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COACH TERMINAL AS IMPORTANT ELEMENT OF TRANSPORT INFRASTRUCTURE

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Abstract. The determination of the coach terminal as passenger logistics hub is described. The factors responsible for successful functioning of this hub are discussed. The location of the coach terminal is one of the important factors. The present coach terminal is located in the heart of the city where land availability is critical. The simulation model of the terminal was developed to complement the design and construction of a new one. The used simulation package VISSIM has visual reference to assist in explaining the complexity of transport node's job and analysis of possible congestions. During the development of the modelling the critical bottlenecks are identified and decisions are taken to reduce the risk of their occurrence, the solution being immediately incorporated into the final design of the coach terminal under development.

Keywords: coach terminal, passenger logistics hub, design, simulation modelling, planning, experiment.

1. Introduction

By definition a coach terminal is a linear construction consisting of specific buildings, platforms and a territory for the rendering of services to passengers and coaches during the routes. To ensure an effective operation of such a linear construction, to be able to render high quality services both to passengers and to haulers in conformity with their needs, the functions and operational activities of a coach terminal have to be evaluated on a larger scale. We would like to suggest considering a coach terminal as a passenger hub of logistics, taking the operational and development model of the JSC "Riga International Coach Terminal" ("Rīgas starptautiskā autoosta") as a basis.

The objective of the development concept of the JSC "Riga International Coach Terminal" is: "To develop the JSC "Riga International Coach Terminal" as a new passenger modular transfer and service point meeting the future requirements for high culture and diversity of passenger servicing and interlinking with other types of public transport – the railway, urban public transport, sea port and airport".

To develop an effectively operating hub of logistics, there has to be an assessment of the main critical factors for the successful operation of such a hub [1]: location, support by government labour forces, etc. (Fig 1).

Today in many countries coach terminals that were built in the middle of the previous century need to be reconstructed or built anew, in conformity with the current requirements for transport development. From this point of view it is especially important to select such a location where a coach terminal would be able to fulfil the functions of a passenger hub of logistics not only now but in future also. This is the reason why in this article we pay attention to factors that are related to the location of a coach terminal and the technical characteristics.

2. Partnership. Opportunities of logistics development

JSC "Riga International Coach Terminal" cooperates with 53 hauler companies and 8 travel agencies, including the concluded co-operation agreements with 21 passenger hauler companies engaged in international transfers, of which 11 are foreign companies. 13 foreign countries are the destination of coaches from Riga International Coach Terminal [2]. There is a list of international routes in 2006 from Riga International Coach Terminal in Table 1. Breakdown of routes by types and directions are characterised by the information in Table 2.

The international routes constitute only 8 % of the total number of the serviced routes of the coach terminal, however for the strategy of coach terminal's operation the development of the coach terminal as an inter-

Passenger Logistic Hub

Strategic location	Support by government	Logistic infrastructure services	Partnership. Opportunities of logistic development	Quality of labour force	Development of information technologies
• Market share; • Location	• Regulation of enterpreneurship; • Tax legislation; • State aid (grants, recovery of losses)	• Technical characteristics of a coach terminal; • Possibilities of inter-modal transfers; • Level of services	• Co-operation with haulers; • Co-operation with public authorities regulating haulers; • Co-operation with other stakeholders (Travel agencies, service providers, etc.)	• Training of personnel; • Management of human resources; • Ensuring high quality services	• IT and telecommunication infrastructure; • WEB based easy interface; • E-commerce platform

Fig 1. Critical factors for Logistics Hub

Table 1. International routes to foreign countries and cities from Riga International Coach Terminal (2006)

Country	Cities
Estonia	Tartu, Tallinn, Parnu
Lithuania	Vilnius, Kaunas, Klaipėda, Šiauliai, Panevėžys, Mariampolė
Russia	Moscow, St. Petersburg, Novgorod, Kaliningrad, Smolensk, Pskov, Ostrov, Luga, Pitalovo
Belarus	Minsk, Vitebsk, Grodno, Braslau, Lida
Ukraine	Kiev, Odessa, Lviv, Dnepropetrovsk, Doneck, Poltava, Luck, Kovel, Dubno, Truskavec
Poland	Warsaw, Belostock, Suwalki, Augustovo, Lodz, Censtohovo, Katowice, Krakow
France	Paris, Lille
Netherlands	Amsterdam, Utreht, Bred, Rotterdam
Belgium	Brussels, Antwerp, Gent
Germany	Berlin, Brehmen, Bonn, Duesseldorf, Dresden, Dortmund, Essen, Frankfurt Am Main, Kassel, Kologne, Karlsruhe, Munich, Munster, Manheim, Stuttgart, Hamburg, Hanover, Nuremberg, Leipzig, Hemnic, Augsburg, Ulm, Magdeburg
Great Britain	London, Canterbury, Dover
Italy	Venice, Bologne, Verona, Milan, Pezaro, Ankona, Peskara, Rimini
Switzerland	Bern, Zurich, Wintertour, Sanktgalen

Table 2. Average number of routes per day and breakdown by directions (at the peak hours in 2006)

Routes	Average number of routes per day						
	Total number per day	7:00–8:00	8:00–9:00	9:00–10:00	16:00–17:00	17:00–-18:00	18:00–19:00
International	60	5	7	1	6	5	7
Long-distance	471	25	35	37	43	48	43
Regional	39	1	1	1	1	6	1
Total	**570**						
By directions:							
Kurzeme	112	6	4	7	9	13	8
Zemgale	214	14	20	16	15	16	15
Vidzeme	104	6	16	10	15	19	18
Latgale	140	5	3	6	11	11	10

national point of logistics and transfer is of significant importance (Fig 2).

From the previous coach terminal on the outskirts of the USSR the Riga International Coach Terminal has now developed into a significant international traffic infrastructure object. Such political and economical factors as

- accession of the Republic of Latvia to the EU;
- development of travel industry;
- movement of labour force;
- visa facilitation, e.g. non-visa entry for the EU citizens to the Ukraine etc., considerably increases the demand for international traffic. Even such factors as the operation of low-cost airlines, creating as if a competition for the in-

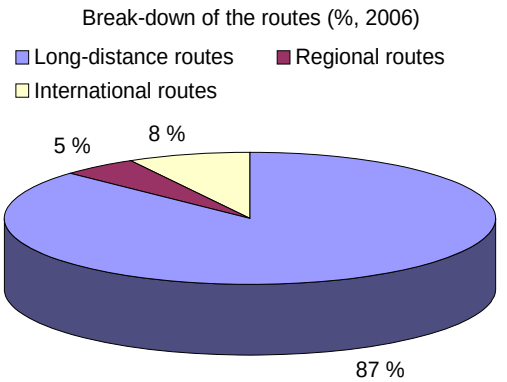

Fig 2. The distribution of routes in the Riga International Coach Terminal

ternational coach transfers of passengers, to a certain extent enhance the promotion of coach traffic from those regions where there still do not exist the services of such low-cost airlines. Within the area of international transportation of passengers it is important to develop the transfer opportunities, and not just from one coach route to another, but to merge it with other types of passenger transport.

The JSC "Rīgas starptautiskā autoosta" (the Riga International Coach Terminal) is a member of the Pan European Association of Coach Terminals, and one of the main objectives of this Association is to develop the logistic services within the area of passenger transportation for both passengers and haulers.

All the above listed factors are of outstanding importance for effective planning of coach terminal's operations, and to ensure in future the perception of a coach terminal as a centre of logistics.

The technical parameters have been selected for the analysis with the objective to make projections of possible risk factors of terminal's operation already during the coach terminal's designing phase, and by minimisation of these critical risk factors to be able to select the best future solution.

3. Logistics, infrastructure, services

It is of outstanding importance for running a coach terminal to have internal logistics of its operation, the level of infrastructure, the variety and quality of services rendered. The most significant preconditions are characterised by the following [3]:

Access possibilities

1. For buses and coaches:
   - 1.1. access roads (streets);
   - 1.2. location of getting on/getting off platforms;
   - 1.3. possibilities of parking between routes;
   - 1.4. possibilities of coach manoeuvring.
2. For participants of external traffic: pedestrians, bicyclists, taxis, users of personal cars, urban public transport:
   - 2.1. pavements, crossings;
   - 2.2. access roads;
   - 2.3. organisation of getting on/getting off;
   - 2.4. parking places.
3. For passengers in the coach terminal:
   - 3.1. for entrance and exit and getting on/getting off platforms;
   - 3.2. traffic/passenger flow to/from/along the platforms;
   - 3.3. the access to coaches (getting on, getting off, location of luggage, assistance to disabled persons, etc.);
   - 3.4. transfer and crossing to other vehicles;
   - 3.5. a plan of the coach terminal, organisation of passenger servicing, compliance with the demands of capacity;
   - 3.6. possibilities of travel tickets reservation/purchase (at the coach terminal, distance reservations and purchases – via agencies, Internet).

Content and layout of information

1. General information on availability of services.
2. Information about coach routes/destinations, interim stops, potential alternative solutions.
3. Information about the coach time schedules at destinations, at interim stops, about the duration of travel, accuracy of compliance with the time-table.
4. Information about the travel costs, about possible cost discounts, bonuses. Order of ticket reservation and sales, various options of payment as well as the options of cost compensation in case of travel cancellation.
5. Information about ancillary services, e.g. movement of luggage, its storage, use of the waiting lounge (waiting lounge or rest rooms) in case of transfer from route to route, etc.
6. Information about physical assistance to disabled persons, persons with children.
7. Information about the rights and obligations of passengers.

Comfort

1. Quality of air, temperature regime within the premises of the Terminal.
2. Sheds, elevators, staircases, escalators.
3. Ensuring clean environment.
4. Convenient lighting.
5. Noise isolation.
6. Waiting rooms, seats.
7. Premises of individual hygiene (toilets, showers, rooms for mothers and children).
8. Other services: ensuring communication services; services of public catering and trade. possible options for pastime, etc.

Security/protection

1. Video surveillance.
2. Presence of security officers.
3. Easy-to-locate first aid office.
4. Prevention of pollution.
5. Measures to prevent various risks (fire security, prevention of terrorism, preventive measures against accidents, etc.

4. Strategic location

The Riga International Coach Terminal is located in the central part of Riga and it provides services to regional, long-distance and international routes, on average rendering services to 565 local and 63 international routes per day. Every year on average 5–6 million passengers receive the services of the terminal.

The location of the coach terminal in the centre of Riga next to administrative, trade, cultural and educational centres is a tremendous advantage for the passengers. An additional advantage is the location of the coach terminal next to a railway station, close to the sea port and at a convenient distance from the airport, as well as with easy access to the urban public transport network.

However, one of the most serious critical factors for a sustainable future development of the coach terminal is the insufficient space of the territory for further development of the terminal. During the peak periods the coach terminal is already operating close to the limits of its capacity. Another critical factor to be mentioned for the activities of the terminal are traffic jams in Riga, – they have negative impact on the compliance with the timetable of coach arrival and departure.

After the assessment of the development of Riga transport system in future and the potential increase of the number of coach passengers, the experts ("Imink" Ltd) recommend to develop the sites for route destination of public transport at several locations in Riga, by developing for passenger transport routes entering and leaving Riga a multimodal transport hub on the outskirts of Riga: the coach terminal-railway-Riga passenger sea port-airport "Rīga", as well as to add the transfer functions to the Riga International Coach Terminal functions also [4].

To increase the carrying capacity of the Riga Coach Terminal according to the amount of the passenger flow, to the supply of services to passengers on the outskirts to develop an additional new system – from three territories located in the buffer zone of Riga historical centre.

One of the support points of the Riga International Coach Terminal is a new coach terminal under development in Riga, Pardaugava, on Vienibas Gatve 6. The territorial location of the land plot is close to the railway station "Torņakalns", next to a newly developing administrative and cultural centre of the city. There is a possibility to develop a rather convenient transfer from buses and coaches to the urban public transport.

The critical factor could be the necessity to transfer to other means of public transport, so as to get to the city centre. The coach terminal to be developed is not equally advantageous for all geographic directions of coach routes. The said negative factors are the main reasons for the determination of servicing sector of a new coach terminal – the coach routes from Kurzeme and Zemgale, according to the priorities of transport organisation in Riga.

A new coach terminal will ensure the possibility to implement the necessary reconstruction of the central coach terminal on Pragas street 1, having the temporary solution for servicing of coach routes on Vienibas Gatve (Fig 3).

5. Decision making about location of a new coach terminal with models

The selected method for analysing the offered decisions is modelling. Considering a coach terminal as a transport node for modelling, it is possible to distinguish at least the following chain of modelling: forecasting of the short-time and long-time demand for transportations; planning of premises scheme inside the terminal, timetable optimisation, etc.

A model (*in decision making*) is a simplified representation of reality. Simplified because reality is too complex to copy exactly and much of the processes complexity is irrelevant to a specific problem. The most important benefits of modelling in decision-making are the cost of mistakes much lower in virtual experimentation and modelling allows the analysis and comparison of a very large number of possible alternative solutions. The main goal of using modelling at the stage of a transport node planning is the analysis of future decisions and their influence on common situation around. A simulation model is the most useful means for it in micro-level modelling. The availability of a simulation model at the pre-planning and planning stages will allow analyzing the possible design solutions and finding out an optimal one.

Simulation generally refers to a technique for conducting experiments (such as "*what-if*") with a computer on a model of a studied system. Advantages of simulation are the following:

- allows including the real-life complexities of problems; is descriptive;
- can handle an extremely wide variation in problem types;
- can show the effect of compressing time;
- can be conducted from anywhere.

The objective of modelling is to develop a transport traffic diagram within the territory of the coach terminal, then adding to it the diagram of foot traffic (pedestrian movement) and the diagram of vehicles' traffic in the surrounding environment of the terminal. The process of model constructing on the basis of the simulation package VISSIM and experimentation on coach terminal new design are described in the article [5]. It was noticed that in general a new coach terminal is able to provide the current schedule. However, the

experiments with simulation model have shown that the scheme of transport vehicles' exits from the coach terminal territory suggested for today is no optimal and leads to a queue formation (Fig 4). In the process of a model construction and its operation analysis the recommendations for the coach terminal design changes had been suggested that resulted in the change of the bus station plan project taking into account the determined disadvantages.

It is necessary to use the simulation model for the stage of new transport node planning. There is a framework for decision making with models in Fig 5. All stages of this process are important but we are paying a special attention to two stages: forecast planning variables and monitoring function. In order to test the solutions it is necessary to estimate the inputs to the model. It concerns knowing not only the current values of these variables but also estimating the future values of these inputs.

These forecasts have to use the future scenarios of territory development and are the object of other serious analysis and modelling.

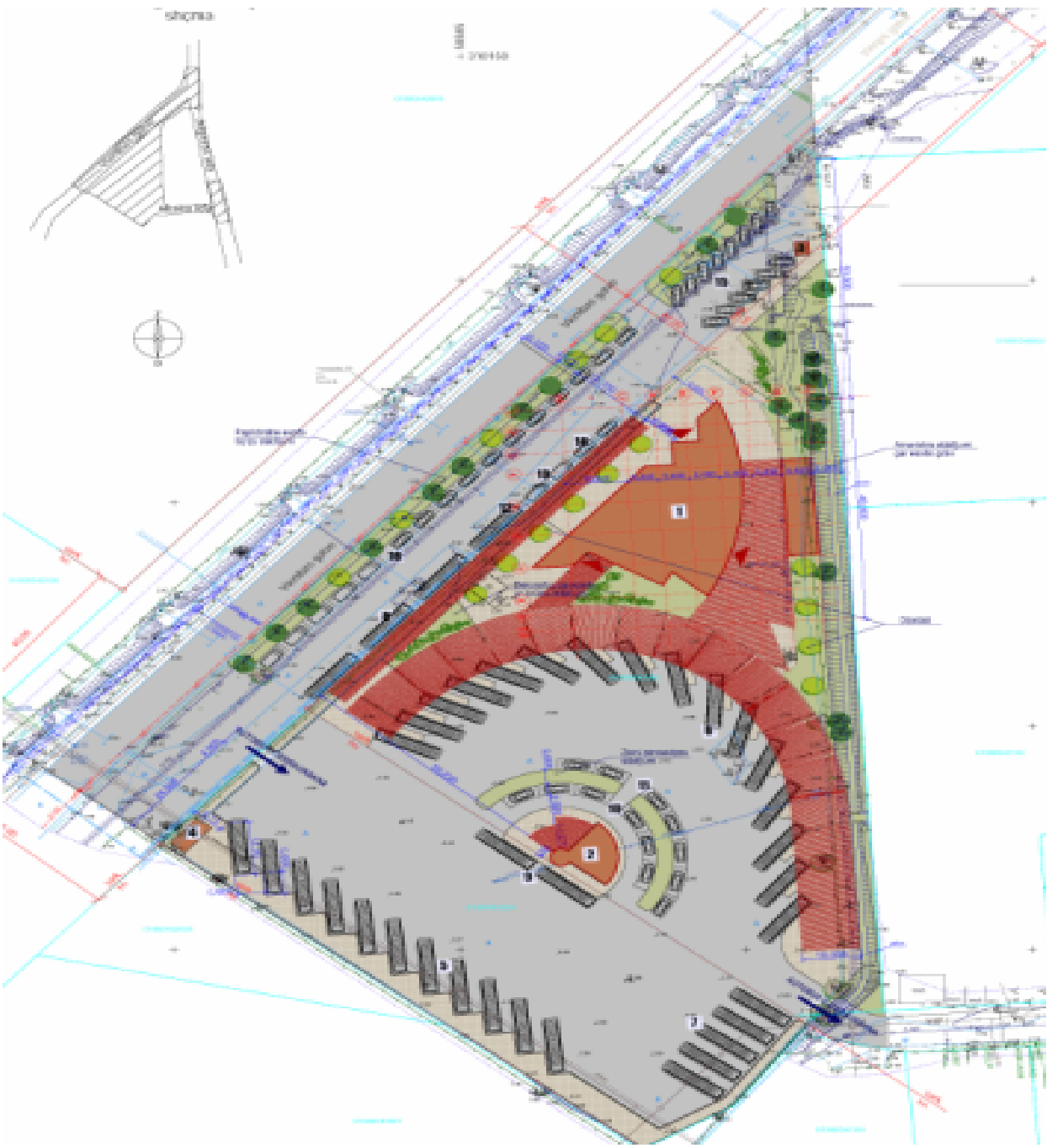

Fig 3. Plan of a new Riga Coach Terminal on Vienības Gatve, Street in Pardaugava

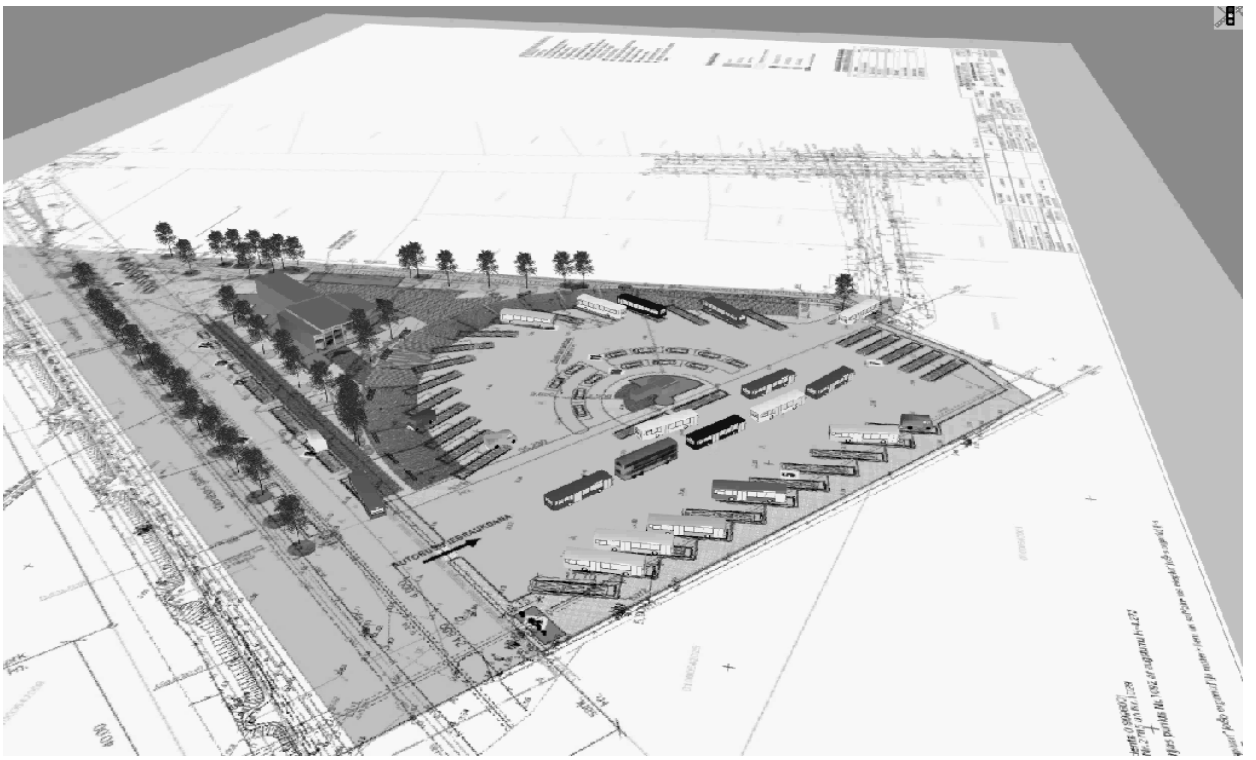

Fig 4. The simulation model of a new coach terminal

A monitoring function is the additional detail to standard process of decision-making with models [6]. This function is the key moment in improving the models. It concerns that: the data, which can be requested additionally, models that can be reconstructed according to changing the strategy and so on. This adaptive decision-making is more flexible and may take into account the fast changing situation in transport system in total.

6. Conclusions

The engineering approach to logistics and transportation implies mathematical modelling and computer-based solutions to optimise the decision making process. The approach to coach terminal as a passenger logistics hub gives the possibility to use the system approach for decision-making in infrastructure planning.

The advantage of using the simulation model at the planning stage of a new coach terminal is described. This model was constructed for analysis of the proposed terminal's design. During the development of the modelling the critical bottlenecks are identified and decisions are taken to reduce the risk of their occurrence, the solution being immediately incorporated into the final design of the coach terminal under development. It is important that the team, which has been working at decision making with models, has a close and constant collaboration between them. Representatives of terminal management and specialists in modelling need to validate each model, each result, using standards of their physical attributes, supplemented with observed timings and passenger quantities within the terminal.

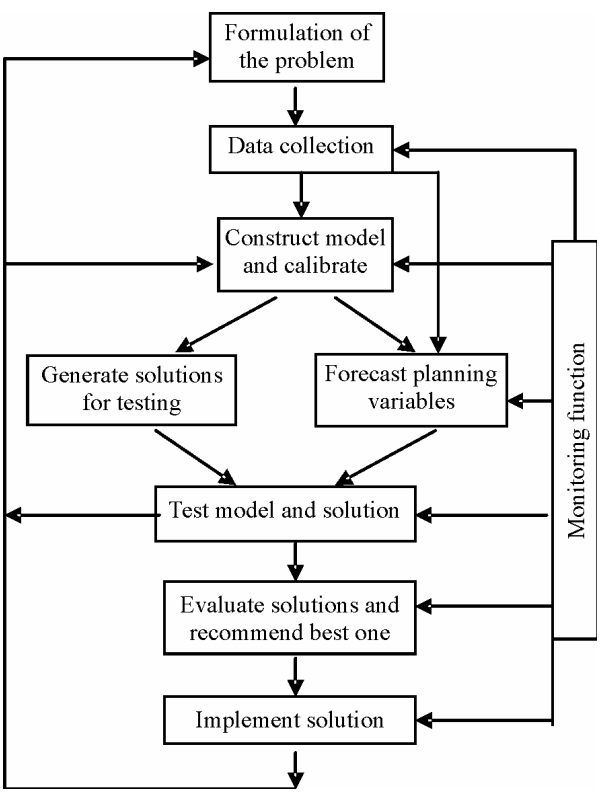

Fig 5. Planning and monitoring with models

References

1. LITTLE, A. D. *Strategy to attract global logistics enterprises in the Republic of Korea*. A report for the ministry of maritime affairs and fisheries of the Republic of Korea, 2003.
2. Pirate. Making Interchange Successful. Handbook& Guidelines. Project founded by EU commission under the transport RTD Programme of the 4th Framework programme. 119 p.
3. Nonpublished materials "Rīgas Starptautiskā Autoosta" JSC. Riga, 2006.
4. Development of public transport route destinations in Riga city, "Imink" Ltd, Riga, 2006.
5. GROMULE, V.; JURSHEVICH, J.; YATSKIV, I. Application of simulation modelling at the stage of transport node planning. RelStat'06, Riga, 2006. *Transport and Telecommunication*, 2006, Vol 7 (3), p. 178–187.
6. ORTUZAR, J. de D.; WILLUMSEN, L. G. *Modelling Transport*. Wiley: NY, 2005. 499 p.