MAIN ESTABLISHMENT CONDITIONS OF LOGISTICS CENTRE AND IT FINANCING FACILITY

Ieva Meidute

Vilnius Gediminas Technical University
Plytines Str. 27, Vilnius, LT-2016, Lithuania
E-mail: jevame@ti.vtu.lt

The paper deals with the Logistics centre that sometimes is called the freight village and is realized as an "integrator" of various transport modes, able to promote intermodal transport. It is mainly an intermodal terminal, which is the primary component of the intermodal transport chain, constituting the node where the transhipment of goods from one mode to the other takes place.
Modern Logistics centre must be perceived as commercial enterprises offering comprehensive transport services to companies. The author points out the problem of investment, finances, revenues and other factors that provide successful operating of the Logistics centre.

Keywords: *logistics centre, intermodal transport, transport node*

1. INTRODUCTION

Currently, the Logistics centre ((LC) sometimes called freight village) is realized as an "integrator" of various transport modes, able to promote intermodal transport [14]. The Logistics centre is mainly an intermodal terminal, which is the primary component of the intermodal transport chain, constituting the node where the transhipment of goods from one mode to the other takes place. There is a consensus in definitions that intermodal transport constitutes a transport process in which at least two of the following conditions are fulfilled:

- Two or more different transport modes (lorry, train, barge, ship, planes) are deployed.
- The goods remain in one and the same transport load unit for the entire journey [5].

In any case a Logistics centre is part of an integrated transport chain that the shipper (customer of the LCs) develops and operates and as such it comprises terminals and rail/maritime transport segments as well as the initial and final segments done in most (if not all) cases by road transport.

However, the potential customer of a LCs, evaluate whether such integrated transport chain produces cost-savings, enhances reliability, decreases transit times and improves quality [8]. Therefore, the customer is the real decision maker for the operators and the others are merely executing the orders.

Hence, the concept of Logistics centre is developed to offer "common" services to various transport and logistics companies located within its site, as well as to other external users. Transport and logistics companies can take advantage from the common infrastructure, equipment and services, without proceeding to heavy and risky investments if they had to choose the "individual"' use. The latter requires that they develop and use a freight centre/village for only their own products, not accepting third parties, and thus exhibiting low or possibly unattainable positive returns. Thus, modern Logistics centre must be perceived as commercial enterprises offering comprehensive transport services to companies rather than as simple infrastructure projects facilitating the single companies' location [12].

2. INVESTMENT FACILITY

Usually, if a Logistics centre confirm to be viable for private investments, a legal entity is formed (with private and/or public funds of the joint venture type Public Private Partnerships (PPP) scheme) that acquires the necessary land, constructs, operates and manages the Logistics centre. Also, it is charged with the negotiations and agreements with the transport companies (forwarders, transport operators, etc.), which are interested for their eventual establishment in the Logistics centre.

Therefore, the financial evaluation of a new Logistics centre is mainly performed based on the viewpoint (and interests) of the private investor. The return on the private sector investment is the major criterion for assessing the feasibility of a project financed by private and possibly public funds, provided that the projects are beneficial for the society. Any financial cost-benefit analysis for the estimation of the return on investment depends on the variable and fixed costs, as well as the revenues of the Logistics centre. Any revenue of the Logistics centre is dependent on the location and operation of various companies, their particular commercial relationship with the LCs, as well as the use of the services offered.

Generally, investment decisions on infrastructure projects are made by the public sector based on socio-economic evaluation. However, PPP type projects need financial evaluation that takes into account uncertainties and the resulting risks [3].

The common methods of incorporating risk in capital investment decisions are the dual risk-return and the risk adjusted discount methods. However, most methods assume that the cash flows of the project are certain, although it is well known that actual cash flows could differ substantially from the forecasted ones. Some have introduced methods to overcome this drawback, like the value at risk systems that comprise the Adjusted Present Value (APV) and Net Present Value (NVP) at risk [9].

The latter utilizes a Monte Carlo simulation with probability distribution of the key variables that affect the cash flow and thus the NPV. These probability distributions can be determined from experience of similar projects. Since there are a lot of uncertainties related to the values of some key-parameters for the financial evaluation of the LC investments (e.g. construction costs, period for construction, traffic volumes, operation and maintenance costs, revenues, etc.) a Monte Carlo simulation is considered as a suitable method to derive the expected values of these key variables.

3. THE FRAMEWORK OF LOGISTICS CENTRE

3.1. Site selection and Traffic Forecasts

At this subsection a site selection is done at two steps: one at a "macro-level" and the other at the "micro-level".

The site identification at the macro-level is the choice of a location with no specific land boundaries, but only a broad area, usually identified with a name of a nearby locality. This is necessary for the estimation of traffic to be attracted by the Logistics centre. Once the traffic forecasting is done, and then the site selection at the micro-level follows. It is concerned with the determination of the land boundaries of the Logistics centre and it is usually done with well-established methods of site selection, employing in some cases multi-criteria analysis.

As for the forecasted traffic to be attracted by the Logistics centre, this is estimated with the application of appropriate models [14]. However, in order to apply these models an assumption about the costs of the services provided by the Logistics centre is needed. Hence, this is a dynamic process that influences the size of the LC, its revenues and in the return (based on the introduced costs for the provision of services) the attracted traffic.

Usually the produced outputs of the models comprise:

- Estimations of daily freight transport traffic in tones and number of truck vehicles per category of goods types;
- Estimated distribution of the total traffic among commodities;
- Estimation of loading transport units (e.g. containers, swap bodies).

3.2. Definition of Services Offered and Corresponding Dimensions

Once the commodity types volumes to be attracted by the Freight village are estimated, the various services to be offered can be determined. They are related to warehousing and storage, parking areas, rail/road terminal and needed equipment, loading/unloading, administration, customs, medical services, banking, food and lodging, gas refuelling, vehicle maintenance, container maintenance, security, etc. There are numerous European projects that determine such needs [1, 6, 10], whereas the IQ [7], research project provides a good overview.

Hence, based on values provided by the above studies/research, the required services and the corresponding size of the areas and the dimensioning of buildings, equipment and other items can be determined. Hence a model is developed that combines the estimated traffic with the needed surface and the required services. To determine the latter, assumptions about the following parameters are needed:

- Ratio weight/volume for each commodity type;
- Accepted minimum height of stowage for each commodity/transport unit;
- Average of time that the various commodity categories remain in the Logistics centre.

The first parameter can be provided by relevant studies [4].

The second parameter is dependent on the type of loading unit used (swap bodies that cannot be stacked, containers that can be stacked) or bulk goods that need other types of storage facilities.

The technical parameters for such designs are well established.

Finally the last parameter can be assessed from other Logistics centre performances [13] or derived from a short and simple market surveys.

Consequently, the surface S_j needed for service j (e.g. warehousing and storage) corresponding to goods of commodity i is estimated by Eq. (1)

$$S_{ij} = f(T_i, Q_{ij}, CC_{ij}), \quad (1)$$

where:

S_{ij} – the needed surface for service j for commodity i,

T_i – daily traffic of the commodity i, in tonnes per day,

Q_{ij} – average time to provide the service j to commodity i,

CC_{ij} – other characteristics of the commodity i related to the provided service j.

Finally the needed surface S_j for service j is the summation of surface per commodity:

$$S_j = \sum f(T_i, Q_{ij}, CC_{ij}). \quad (2)$$

As an example, the equations that provide the needed surface for warehousing and storage is presented:

$$Ss_i = T_i t_i e_i H_i, \quad (3)$$

where:

T_i – daily traffic of the commodity i, in tonnes per day,

t_i – average time that commodity i usually remains in a warehouse area,

e_i – the ratio volume per weight of the commodity i, in m^3/tonne,

H_i – the usual height of stowage of the commodity i in warehouses, in m.

Applying this formula for all (ν) commodity types, the total surface needed for warehousing and storage is:

$$Ss = \sum_{i=1}^{\nu} (T_i t_i e_i H_i). \quad (4)$$

Therefore by applying the model of surface estimation, outputs are produced related to:

- Total surface and height of storage and warehousing covered areas;
- Total surface of open air areas;

- Total surface of parking areas;
- Size of administrative buildings;
- Surface of rail/road terminal and transhipment area;
- Number and capacity of various loading/unloading equipment;
- Total length of internal road network and connection to the main road network;
- Total length of internal rail network and connection to the main rail network;
- Total length of other technical infrastructure (electricity, telecommunications, sewage).

3.3. Estimation of Investments and Operation Costs

On the basis of the results of subsection 4.2, the following investment cost items are estimated:

- Land acquisition cost;
- Total construction cost and;
- Equipment acquisition costs.

These cost categories are classified as fixed costs in the evaluation methodology. The real estate cost is defined according to the current market unit prices (€/square meter). The estimation of construction costs is based on observed unit prices in other similar construction projects and they are grouped into construction costs for land development, buildings, transhipment terminal, acquisition of equipment, etc. In addition to these fixed costs, there are the variable costs that are related to the operating expenses of the several facilities in the Logistics centre. They are termed variable, since they are dependent on the volumes using the facilities/services.

The total of the above costs - on an annual basis – C_m (for year m) will be used for the financial evaluation. To handle the uncertainty about the investments costs and the years needed for the construction of the Logistics centre, a Monte Carlo simulation could be applied to calculate the expected final cost and the number of years needed to construct the LC.

In the case of the expected final construction cost of the project, it is assumed:

$$\text{Initial cost} = X_a * \text{Surface of Logistics centre}, \tag{5}$$

where: X_a is a unit cost in euro/m^2 of surface.

Thus, by taking "a" from historical data and assuming a probability distribution of the final cost, based on post-assessment of similar projects, 10,000 iterations of Monte Carlo technique are applied in order to calculate the expected final cost. This is done by calculating the cumulative distribution of "a" and by using random numbers.

3.4. Evaluation

The evaluation stage comprises two distinct and complementary approaches: the financial and the socio-economic evaluation.

The necessity for two parallel approaches derives from the very nature of a PPP. The achievement of an agreement between a public authority and a private investor depends on various factors, due to the fact that each member has different incentives and expects different kinds of benefits [13].

The private investor aims at increasing the return on investment. On the contrary, the public authority aims at increasing the benefits for the society and implementing its wider policy and plans. In order for an agreement to be reached between the two actors, it is essential for both to comprehend the specific requirements and to conclude a contract, which will satisfy their pursuits with the best possible way.

Therefore, the financial evaluation examines the private investor interest and the socio-economic evaluation examines the public interest. Specific socio-economic evaluation methods can be used on the basis of cost-benefit and/or multi-criteria analysis [2].

A co-funded (PPP) project involves an interrelation process between private and public sectors, as shown in Fig. 1 [9].

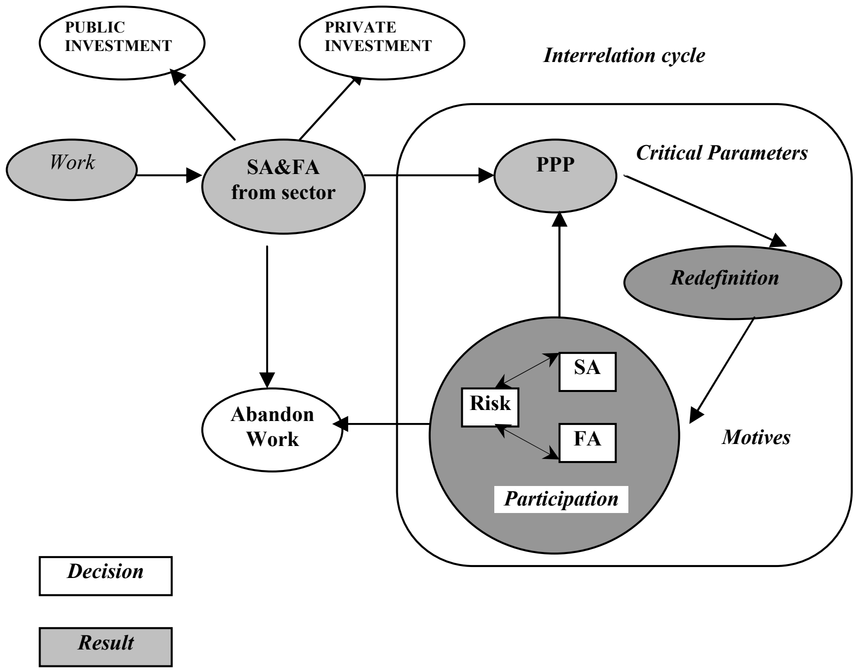

Figure1. *The interrelation process in co-funding projects on a PPP basis*

At the left side of the figure the decision process by the public authority to go ahead or not with the project is presented. The public authority performs (with its own values for the variables) the socio-economic evaluation and a sort of financial evaluation. Based on these results, a decision is taken.

The right side of the figure presents the process to be followed for a PPP project, once the public authority launches the project. It shows the interactive process between the public and private bodies in determining the acceptable (by both) conditions for the PPP scheme. The presented methodology in this paper is addressing this process.

According to the results of these parallel methods, the following cases could arise:

- **Case 1**

FA (Financial analysis results, e.g. return on investment) LESS THAN the acceptable limit (according to a rate of return, which has to be higher than the best rate in the market), and SA (Socio-economic analysis results, e.g. IRR or NPV for national economy) GREATER THAN the acceptable limit (according to the internal rate of return, which has to be higher than the opportunity cost of capital or NPV >0).

In this case the project may be taken over by the government or co-financed by a private investor under certain requirements.

- **Case 2**

FA > acceptable limit and SA > acceptable limit

In this case the project can be financed either by the government or by the private sector. It is an advantageous case for PPP.

- **Case 3**

SA < acceptable limit

In this case, the project cannot be realized, even though its financial evaluation is encouraging.

Assuming that the socio-economic evaluation produces positive results for the national economy (including the consideration of external costs, as environmental impacts and other social related costs) then the financial evaluation (appraisal) is necessary to assess whether PPP schemes are possible.

4. FINANCIAL EVALUATION

The financial evaluation process is described in Fig. 2 [14], where the steps followed and the variables considered are shown.

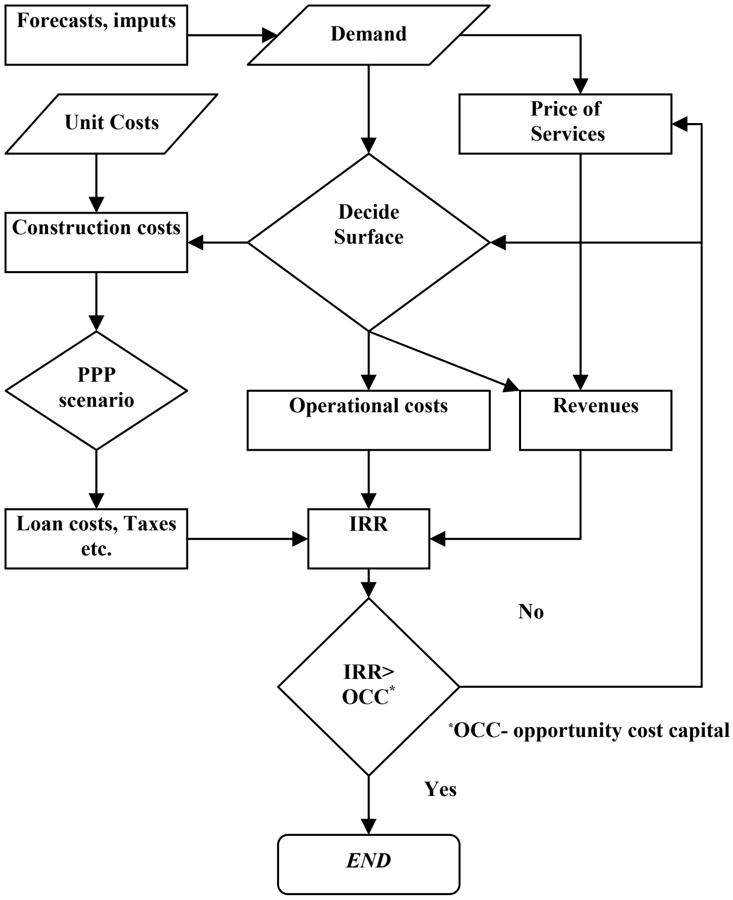

***Figure 2**. Financial evaluation process for each financial scheme*

Primarily, the alternative scenarios of funding schemes have to be introduced. The alternative scenarios derive from various combinations of three funding sources:

- Private investors (equity),
- Bank loans,
- Public subsidies (actually free money for the private investor).

Therefore, four general funding schemes are possible for the development of a PPP in the Logistics centre:

1. Combination of private investments, bank loans and public funds.
2. Combination of private investments and bank loans.
3. Combination of private investments and public funds.
4. Fully private investments.

For each combination, the Internal Rate of Return (IRR) of private funds (equity) is calculated. It is an important indicator of the private sector willingness to invest.

The first criterion for the choice of the appropriate investment scheme is the IRR. It is well established that the IRR must be greater than the opportunity cost of capital, or in another words - the most profitable risk-free investment, otherwise the investment is not viable and as such is not worth considering. The IRR of a capital budgeting project is the discount rate at which the NPV of a project equals zero:

$$NPV = 0 = \sum_{i=0}^{t} \frac{CF_t}{(1+IRR)^t} = CF_0 + \frac{CF_1}{1+IRR} + ... + \frac{CF_t}{(1+IRR)^t}\ , \tag{6}$$

where CF_t – the cash flow at time t.

In addition to this criterion, in order to safeguard a positive return every year, the net cash flow (annual revenues-annual expenses, including taxes, loan repayments, etc.) must be positive. In the event of negative returns the company could become bankrupt. Thus, this is the second criterion that has to be fulfilled in order for the private sector to invest.

On the other hand, the private sector aiming at maximizing its profits, will seek the maximum participation of public sector. Hence an upper limit for public subsidies has to be introduced, as a percentage of the total value of the investment, termed p_1. In addition, bank loans are not for unlimited amounts and as such, they need to be constrained to a maximum value, determined by the market, and on percentage basis being $1-p_1-p_2$, where p_2 the percentage of private funds (equity). In addition, the required repayment period is negotiable between the bank and the private investor, and thus there is no fixed a priori value [12].

Thus for a total investment costs C_m, the different sources of capital are:

$$C_m = p_1 \times C_m + p_2 \times C_m + (1-p_1-p_2) \times C_m . \quad (7)$$

In order to find the best funding scheme a linear programming model is applied. For a given number of years t related to financial evaluation time period, the model seeks to maximize the IRR by changing p_1, p_2 values, under certain constraints. The mathematical configuration of the model is:

$$Objectivefunction: MaxIRR(p_1, p_2) . \quad (8)$$

Subject to (with constraints):

$p_2 \geq a \times p_1$;

$p_1 \leq b$;

$(1-p_1-p_2) \leq c$;

$p_1, p_2 \geq 0$;

$CF_t \geq 0 \, for \nabla t$

Based on the above it is obvious that the public funds (if any) are treated as windfall gains for the private sector. On the other hand, as with any private investment in an infrastructure project, it has risk implications. To compensate for such risks, the public funds are necessary to minimize the exposure of private funds. However, if the project proves successful, this will result in potential windfall gains for the private investor, their value depending on the amount of public funds. In addition, if with another arrangement, the private investor is allowed to adjust prices (and thus increase revenue) due to inflation, this might result in further windfall gains [15]. In the proposed methodology risks associated with traffic volumes forecasts and values of some key - parameters are treated with the application of the Monte Carlo simulation.

4.1. Fixed Costs

The fixed costs make the Freight village operational and include costs associated with the construction, such as the land acquisition, the construction related expenses and the equipment acquisition costs. They are included for the year they are occurring. In general the construction costs are a function of the Logistics centre size.

Thus, if the unit price, the total construction costs could be estimated:

$$C_m = f_1(S) , \quad (9)$$

where S – the surface of the Logistics centre.

Also, in the fixed costs, the loan payments are included on an annual basis. In addition, the fixed costs could include:

- Provisions for initial expenses overruns and unforeseen expenses (intangibles) during the construction stage.
- Funds necessary for miscellaneous expenses and consumables during the first period of operations (usually 6 months), as well as insurance premiums during construction [11].

4.2. Variable Costs

As variable costs, the operational costs of the Logistics centre are considered, such as staff salaries, maintenance, electricity costs, water consumption, telecommunications, insurance of the Logistics centre (building, equipment, etc.), as well as miscellaneous expenses.

The staff salaries depend on the number of employees and the level of salaries, according to the staff specialization. There is a category with permanent staff, and another one with temporary staff. The latter depends on the traffic volumes of the Logistics centre and/or the opening hours. To simplify the method, it is worth to distinguish four categories of salaries:

- Category A: high salary (managerial),
- Category B: high - middle salary (scientific-technological support),
- Category C: low - middle salary (technical),
- Category D: low salary (handling).

The annual amounts of the four categories are defined according to actual salaries practices and the applicable laws in the specific country. Similarly, the number of shifts necessary for each job category is estimated.

$$C_p = \sum C_{pa} \times N_i + \sum C_{pb} \times N_j + \sum C_{pc} \times N_k + \sum C_{pd} \times N_l \, , \quad (10)$$

where: N_i – number of jobs and shifts of category A;

Nj – number of jobs and shifts of category B;

Nk – number of jobs and shifts of category C;

N_l – number of jobs and shifts of category D;

C_{pa} – annual salary for Category A, according to prevailing market conditions;

C_{pb} – annual salary for Category B, according to prevailing market conditions;

C_{pc} – annual salary for Category C, according to prevailing market conditions;

C_{pd} – annual salary for Category D, according to prevailing market conditions.

Alternatively, if no details of the personnel are available, they can be estimated as a function of the surface of the Logistics centre, based on values from other similar LC, since $C_p = f(noofemployees)$ and no of $employees = g(S)$, i.e.:

$$C_p = f_2(S) \, . \quad (11)$$

The other variable costs relate to the consumption of energy and the intensity of using the various technical infrastructures. To estimate these costs on an annual basis, indicators for the respective consumption are needed, such as average electricity consumption per m^2 of floor area of buildings, average water consumption per m^2, etc.

For certain services, such as telecommunications, an indicator higher than the market average must be used, since transport and logistics activities use quite intensively telecommunication services. Therefore, the cost C_{ti} for the use of technical infrastructure i is provided by:

$$C_{ti} = A_i \times P_i \times S \, , \quad (12)$$

where: A_i – the yearly average consumption of the service i (e.g. in kWh for electricity, m^3 of water, etc.);

P_i – the price of the service per unit.

Consequently, the total cost for the use of technical infrastructures C_t is given by:

$$C_t = \sum C_{ti} \ . \tag{13}$$

Alternatively, if no details are available, they can be estimated as a function of the surface of the Logistics centre, based on values from other similar Logistics centre, i.e.:

$$C_t = f_3(S) \ . \tag{14}$$

In addition, the following items are included in the variable costs: Maintenance C_{main}, and insurance costs C_{ins}. The corresponding annual amount is estimated according to the prevailing market prices, taking into account the floor area of the buildings as well as the total surface of the Logistics centre:

$$C_{main} = f_4(S) , \tag{15}$$

$$C_{ins} = f_5(S) \ . \tag{16}$$

Thus, the total yearly variable costs are:

$$C_v = C_t + C_{main} + C_{ins} \ . \tag{17}$$

For the first year, the total expenses also include a cost item related to start-up costs (when no revenues are collected, but operations take place).

5. REVENUES

The revenue of a Logistics centre are expected to be generated by:

- Rental of warehouses, storage spaces and offices;
- Rental of outdoor spaces for cargo placing;
- Concession of the hotel and restaurant exploitation;
- Fee on the revenues of the gas station;
- Charges on operations of the intermodal transport terminal.

The revenues from renting spaces and food and lodging establishments are calculated according to market prices per m^2 of rented space. The rental prices per m^2 differ according to the respective operation type in use at the rented space. Hence, they are classified as follows:

- Price of conventional storage space;
- Price of specialized-temperature control storage spaces;
- Price of office buildings;
- Price of outdoor spaces.

Consequently, the total yearly revenue from rental R_r is

$$R_r = \sum (S_i \times P_{ri}) , \tag{18}$$

where: S_i – the surface of facilities of type i;
P_{ri} – the yearly price for rental of facility of type i, currency units per m^2.

Alternatively, this can be expressed:

$$R_r = g_1(S, P) , \tag{19}$$

where P – the price of the services.

The revenues from the operations of an intermodal terminal constitute one of the most significant sources of income for the Logistics canter. The transhipment from a transport mode to another (e.g. rail/road) is considered as a service offered by the Logistics centre. The relevant revenues on a yearly basis emerge from the consideration of the expected traffic of unitised cargo and the applied competitive market prices for transhipment operations. The final calculation per year is also based on the assumption of the average 1,5 movements per loading unit [6, 7], since one loading unit might need one or two different movements (in the cases of intermediate placing or storage of products).

Consequently, the total annual revenue from the intermodal terminal is:

$$R_t = 1.5 \times T_u \times P_t , \qquad (20)$$

where: T_u – the expected traffic of unitised cargo in the Logistics canter, in tonnes/year (as forecasted in Stage A of the methodological framework, after the Monte Carlo simulation).

P_t – the charge per crane movement, in monetary units per movement. It is determined by the Logistics canter administration according to the adopted pricing policy.

Alternatively, this can be expressed as:

$$R_t = g_2(D,P) , \qquad (21)$$

where: D – The demand for the specific service.

P – The price for the service.

The revenues from the gas station are considered as a fee on a percentage basis on the gross revenues of the gas station concessionaire. In order to calculate the total revenues of a gas station, the method considers the average daily-expected traffic of road freight vehicles in the Logistics Centre, as forecasted in Stage A, after the Monte Carlo simulation. Furthermore, the average capacity of the trucks fuel tanks and the current price of fuel per litre are considered. Existing practices suggest [9] that 50 % of vehicles are refilled inside the Logistics centre. This is due to the fact that many of the incoming vehicles from close origins will have their fuel tanks full, while the trucks, which carry a cargo from a distant origin or depart for a long journey, will need re-filling at the Freight village. Consequently, the total yearly revenues R_g from the gas station are calculated by:

$$R_g = z \times T_r \times A_c \times P_f \times e , \qquad (22)$$

where: T_r – the annual truck traffic of the Logistics centre, in number of truck vehicles;

A_c – the tank average capacity of trucks entering the Logistics centre;

P_f – the fuel price, in currency per litter;

e – the applicable fee, to emerge from the Logistics centre pricing policy and negotiations with the concessionaire (as a percentage).

z – percentages of number of trucks for refuel.

Alternatively, this can be expressed as:

$$R_g = g_3(D,P) . \qquad (23)$$

Consequently, the total annual revenues of the Logistics centres are provided by:

$$R = R_r + R_t + R_g . \qquad (24)$$

6. CONCLUSIONS

1. The evaluation methodology, developed in this article is a specific tool, which can be integrated in a wider methodology for planning and evaluating investments in new Logistics centre, when a mix of public and private funds exists.

2. Four stages are distinguished, namely (A) site selection and traffic forecasts, (B) definition of services offered and corresponding dimensions, (C) estimation of investments and operations costs and (D) the evaluation. The elaborated financial evaluation model optimises for the private sector the

possible funding scenarios. It allows maximizing the return on investment of private funds, given the total investment needed. Finally, the model tests the attractiveness (with the calculated IRR) for a private investment in a new LC, in relation to other available opportunities in the market.

3. The identification of the variable and fixed cash flow items (expenses and revenues) for the particular case of LC is a significant contribution to the development of the evaluation model.

4. Moreover, the wider planning methodology is structured in such a way, to minimize needs for additional data input.

5. More concretely, most of the data needed for the application of the financial evaluation model derive from the traffic forecasts. Traffic data is the key variable that determines the services to be offered by a Freight village, as well as their dimensioning, which in turn defines most of the fixed and variable costs, as well as the expected revenues.

6. This article shows that an easy to be applied evaluation method with the corresponding models have been developed specifically for Freight villages. The unique features and characteristics of the LC as a transport infrastructure project, makes it different from road and rail projects, and thus a specific method is necessary.

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