Construction demand: a model of research and forecast for Latvia from 2002 to 2025

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CONSTRUCTION BRANCH: MODEL OF RESEARCH AND FORECAST FOR LATVIA from 2002 till 2025.

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In the paper it has been analyzed specific character of building economy; developed a model of branch forecasting, forecast of construction branch in Latvia.
The model consists of two parts: formation of demand and supply. The basic role belongs to demand forecasting. Demand form three components: 1) enterprisal demand for industrial construction and other type of construction, 2) demand on dwelling construction and 3) state construction orders.
In the paper changes in demand are investigated on the basis of increase of population common well-being level, transition of inhabitants from one income group to another and transition influence on formation of construction demand.

Key words: construction economy, dynamic simulation, econometric model, forecasting.

Among the preconditions of national economy development are enterprisal need for basic means, including industrial buildings and structures. At the same time national economy needs to meet the demand of inhabitants for dwellings and other type of buildings. Thus construction production consists from constructed, industrial building being repaired at the moment, dwellings and other type of buildings and structures, communications etc. The growth of construction production specifies both long-term perspective state development, and increase of well-being level of population. Development of construction branch outstrips and stimulates general development of national economy.

Volume of executed civil construction essentially increased in the last years in Latvia. In 2000 construction constuted 6,8% from gross national product (GNP). In 2000 trading space construction has grown by 74%, dwelling construction has grown by 37%, main pipelines construction, communication and power lines construction has grown by 33%. Now in branch works about 6,5% from occupied in national economy and about 13% in branches connected to construction. Construction legislative base has become stronger, professionalism of market participants has grown, new technologies have appeared, improving both design stage and montage and supervision. The level of competition has increased. Now among primary factors of competition are not only construction costs, but also effective organization of all construction process. Those businessmen who are using modern technologies not only in construction process, but also in management, economic substantiation of projects are successful.

One of the main economic milestones is planning. In construction planning plays special role because construction process is long, labor- and capital intensive. Construction characterizes complex technological production; multilateral economic communications with other branches of national economy, plenty of participants of investment process, and features of building production: individual character, long service time etc. Modern management, planning is based on forecasts. Forecasts determine both commercial and national entity behaviors.

There are many problems in national economy and enterprisal forecasting. In economic theory there are a lot of methods and tools of separate parameters forecasting. Methods of historical data analysis are not reliable for forecasting in conditions of tendency change; expert methods are subjective in the essence. Methods, which use economic interrelations, are more reliable. The multilateral approach to models of development forecasting reduces shortages of each separate method. One of main forecasting tasks is to research economic interrelations between parameters or objects of forecasting, creating explanatory model. In construction process separate parts are closely connected, a gain of one object is not possible without general development. The complex approach is necessary for construction branch forecasting. Analysis of internal interrelations is much of importance and should be given some attention not less than researching traditional branch parameters. Taking into account economic interrelations it is possible to expand forecasting in time, and to raise forecast quality to earlier not achievable level, using qualitative and quantitative methods of forecasting.

The offered model of building branch forecasting consists of two basic parts: formation of demand and supply. The basic role in building branch forecasting belongs to forecasting of demand for building production. Demand for building production forms three components: 1) enterprisal on construction industry demand, commercial and other type of buildings and structures, 2) demand on dwelling construction and 3) state (and municipal) building orders. Each component of building production demand has the laws of formation and describing parameters.

1. Forecasting volume of state building orders.

Volume of state (and municipal, further- state) building orders depends on means incorporated in state investment program. This document determines prior state investments directions with detailization by separate projects. The state investment program is accessible to businessmen, making plans for next years, but in reality on intermediate and long-term periods state consumption is a forecasting object. It is determined, that general economic growth, state

incomes' and costs growth are directly interconnected and proportional to growth of state investment program and number of state building orders.

The average volume of state building orders can be defined by following equality (formula 1):

$$\mathbf{V_t = V_{t-1} * \Delta} \qquad (1)$$

Where: Vt - volume of state building orders in predicted period (t),
Vt-1 - volume off state building orders in previous period before forecasting period (t-1),
Δ - general economic growth.

In scientific literature there are considered other methods which mostly search for mathematical tendencies (trend, cycle) and expert estimations (Gaither N. 1990). In intermediate time interval given methods may raise quality of forecasting. But, without considering economic interrelations, relation of volume of state building orders with general economic growth is not possible to forecast in long-term period, especially in changing conditions.

2. Dwelling construction demand forecasting.

Next part of demand forecasting for building production is to define population money resources planned for dwelling construction and its reconstruction. It is accepted, that only private persons form dwelling construction demand and its reconstruction (further- private demand). Dwellings which belong to enterprises and private persons crediting for dwelling construction and its reconstruction are objects for enterprisal activity which is not connected to solvency of private persons and about it will be told in section 3.

Determination of private demand is based on a principle, that inhabitants part of their incomes spend for building production consumption. The bigger an inhabitant income, the bigger its building production consumption. General consumption of building production in state depends on number of inhabitants and their income. The average income of inhabitants, an average share of an inhabitant income directed to purchase of building production, multiplied on number of inhabitants, may give approximate private demand. Given parameter will not show direction on what objects private demand will be directed; how changes in private demand depend on changes in amount, structure of population, change of incomes and general economic growth.

In private demand forecasting it is recommended to divide inhabitants on level of their income to five groups. 1) inhabitants whose income level does not allow to buy building production and which don't make repair work. 2) inhabitants whose level of income allows to make repair work and which carry it out regularly by necessity. 3) inhabitants whose income level allows to buy an apartment and which do it to improve they living conditions and to invest available free capital.

4) inhabitants whose income level allows to buy private house with land plot and which do it to improve they living conditions and to invest available free means. 5) inhabitants with highest incomes.

Simple division of inhabitants on groups raises quality of forecasting; it happens because of deletion of the first group (the first group does not exist in building market), and because of improvements in mathematical sampling, processing of data. But qualitative shift in forecasting can not be reached with this tool. For this goal, it is also necessary to take into account such characteristics as: 1) growth inhabitant number, including natural, 2) increase of inhabitants income a propose of general economic growth, 3) structural changes among population a propose of general economic growth.

It is known, that number of inhabitants in the following period naturally depends on number of inhabitants in given period, on number born, died, migrated in given period. Number of born and died also depends on number of inhabitants in given period, and this parameter is aso influenced by general economic growth, - more economic growth, there is bigger coefficient of natural inhabitants growth. Migratory processes in countries with high level of life, with constant economic growth result in increase of population. The above mentioned parameters are related to well-being level of population. Economic growth causes increase of well-being level and influences increase of population. The Fig. 1 reflects model of increase of population.

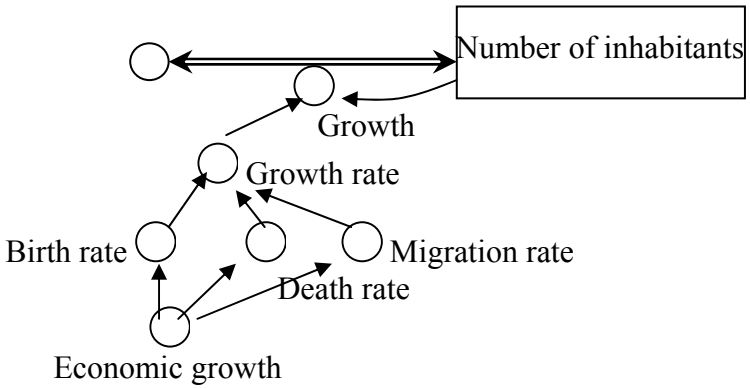

Fig. 1 Model of an increase in population

The model can be shown as a formula (see formula 2).

$$P(t) = P(t - dt) + IDp\, dt \quad (2)$$
$$IDp = P * KDp$$
$$KDp = \Delta * (IDs - IMs + IM) / P$$

Where: P(t) - Number of inhabitants, IDp - increase of population, KDp – coefficient of population growth, Δ - Economic growth in comparison with previous period, IDs – number of inhabitants born, IMs – number of inhabitants died, IM – number of inhabitants migrated.

The Fig. 1 shows above mentioned model of population growth. It is possible to use specified forecasting model to forecast general population number, and growth of population in separate groups. Economic growth influences population groups differently, but most of all groups group of poor people depend on it. Taking into account growth of population, it is possible to improve essentially quality of forecasting of private demand.

The offered model of forecasting of private demand is based on an assumption, that during constant economic growth well-being level of population and incomes of population grows. Part of population proceeds in group with higher incomes, at the same time average income of each group increases. The Fig. 2 shows a model of structural changes in population.

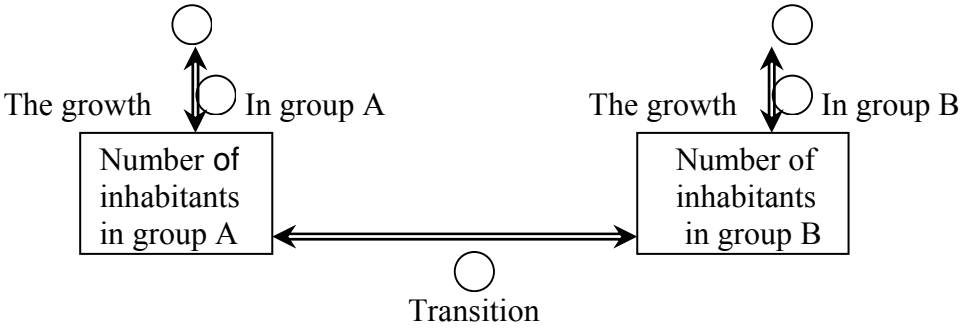

Fig. 2 Model of structural changes in population

The model can be shown as a formula (see formula 3).

$$Pa\,(t) = Pa\,(t - dt) + (IDp\ a - x)\,dt \qquad (3)$$
$$Pb\,(t) = Pb\,(t - dt) + (IDp\ b + x)\,dt$$

Where: P i - number of inhabitants in group i, IDp i - growth of population in group i, x - Transition.

From Fig. 2 it is obvious, that amount of population in group is influenced by growth and transition from one group to another which is determined by transition ratio. Transition ratio shows, which part of group in this circumstances will proceed in group with higher incomes. In the paper it is described more thoroughly transition ratio, its economic essence and methods of formation.

For understanding transitional ratio economic essence, it is necessary to abstract from increase in population and increase of population incomes. It means, that in studied object amount of population by groups in any period is constant and average income of an inhabitant in any group is constant in time. In such conditions economic growth can be reached only by improving general well-being level (due to transition of population in groups with higher incomes), in other words, can be reached by changing population structurally. Knowing level of economic growth and incomes and amount of inhabitants in everyone group, it is possible to define number of

persons who will proceed from one group to another and their relation to number of inhabitants in various groups, i.e. transitional ratio. Theoretically given situation is shown in formula 4.

$$\Delta - 1 = [\Sigma(R_i * P_i') - \Sigma(R_i * P_i)] / \Sigma(R_i * P_i) \quad (4)$$

Where: Δ - economic growth in comparison with previous period,
R_i - average income in group i, P_i - amount of inhabitants in group i in period t,
P_i' - number of inhabitants in group i in period t+1,
$P_i' = F(P_i) = k * P_i$; $\Sigma P_i = At P_i'$; $\Sigma P_i' = a*P1 + b*P2 + c*P3 + d*P4$
k - transition ratios according to each group; a, b, c, d - transition ratios from 1st groups to 2d; from 2d in 3rd; from 3rd in 4th; from 4th in 5th.

Formula 4 shows, that economic growth with our assumptions (in previous paragraph) depends only on structural changes of population. Structural population changes determine transitional ratios a, b, c, d. The economic problem is to define influence of everyone variable ratio in formation of general growth. There are following economic approaches to solve this problem:

1. Influence of each group on formation of general growth is directly proportional to amount of inhabitants in group (method of simple average).
2. Influence of each group on formation of general growth is directly proportional to aggregate profits of group (method of weighed average).
3. Transitional ratios for groups with smaller incomes are bigger than transitional ratios of groups with biggest incomes (differential method). In greater extent economic growth forms in transition of population from poor groups to groups with average incomes, and in smaller extent- from average income groups to prosperous. Advantage of given approach is that economic growth influences more on poor layers of population, as it is observed in practice. Run away from poverty is easier than to become a millionaire.
4. Transitional ratios for groups with smaller incomes are smaller then transitional ratios of groups with biggest incomes. The approach is opposite to 3 point (to differential method) and may be actual only in rare exceptions, that is why in this paper it is described.

Using given approaches, it is possible to determine economic growth a propose of structural changes of population. Formulas determing transitional ratios which taking into account increase in population and changes of average income by groups of incomes are shown in table 1.

1 table

Definition of transitional ratios formulas

	Simple average method	Weighed average method	Differential method
a	$(\Delta^{[1.59*B]}-1)*P_i/\Sigma P_i$	1) $(\Delta^{[1.89*B]}-1)*R_i*P_i / \Sigma(R_iP_i)$ vai 2) $((\Delta^{[2.08*B]}-1)/\Delta)*R_i*P_1 / \Sigma(R_iP_i)$	1) $(\Delta^{[1.49*B]}-1)*P_1/\Sigma P_1$ vai 2) $(\Delta^{[2.65*B]}-1)*R_1*P_1/\Sigma(R_iP_i)$
b			$a*P_2/P_1$
c			$b*P_3/(P_1+P_2)$
d			$c*P_4/(P_1+P_2+P_3)$

Where: a, b, c, d - transitional ratios, Δ - economic growth,
$B = (Dt/Dt-1)^2$; $D = \Sigma (RiPi)$
Ri - average income in group i, Pi - number of inhabitants in group i.

In table 1 are shown constant multipliers calculated on the basis of real data (LR CSP), dividing Latvian inhabitants on above mentioned five groups of incomes. Transitional ratios, determined help of with these formulas carry out theoretically certain formula (see formula 4). The rounding-off of constant multipliers creates mistake of -0.102%, which it is possible to disregard in economic calculations, because of its insignificance, or if it is necessary, it is possible to correct. Mathematical mistake is less using simple average method, and 2nd weighed average method and 1st differential method, but it does not mean, that they should be used everywhere. First of all choice of the method is determined by economic essence of method.

In simple average method all ratios are designed using only one formula (see table 1). Shortage of this method is that it does not take into account incomes of population; also it does not react to changes of incomes by groups, and also on change of aggregate income. This method is recommended to use when economic growth forms increase of population.

The weighed average method provides calculation of transitional ratios using two formulas. For all groups indifferently to income, formula of calculation of transitional ratios is identical (see table 1). Essentially formulas do not differ, but second formula more emphasizes role of economic growth in calculating transitional ratios. Thorough calculation of economic growth allows to reduce essentially method's mistake. Method's shortage in comparison to other methods - occurrence of mistake, under conditions of population structural changes. If ratio of population growth in separate groups would coincide with population general growth ratio, mistake of the method is the same as using other methods.

Differential method provides, that for each group transitional ratios should be calculated using different formulas. Transitional ratio a (transition from 1st group to 2nd) can be calculated, using both method of simple average, and method of weighed average. Other ratios are designed taking into account previous level ratios (b is designed, taking into account a, etc) and relation of inhabitants in group to total accumulated number of inhabitants in previous groups (see table 1). Differential method's mistake is small for simple (first) formula. Differential method's shortage is similar to other methods, the method takes into account new economic quality, but it does improve essentially accuracy, mistake of 1st differential method is not less than mistakes of simple average and 2nd weighed average methods.

It is necessary to note, that in table 1 it is not considered 3rd differential method, which determination is connected with 2nd weighed average method, and theoretically possible differential method which basis is relation of total income of a group to total accumulated income of inhabitants in previous groups. Given methods are not described because of their inadvisibility and impossibility of practical application, so as the methods make very big mistakes in varying conditions (more than 8 %).

Thus, knowing the structure of inhabitants, it is possible to proceed to general model private demand forecasting, shown at Fig. 4.

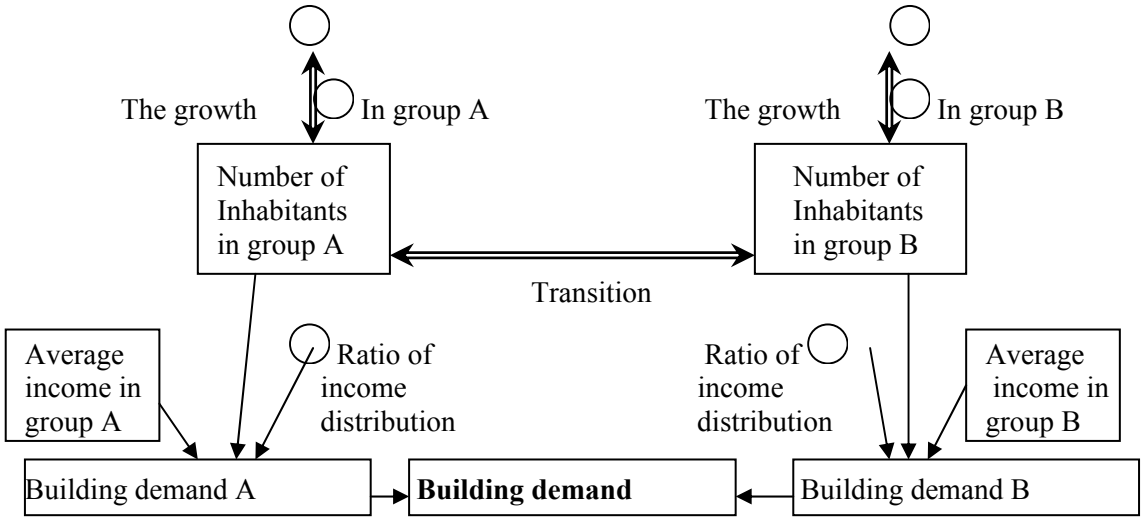

Fig. 4 Model private demand forecasting in construction

The model can be shown as formula (see formula 5).

$$B\ iedz = B\ iedz\ a + B\ iedz\ b \quad (5)$$
$$B\ iedz\ i = Pi\ (t) * Ri * APC\ b$$
$$Pa\ (t) = Pa\ (t - dt) + (IDp\ a - x)\ dt$$
$$Pb\ (t) = Pb\ (t - dt) + (IDp\ b + x)\ dt$$

Where: B pri - general private building demand, B iedz i – private building demand in group i, P i - amount of inhabitants in group i, Ri - average income in group i, APC b - income distribution ratio (average propensity of building production consumption), IDp i - increase of population in group i, x - transition.

Fig. 4 shows, that general private building demand consists of sum of demands of separate groups of inhabitants; demand of inhabitants in group depends on number of inhabitants in group, income ratio of income distribution. Given model allows to forecast private building demand qualitative, taking into account its economic interrelations, parameters of formation and dynamic development of processes.

3. Forecasting of commercial building demand.

Next part of building demand - enterprisal demand for construction industrial, commercial and other type of buildings and structures (further - commercial building demand). Main assumption in forecasting of commercial building demand: enterprises continuously restore buildings, using means received from enterprisal activity. Actually given assumption may not be effective in short-term and intermediate term- buildings may function without repair 10 - 15 years. But in long-term period in conditions of effective enterprisal environment given assumption justifies itself completely.

It is possible to accept, that commercial demand is equal to reduction (in money expression) of enterprsal buildings because of deterioration of buildings in commercial- production activities. Using sum of deterioration it is possible to define commercial demand. Actual deterioration has no connection to accounting and economic deterioration of buildings (depreciation). Actual deterioration determines industrial intensity and technical parameters of buildings, major of them –stipulated time of operation of a building, maximal time of operation, time of full physical deterioration without repair, reserves of restoration and service life of a building. Technically in the first years of operation of a building it demands smaller capital investments for repair, but in the following - bigger. Costs for operation of a building can be determined using formula 6.

$$\mathbf{S = Ss * k / (A - t)} \qquad (6)$$

Where: S - costs for operation at the moment t, Ss - costs for construction of a building, k – restoration ratio, A - maximal time of operation of a building, t - time, $A > t => 0$.

A new building can be build, when means invested in repair of a building prolong building service time than means invested in construction of a new building. These are conditions of restoration of buildings. Given time can be calculated, using formula 7.

$$\mathbf{t = (S - Ss) *T1/Ss} \qquad (7)$$

Where: T1 - time of full physical deterioration without repair.

Formulas 6 and 7 are related with physical deterioration of buildings in time, indifferently of their using intensivity. More often enterprises build and use buildings being based on interrelations shown in formulas 6 and 7. Nowadays additionally to operation and construction of buildings exists obsolescence of buildings which is not described by the above mentioned interrelations. Obsolescence of buildings means that profit received from its use during service of a building is less than its possible profit after reconstruction. Obsolescence of buildings is observable internationally. Because of high prices of heating energy, there is an actual problem

of buildings heat insulation in Latvia. In the big cities of USA (for example, New-York) use of 5-9 floor houses in city center not effective because of high prices of land, therefore in place of such houses erected buildings not less than 25 floors.

Obsolescence of buildings determines changes in building technologies and economic- social changes, including economic growth. In the given paper there is no purpose and task to forecast change in building technologies. In the paper it is accepted, that changes in building technologies, their economic influence reflects general economic growth (GNP growth). So, the GNP growth covers difference between determined by formulas 6 both 7 and real commercial building demand. Taking into account GNP growth in formulas 6 and 7, it is possible to determine real commercial building demand.

Knowing number of buildings in enterprisal disposition, year of their construction and other technical parameters, it is possible to calculate physical deterioration of buildings and means needed for their restoration. In calculation it is expedient to divide buildings on groups reposing of their construction time. The model of commercial building demand is shown on fig. 5.

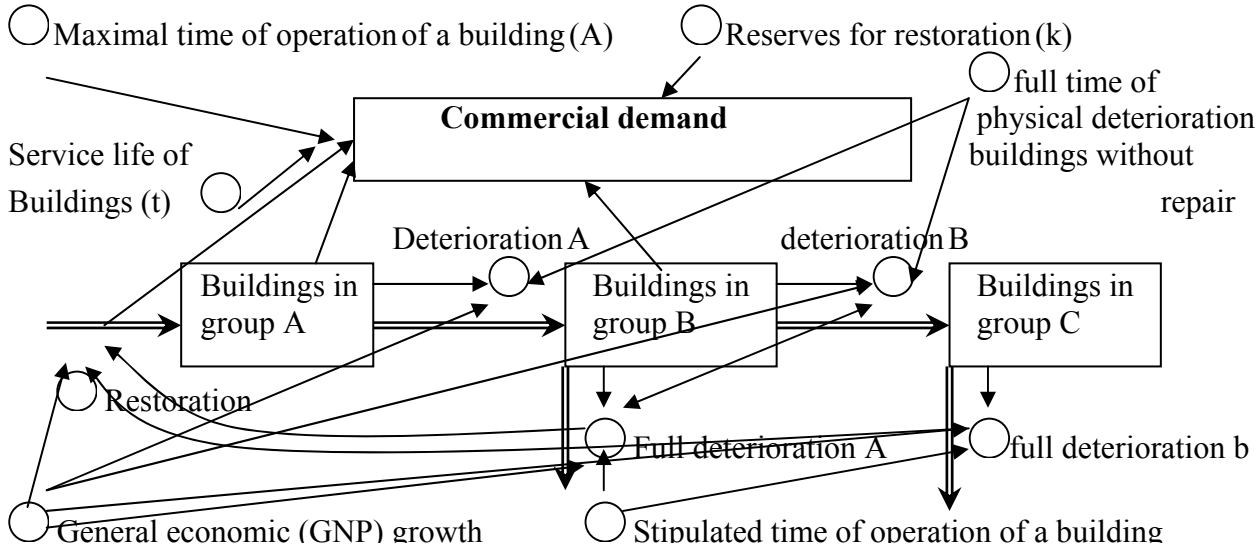

Fig. 5 Model of commercial building demand

The model can be shown as a formula (see formula 8).

$$B_{com} = Re + Ea * k / (A - t) + Eb * k / (A - t) \quad (8)$$

$$Re = \Delta * (Mg\ a + Mg\ b)$$

$$Ea(t) = Ea\ (t - dt) + (Re - Ma)\ dt$$

$$Eb(t) = Eb\ (t - dt) + (Ma - Mb - Mg\ a)\ dt$$

$$Ec(t) = Ec\ (t - dt) + (Mb - Mg\ b)\ dt$$

$$Ma = \Delta * Ea * (T1 - t) / T1$$

$$Mb = \Delta * Eb * (T1 - t) / T1$$

$$Mg\ a = \Delta * Ea * T / (T - t)$$

$$Mg\ b = \Delta * Eb * T / (T - t)$$

Where: B com – commercial building demand, Re – restoration of buildings, Ei – buildings in group i (in money expression), k – factor of restoration of buildings, A – maximal time of operation of a building, t - time of operation of a building, A > t = > 0, Mg i – full deterioration i, Mi – deterioration i, Δ – general economic (GNP) growth, T1 time of full physical deterioration of a building without repair, T – stipulated time of operation of a building.

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General building demand forms enterprisal solvent need to construct industrial, commercial and other type of buildings and structures, dwellings and state building orders. Major topic in forecasting of building branch development is to understand internal economic processes. Explanation of demand forming mechanisms gives a possibility using various mathematical-economical methods to develop forecasts, to model development of a situation.

4. Practical implementation of construction industry forecasting model.

Use of offered model of forecasting of building branch is important so as allows to reduce influence of uncertainty to choose perspective ways of development of national economy and enterprisal activity, both allows to achieve economic efficiency. Complex approach to building branch forecasting (and also to other industrial branches forecasting) is rather new and poorly investigated aspect in economic theory and practice.

1 table

Basic initial data for construction industry forecast

Forecasting year / Parameter	6 (2006)	12 (2012)	18 (2018)	25 (2025)
GNP growth, %	2.67	0.45	0.08	-0.01

In the report all forecasted parameters are not shown taking in to account difficulty of the model. The most important parameters are in the table 2.

2 table

Construction industry forecast in Latvia 2000- 2025

Forecasting year / Parameter	6 (2006)	12 (2012)	18 (2018)	25 (2025)
1	2	3	4	5
Volume of the state building orders, mill. Ls	**137.98**	**145.83**	**147.54**	**147.71**
Transition ratio a, %	1.75	0.35	0.06	-0.01
Transition ratio b, %	1.32	0.29	0.05	-0.01
Transition ratio c, %	0.26	0.07	0.01	0.00
Transition ratio d, %	0.09	0.02	0.00	0.00
Population in the first revenue group P1, pers.	1215811	1153124	1180716	1252669
Population in the 2nd revenue group P2, pers.	918556	951311	989891	1052385
Population in the 3d revenue group P3, pers.	183702	225899	243080	259553
Population in the 4th revenue group P4, pers.	60799	62982	65764	69954
Population in the 5th revenue group P5, pers.	994	1188	1273	1359
Total income in the first revenue group P1, mill. Ls	187.35	190.81	198.39	210.90

Continue of 2 table				
1	2	3	4	5
Total income in the 2nd revenue group P2, mill. Ls	3538.68	3935.29	4158.08	4429.58
Total income in the 3d revenue group P3, mill. Ls	1132.32	1495.16	1633.71	1747.97
Total income in the 4th revenue group P4, mill. Ls	608.98	677.40	718.24	765.55
Total income in the 5th revenue group P5, mill. Ls	13.79	17.69	19.25	20.59
Private construction product demand, mill. Ls	**339.58**	**396.29**	**423.30**	**451.59**
Buildings in group A(new buildings), mill. Ls	1711.11	1774.53	1830.73	1896.23
Buildings in group B(from 25 to 50 years old), mill. Ls	1145.30	1212.39	1253.23	1285.20
Buildings in group C(from 50 to 75 years old), mill. Ls	334.22	304.17	257.63	205.74
Buildings in group D(old buildings), mill. Ls	376.57	332.94	293.95	249.81
Renovation of buildings in group A, mill. Ls	19.74	21.73	23.88	26.46
Renovation of buildings in group B, mill. Ls	22.03	24.74	27.24	29.89
Renovation of buildings in group C, mill. Ls	7.91	7.64	6.89	5.89
Renovation of buildings in group D, mill. Ls	9.47	8.89	8.36	7.60
New buildings and structures construction, mill. Ls	821.01	766.58	720.15	675.61
Commercial construction product demand, mill. Ls	**880.16**	**829.58**	**786.52**	**745.45**
Total construction product demand, mill. Ls	**1357.72**	**1371.71**	**1357.36**	**1344.74**

This model, developed forecasts can use governmental services, commercial companies, scientists and students in their work.

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Skribans V. Būvnozare: pētīšanas modelis un prognoze Latvijai 2002- 2025.
Ekonomiskā teorijā un praksē ir daudz metožu un paņēmienu prognozēšanai. Vispiemērotākās ir metodes, kuras izmanto ekonomiskās sakarības. Darbā piedāvāts būvniecības piedāvājuma prognozēšanas modelis. Kopējo būvpieprasījumu veido uzņēmumu ēku būvēšanas un remonta maksātspējas vajadzības, dzīvojamo ēku pieprasījums un valsts pasūtījumi. Galvenā darba novitāte ir saistīta ar privātpersonu būvniecības pieprasījuma prognozēšanu. Piedāvātā prognozēšanas modeļa lietošana ir svarīga, jo ļauj samazināt iedarbību nenoteiktos apstākļos, ļauj izvēlēties perspektīvus ceļus uzņēmējdarbības un tautsaimniecības attīstībā, sasniegt ekonomisko efektivitāti. Kompleksa pieeja būvnozares prognozēšanai ir samērā jauns aspekts ekonomiskajā teorijā un praksē.