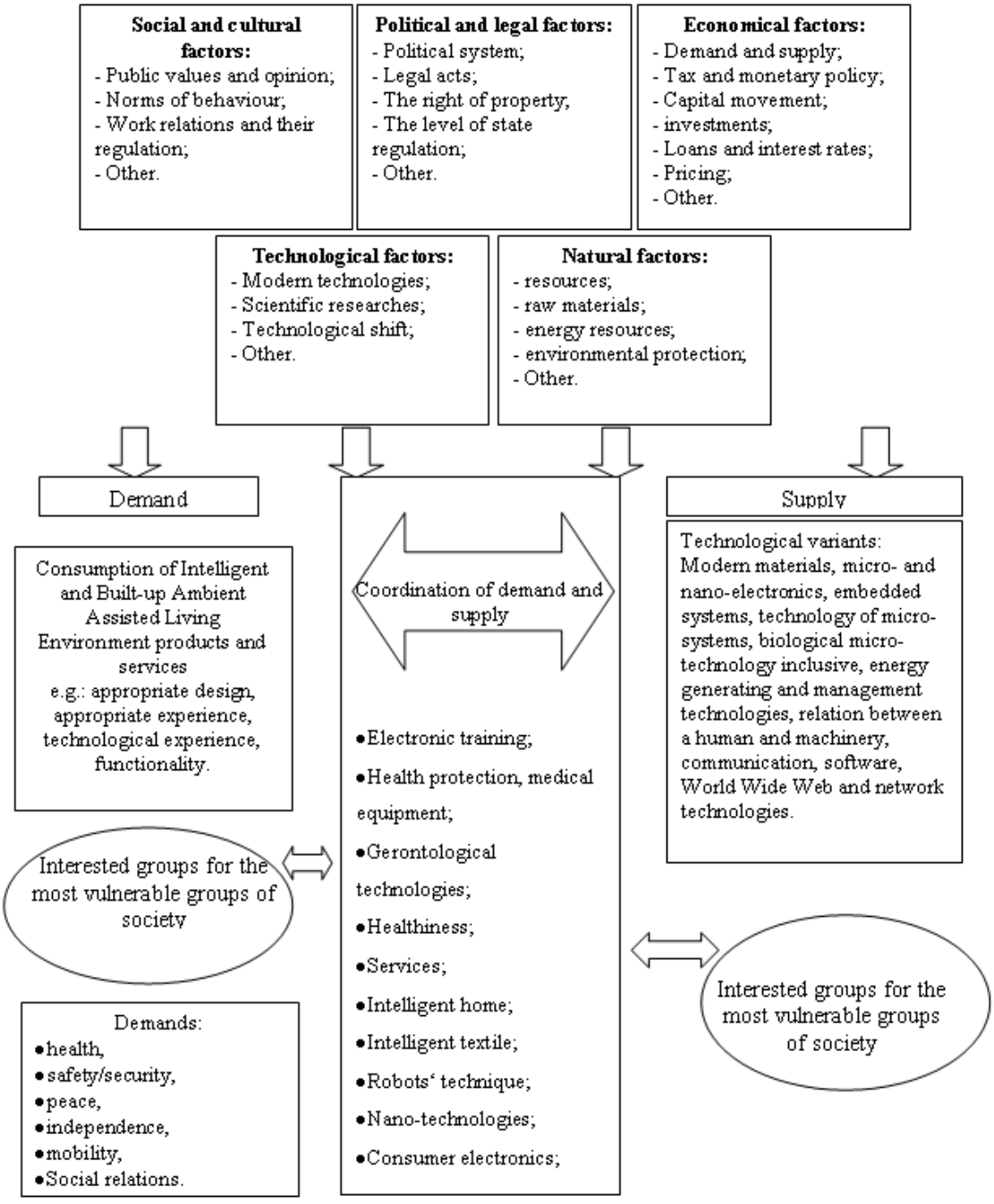

Figure 1. An Intelligent and Built-up Ambient Assisted Living Environment model

unemployment. They also affect change of other indicators (GDP change, consumer income, level of savings, prices of goods, opportunities to get loans). Economic development is irregular-cyclic. Most often construction of housing and its adjustment to the most sensitive social groups, as well as construction and development of intelligent built-up ambient assisted living environment, is funded through loans; therefore, the amount of construction work and possibilities to construct intelligent built-up ambient assisted living environment depend on interest rates.

Social and cultural environment consists of institutions and other factors which help to shape and understand the main social values, opinions and norms of behaviour. Human personality matures in certain society, which determines the main values and opinions. Settled outlook later affects person's relations with other people [4]. Each social group acts in a certain cultural environment, which consists of specific traditions, customs and people following them. Social and cultural factors typically are consistent, the main traditions are passed from generation to generation, and they are strengthened by social institutions: laws, church, etc. Labour relations are among the most important factors of social and cultural environment affecting the efficiency of intelligent built-up ambient assisted living environment. Improved labour relations and career opportunities, as well as use of the newest technology, help organisations, which work with persons from the most sensitive social groups, to use their potential better and to improve efficiency of intelligent built-up ambient assisted living environment.

Political and legal environment has a direct influence on intelligent built-up ambient assisted living environment. Political and legal environment consists of: political system, legislation and ownership rights. State and public establishments and organisations, as well as other stakeholder groups influence political and legal environment. Business is especially dependent on the level of bureaucracy in the current system. The complex process of issuing of construction permits can be provided as an example.

Developed countries adopt laws on control of business for several reasons. The first reason is protection of companies against other companies (e.g. small companies against large). Antimonopoly agencies, organisations supervising competition, commissions on monopolies and mergers help to guarantee observation of laws on competition. The other purpose of state regulation is to protect consumers against illegal actions of businessmen. Some companies, unless they are controlled, would produce cheap products, lie in their advertisements and cheat on their clients by specifying incorrect weight and price on packages. Some countries have strict laws protecting consumer rights. For example, Norway banned some forms of promotion used to stimulate buying – contests and bonuses – as improper or incorrect methods of product support.

Developed countries try to make direct reduction of state expenditures on housing, as well as on construction and development of intelligent built-up ambient assisted living environment. They also strive to reduce expenditures in other ways, for example, by cutting of indirect subsidies. Reasons and trends of reduction of state funding on housing are completely different in Lithuania. They are determined by national macroeconomic and social changes: privatisation, decentralisation, decreasing role of the state and increasing prices of energy resources. Therefore, it is inexpedient to reduce state expenditures (direct and indirect) on housing in Lithuania before the main housing problems are solved.

Technological environment. New technology opens new markets and brings new opportunities. Changes are very swift in technological environment. Companies which fail to foresee and to keep up with shift of technology are forced out from the market. Lifecycle of technology becomes shorter. Scientific research and creation of new technology requires considerable investment. For example, pharmaceutical companies spend from 350 to 450 million euros on development of a new drug. Whereas creation and installation of new technology costs a lot, numerous companies only improve their existing products slightly instead of risking investment into new technology research. Numerous companies, in order to avoid risk related to creation of new technology, just copy products of competitors intended for construction and development of intelligent built-up ambient assisted

living environment. Often they simply slightly change certain characteristics or the style. Therefore, most part of research on new technology is rather in the position of defence than attack.

Natural environment and energy saving. Built and human environment functions in certain natural environment, affects and is affected by it. Natural environment supplies raw materials and resources for construction and development of intelligent built-up ambient assisted living environment.

Lithuanian industry of building materials and products consumes most part of electricity and other types of energy (except for the energy industry). In Lithuania, production of building materials and products demands more energy (due to outdated production technology) than equivalent processes in Western Europe.

Governments of most Western European countries and the USA provide various forms of funding for energy-saving measures in buildings. Energy-saving measures for buildings are expensive and their investment return period is long. Therefore, representatives of the most sensitive social groups lack sufficient funds for implementation of such measures. This and other reasons make them have less interest in implementation of energy-saving measures for buildings compared to the state. State support is necessary in stimulation of energy saving. Efficient consumption of energy resources has considerable influence on economic situation. About 40 % of Lithuanian energy resources are consumed through energy supply to residential and public buildings. Currently, refurbishment and energy saving is among the main issues both in developed countries and in Lithuania. Building activities must be planned in the manner which would grant reduction of the negative effect on the environment to the possible extent and the lowest consumption of energy during the entire building lifecycle (i.e. goal setting and designing, manufacture of building products (including recycling and recycled materials and products), construction, maintenance, facility management and demolition).

Use of energy efficient technology in construction will reduce not only emissions of pollutants causing the greenhouse effect but the general expenditures of building lifecycle as well. Installation of solar technology will reduce emissions of pollutants and save funds. Construction companies and the state need additional expenditures for transportation and utilization of construction waste. Reduced amounts of waste during building lifecycle help to save state funds and funds of construction companies. Minimisation of construction waste has other positive effects as well. Part of waste (e.g. concrete) can be recycled and reused. Bricks and metal can be reused without recycling. Less construction waste means resource saving both for the contractor and for the state, as well as environment protection.

EU imposes strict environmental requirements on industrial waste [5]**.** Environmental policy forces to search for the best ways of industrial waste reuse. Construction is the main consumer of powdery substances and the industrial branch able to use waste of other industrial branches.

Air and water pollution has reached dangerous levels in most cities of the world. Most part of the largest cities of the world suffers from air and water pollution. Companies, especially those producing considerable amounts of industrial waste, complain of expensive fulfilment of liabilities related to ecological requirements and to implementation of new, environment-friendly technology in manufacturing processes.

4. MICROECONOMIC FACTORS AFFECTING INTELLIGENT BUILT-UP AMBIENT ASSISTED LIVING ENVIRONMENT

During creation of the IABAAL model, various factors of micro and macro environment must be assessed. For example, efficiency of the model depends on various micro-level factors. These factors depend on meso and macro level factors (intelligent built-up ambient assisted living environment is regulated by various laws, normative documents, etc.). For example, rather high taxes make national companies either go bankrupt or reduce their efficiency (competition from international companies willing to join the local market decreases due to increased taxes) because of the huge load of taxes. On the contrary, tax reduction attracts international companies to the

local market and they either take away the market share of national companies or the national companies are forced to improve their efficiency in face of such competition. The effects of such process can be observed in various areas (unemployment, changing levels of tax collection, etc.) [2].

The efficiency of the model of intelligent residential built environment is affected by various factors at micro-level:

- land prices and prices of buildings;
- local infrastructure;
- information systems;
- nanotechnology;
- integrated designing of the building lifecycle process;
- improved efficiency of the supply process of construction materials and products through use of internet technology;
- life-long learning;
- funding of construction of intelligent housing;
- contraction agreements;
- process of goal setting;
- designing process;
- process of arrangement of intelligent built-up ambient assisted living environment;
- maintenance process;
- facility management, etc.

It must be stressed that micro-level factors depend on macro-level factors. For example, all activities of the model of intelligent built-up ambient assisted living environment are regulated by various laws and normative documents adopted at the macro level.

5. CONCLUSION

An original model of housing in integrated intelligent built-up ambient assisted living environment has been created; it analyses: intelligent built-up ambient assisted living environment; assessment and improvement of its efficiency using information and intelligent technology; the stakeholder groups acting in such environment and seeking their goals; as well as external and internal micro and macro environment (social, cultural, political, legal, economic and technological factors) as a whole affecting the environment and stakeholder groups. A comprehensive discussion of components of the IABAALE model of housing is provided.

A detailed description of micro and macro environment factors affecting IABAALE is provided. The influence of such factors on IABAALE is described.

Composition of IABAALE target groups, environment conditions, various situations and the current and future household types are analysed. This analysis is used as a basis to assess needs of target groups.

IABAALE solutions are described, areas relevant to creation of IABAALE and some general features are distinguished, and practical examples are provided.

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