OBSOLESCENCE ANALYSIS OF MAINTENANCE AND OPERATION OF PUBLIC TRANSPORT SYSTEMS. CASE STUDY: TRAMWAY OF ORADEA

CSUZI I.*, CSUZI B.I. **
* Oradea Transport Local SA,
** ROMATSA RA,
dir.gen@otl.ro ; botond.csuzi@romatsa.ro

Abstract: Maintenance of transport infrastructure and vehicles is important cost element of the budget of local transport companies, cost reduction is optimized by adapting appropriate strategies. Obsolescence can directly and indirectly influence the operation and maintenance of public transport systems. Challenged by the technical wear and lack of spare parts, it is impossible to cover increased needs with amenities to the given level. The reliability and availability of transport systems will be adapted at minimal cost and maximum safety criteria. Case study: the tram system in Oradea.

Keywords: obsolescence, reliability, disponibility, LCCM, maintenance optimization

1. INTRODUCTION

Basic budgeting community service of local public transport (PT) is one of the major legislative and local challenges. In order to balance the budget by their earnings complemented by subsidies given both categories facility and for compensation of operating losses cost indicators is essential. Investments are supported by its own funds and public funds, so the mean time correlation function (MTBF) correlated with total life cycles are comparable. Category local PT, as well as compact analysis system is a system of very long duration in major world cities PT has reached even almost two centuries already! Longevity, continuity of service requires careful planning of the entire structure, components will be synchronized with operational needs. The concept of physical wear and obsolescence is clearly palpable in a multi-criteria analysis focused on these concepts, it is present in almost all industries.

2. THE NOTION "OBSOLESCENCE"

The dictionary definition of the word obsolescence is: *"a technological downgrading industrial material by the appearance of another, more modern; obsolescence. = Professional obsolescence aging process components as a result of assimilation of professional scientific and technical progress "(derived from the English / French: obsolescence).[http://www.webdex.ro/online/dictionar/obsolescenta]*

Obsolescence of subsystems or systems are characterizing the long-term is commonly used in relation to consumer goods (cars, appliances, etc ...) and in industry and other sectors such as medicine, education, etc .... Study of the effects and costs of obsolescence is becoming more processed, the number of publications are in a marked increase [1].

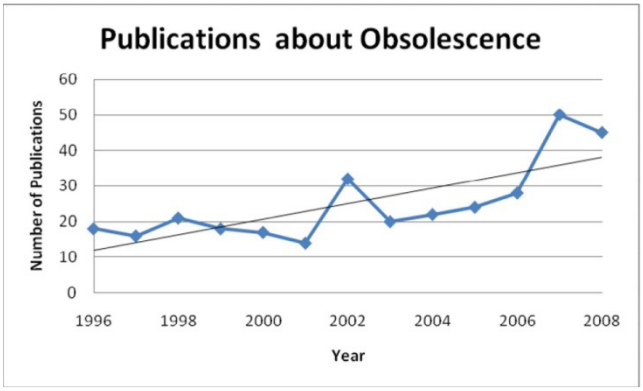

Fig. 1. Publications about topics of obsolescence (USA, 1996-2008)

Technical wear through development and intensification of industrial production through the development of maintenance concepts (especially those parameters based on reliability) by technological applications based on the latest scientific results almost entirely mastered. They are forecasting procedures which are elements for establishing the parameters most relevant wear of the component studied the life cycle of the product is known by the actions evidence of the operation. Times defined the products/systems are relevant in determining the quality of product/service/systems (PSS), the basic element in addition to the functional parameters in cost.

In general, wear is a process of consumption of instruments of labor in the use or non-use of their form can present both physical wear and as the obsolescence [6]:

a.) the physical wear (UF-uzura fizica) product/ equipment/system - a process of gradual loss of technical and operational properties, as a result of operating or action due to natural factors. Physical wear is accompanied by the gradual transfer of the value of the

machine/equipment on the products/services created and its recovery by selling products/services. Natural wear is caused by a number of factors such as mechanical, chemical, thermal, etc., which acts both during operation and during standstill. Among the effects of wear and tear include: erosion by friction, crushing surface deformations of mechanical sub-assemblies, breaks organ of mobile machines, fissures and cracks such heat, rust attacks the chemical, wear chemical attrition endurance (intensive use) wear untreated by proper maintenance, etc

b.) obsolescence (UM- uzura morala) - the process of decreasing value for the system/equipment/product due to the emergence of means of employment of the same type, cheaper, or technical performance or lack of spare parts for further maintenance. In this case it is necessary to adopt measures to mitigate the effects conservation functional characteristics of the vehicle/equipment and upgrading the existing one.

Very important is to distinguish between technical and moral wear, the relationship can not be perceived as a one-way: wear while technical obsolescence may cause, but the reverse is not a direct dependence. Obsolescence may occur as a result of several actions and events in the life cycle of a product (whether singular or cumulative).

In urban public transport (UPT) can identify the object of study of the life cycle and obsolescence, as a complex term, product/service/system (PSS) with the possible elements:

- Product transportation vehicles (trams, trolley buses), vehicle equipment and facilities (fleet management systems, and travel information), infratsructură elements (rails, switches, buildings, etc ..), machinery and other equipment, tools and equipment maintenance, equipment stations, any material elements necessary for the functioning UPT, etc ...
- Service: the operating activities of the public transport service by running races in the graphs and detailed routes within the parameters prescribed by the transport order, including related activities of ticket sales and the control and verification thereof ...
- System: UPT define the whole system, that includes all operating activities, execution, providing the necessary vehicles including their maintenance execution, providing the necessary infrastructure in the coverage and quality prescribed,

2.1. PSS LIFECYCLES

The concept of life cycle for PSS is borrowed from demography. You can define lifecycles five representative PSS [1]:

- Conception, design, development
- Production, construction, commissioning
- Operating, mining
- Maintenance, repair, maintenance operation
- Withdrawal decommissioning under wear (physical or moral).

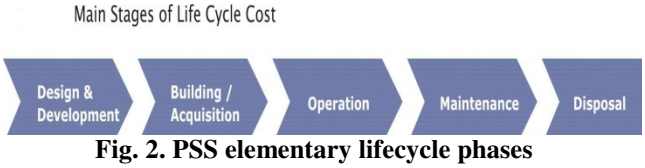

Fig. 2. PSS elementary lifecycle phases

Careful observation of behavior PSS concluded for five stages with distinct economic size of economic indicators being correlated with the phases of the life cycle of PSS. These steps can be grouped into two broad subcicluri: one innovation (including technical development of PSS) and one economic development (between PSS and the market launch of its commercial decline).

I. Product Creation: begins when identifying and exploit new PSS idea, outlines future technical and commercial details the short, medium and long term. Between birth conception, design and creation PSS are not sales, but we have extremely high costs, including those for research and development activities and marketing studies.

II. The introduction: (launch) is the period during which launched the new PSS is already beginning to appear receipts. Profits can be negative or relatively low due to low revenues and high costs of logistics and promotion.

III. Growth: is the acceptance period imposed by the market and revenue growth, profit default. At this stage the question of choosing between a high market share, with moderate profits, but longer-term and lower market share, but big profits in the short term.

IV. Maturity: period appears as revenue slowdown because PSS has been accepted by the majority of users / potential buyers. Most PSS is in this stage of their life cycle. PSS depends on the success of continuous innovation, leading either to the development, expansion of intrinsic and extrinsic market developments PSS (improving quality, its specific characteristics and hence the attractiveness of) or the new marketing strategy development.

V. The decline: is the period when revenues and profits are dropping rapidly (due to technical progress, change user preferences, increasing competition, market changes and developments nefavorizante). At this stage you can make efforts to maintain PSS market, but are relatively high risks of losses incurred by cost increases. Decision removal from the market of PSS is in addition to economic criteria influenced by medium and long-term strategies of companies, which may prolong the agony on social or marketing of a product future.

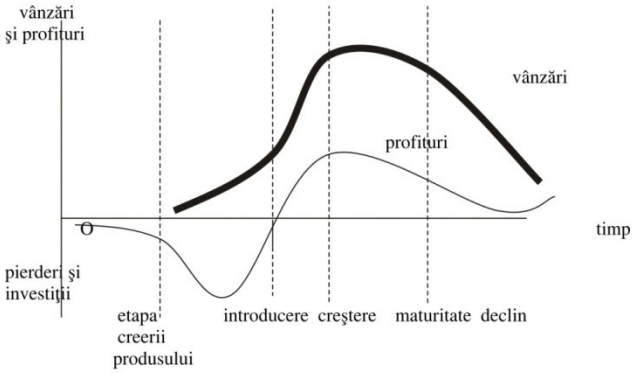

Fig. 3. Evolution of income and profit for PSS lifetime

Looking at a generalized level, not all follow the curve in "S" cycle of life, some can record rapid fall after introduction phase, others remain a long time in the mature stage or declining stage, can learn new growth phase as a result of its repositioning or sustained

promotion. The concept of "product life cycle" can refer to a class of products, the life cycle of a trade mark can change rapidly due to competition action.

Previous Release of a new product to determine "life expectancy" of it using a number of methods for forecasting such as extrapolation method phenomenological previous experience, comparison, the premise of evolution of PSS could be similar to the a previously released earlier. You can use intuitive methods of forecasting and simulation techniques.

Determining the stage of the life cycle that is at a time PSS and especially predicting its evolution future is a difficult (because of the multitude of information on developments in products on the market, the difficulty of a correct symptoms they present a particular product, lack of purpose 'perfect information system, etc.).

The evaluation can use a number of indicators such as:

a.) the extent of PSS (determined by the number of consumers, travel);

b.) the depth of the PSS (expressed in volume and value volume or frequency of use of PSS by consumers/travelers);

c.) the delivery speed of the product on the market (determined by the time it generalizes the territory for distribution PSS).

The tender age and diagnosis research phase in the life cycle that is at a time may be used as qualitative parameters

a.) the image that has a certain PSS among users/consumers;

b.) the degree of loyalty shown by customers for it.

2.2. CHART CADMID

Basically lifecycle simplified product / system can be defined generally by the five stages of life demographics listed are: birth (creation and prototype), childhood (first steps on the market), adolescence (evolution of initial product / system), maturity (only if viable products reach this stage) and decline ("death" through product obsolescence). Analysis of each stage of the life cycle must be made multi-criteria are aspects of marketing, technical and economic efficiency, including energy efficiency-optimizing effects on the environment by pollutants emanate ecological quality of the product/system ...

In its analysis of PSS, which is supposed to be used over a long period, especially those that have mandatory safety features specific (passenger road / naval / air) can define the state chronological lifecycle of its after as follows:

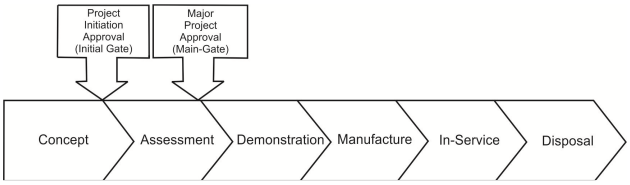

Fig. 4. Definition of life cycles by chart CADMID

Concept: PSS as necessary devising market formulated by potential users

Project Initiation Approval: approval of PSS development (feasibility)

Assesment: evaluating design and production work (feasibility studies and profitability)

Major Project Approval: approval of the draft budget

Demonstration: Preparing execution / production and launch of PSS, simulation and verification

Manufacture: manufacture / construction / assembly PSS

In-Service: the use, operation, use PSS (as a revenue generator)

Disposal: decommissioning, operation of the withdrawal of one or PSS due to factors

The PSS lifecycles define two major phases: active and inactive. The first period, characterized in particular by PSS development (from birth to maturity) is the definition of success for PSS, with growth factors tends to give as long an extension of this period. Obsolescence of the appearance, the appearance of obsolescence is important to identify its time of its effect and possible countermeasures.

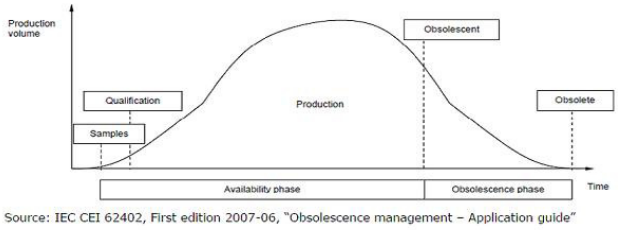

Fig. 5. Obsolescence phase identification

2.3. ANALYSIS OF CAUSATION AND EVOLUTION OF OBSOLESCENCE

Life cycle curve of a PSS indicates the evolution of production/service directly related to its price [2]. Just after the launch we have period of growth, spread at a high price, which gradually decreases to the peak of the cycle occurs at a time change as a result of some specific event (the appearance of a PSS new actions by competitors, changes in technology, etc. ...), which basically define PSS decline. The length of the period of maturity, saturation PSS is in defining the period of wear of obsolescence.

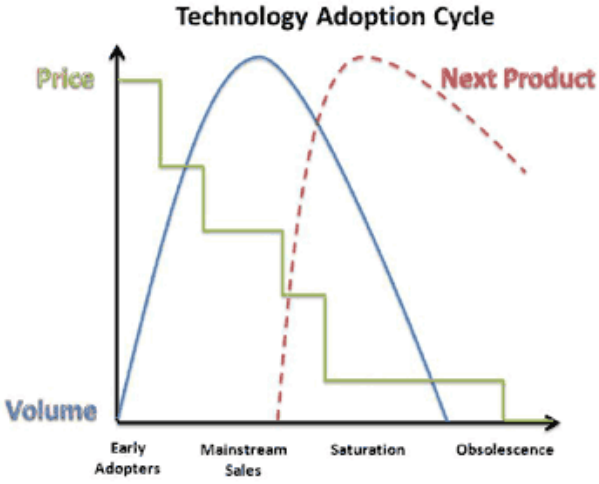

Fig. 6. New technologies effect on obsolescence

The cause obsolescence can be analyzed by multi-criteria approach of lifecycle aspects of PSS. Obsolescence can be caused by single or cumulative following:

a.) the effect of depreciation techniques: physical wear, mechanical deformation, loss values of the parameters prescribed as a result of movement, friction and other phenomena or chemical action undesirable if the weather and direct contact with chemicals aggressive (rust, loss of quality mechanical properties of materials, etc ...)

b.) the effect of the causes of technological major changes occurred in use as interaction with other modes of use (where travel tickets, validators of printed tickets are used at electronic cards at stations recovery of 6 kV for the modernization 20 kV and following turn requires changing cells that are obsolete in this case, although technically are fine)

c.) the effect of changes requirements consume tors / users: If PSS new requirements appear to increase the comfort of TPU, such a vehicle, while it is functional can not put into operation under the new requirements, is taken out of service why obsolescence. For services in the TPU existence of a route through the same life cycle as a product material (equipment or vehicle) when launching a bus service is a requirement of prospective travelers, but in the time of social and human or economic changes need mobility, users change habits and declines that route through attrition and restriction or even abolition reach.

d.) effect of maintenance costs: if preventive maintenance and corrective necessary tools, equipment, technologies and parts and components parts each has a pronounced effect on ensuring the reliability required of the product or where PSS are minimum requirements safety, which requires scrupulous observance of the provisions. Theoretical and practical measures and procedures of management lifecycle costs (Life Cycle Cost Management = LCCM) having sufficient input by its correlations roughly define very good condition and comes into obsolescence period. Obsolescence is directly influenced by ensuring continuity of necessary spare parts and subassemblies to ensure maintenance requirements (from excess increase in the cost of parts and subassemblies components of PSS, unable even to their acquisition being already out of production by suppliers.

e.) the effect of reasoning economic: because of the emergence of other technologies more modern and cheaper, reducing costs through reorganization and improvement to other PSS concurrent change reports in efficient operation, individually or cumulatively tend to operate lifecycle of obsolescence.

2.4. ASSESS AND REDUCE OBSOLESCENCE

The emergence of the phenomenon of obsolescence can not be stopped or eliminated, but by recognizing the correct and timely manner the causes and possible effects of rehabilitation, reconstruction can help to extend the maturity, delaying the onset of obsolescence or maintain it at an acceptable level, but can not block its training.

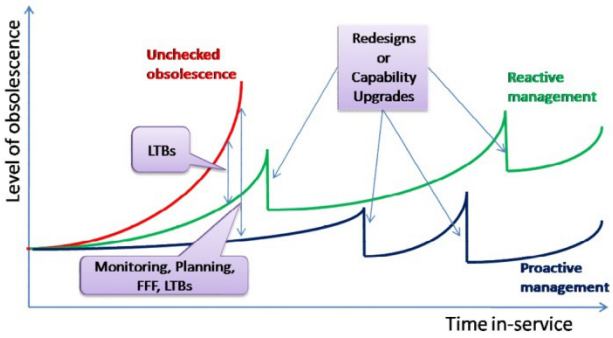

Fig. 7. Obsolescence evolution analyzis

As shown in the figure above (Fig/ 7.), red asymptote occurs in untreated cases in terms of obsolescence, without forecasting measures, without correction may happen a rapid downgrading of PSS. Treating the phenomenon of obsolescence can be performed by reactive methods (redesign) and proactive (planned upgrade). If the operation of a PSS within extended avoiding key interventions to appear serious risk of excessive growth of obsolescence, significant costs related to obsolescence will occur only if it becomes mandatory a redesign for continued use (redesign, optimization, efficiency, retrofitting of the same PSS). These interventions are rare, have the effect of reducing obsolescence meant extended life cycle for a new stage of maturity. In the first period of the life cycle, especially when a design preventive for a minimum level of obsolescence can be made through proactive management of obsolescence (as part of LCCM) upgrades consecutive maintenance costs relatively much smaller, but observation higher initial investment in developing PSS, including research and development (R&D) costs of adapting to forecasting techniques.

Obsolescence analysis can not be done in general terms only stating the first level of the thematic analysis: system, subsystem, element or component replacement part. Will be established before the effective design and choice of technological solutions and mandatory minimum requirements, ie what level of creativity and tech budgeting applied by limiting PSS. There are cases where you can define larger amounts for initial investment, the R&D activity, the distribution of lower costs during production and operation, or in another case supports an initial investment low, but operating costs significant. Analysis and decision belongs to him who planned lifecycle decide the future PSS.

After P.Sandborn [3] are two types of obsolescence forecasting analysis, one based on the materials used (MRI - Material Risk Index) and another based on permanent revision of the possibilities of rehabilitation (DRP - Design Refresh Planning).

a.) MRI- Material Risk Index: materials, parts, components, subassemblies used in the product qualities define its future. Items can be mechanical, electrical, electronics, general purpose or specialized, modular or monoblock with fixed or interchangeable destination. This multitude of variations can be generated by applying criteria different lifetime, define lifecycles, including current and future costs. As an example in the electronic components discrete non-product will probably be

uncompetitive because gauge or high costs effectively and maintenance will cost more by the deficiency diagnostizării to the electronic component, but will ensure a much longer duration of life against a similar product designed on special dedicated tracks. Quality of materials (electrical parameters, mechanical work security other chemical qualities continue throughout the period and kept in good working, etc ...) decide an important element of the cost, and planned level of risk can be adjusted by these decisions.

b.) DRP- Refresh Design Planning: Planning retrofit, redesign PSS design is implemented in the state in formulating conceptual requirements, thus recommends upgradeable modular interchangeability or assurance regarding various manufacturers / suppliers of spare parts, the modules or parts of the PSS. Careful preparation to allow refurbishment while streamlining the maintenance costs, a calculation of costs on a longer operation by delaying obsolescence. Retrofitting is somewhat dependent on the previous method of risk materials, but expands on some strategies for manufacturers of parts, such as the amount Skid Control (MOQ=Minimum Order Quantity) and planned system of maintenance (various strategies approach to reparations through the expected minimum reliability).

Approaches for treatment and delay the emergence of obsolescence is based on the depth of the analysis comes down to what level [1]:

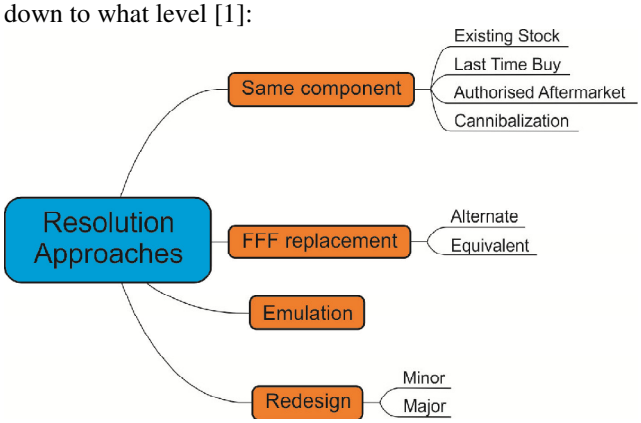

Fig. 8. PSS obsolescence treatments

In the subassemblies and components big challenge is how to provide the necessary spare parts both for scheduled repairs as well as current ones, which are strategy maintenance discussed (Anglo-Saxon, with the possibility parametric analysis or German, with provisions fixed level Operating hours or distance operated). Variants management issues are starting from an existing stock, liquidated stock, alternative suppliers (after market) to "cannibalization", ie killing of a produc/subsystem for the recovery of parts functioned to maintain the operation of the remaining state acceptable most points. In some cases, even modular systems can ensure comparability with another similar product or another manufacturer dedicated interchangeable. If it requires not only a repair or maintenance during use, but requires a return to the cycle of maturity to extend the period of obsolescence is recommended redesigning review of PSS by upgrade or redesign, which can be major or minor, again depending on the depth of penetration into the system, which are both technical and financial possibilities of the proposed process.

3. CASE STUDY: THE TRAM SYSTEM IN ORADEA

Oradea tram system has distinct sub-structure elements influencing the results of a multi-criteria analysis of obsolescence. An approximation of the structure of materials needed for a public transportation system with electric traction is:

a.) the existing tram lines, designed as routes operated by scheduled TPU;

b.) The necessary infrastructure for mining (including switches and crossings rail stations, embarkation / disembarkation of its facilities, kiosks and ticket machines, pillars supporting contact wires, fuel / rectifiers;

c.) Vehicles with associated facilities

In terms of operating trams should look like TPU component of the system, which depends on operating procedures depends on the human element of our offering and of using regular passenger service. Elements of economic reasoning can not be neglected, public service efficiency as a result of optimizing the correlation with the social element in the development of graphics circulation.

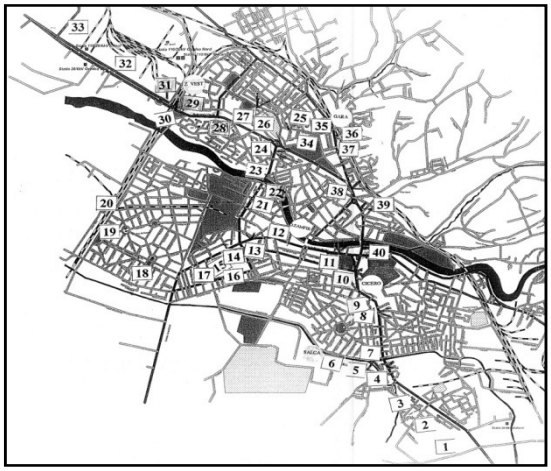

Fig. 9. Contact wire network elements

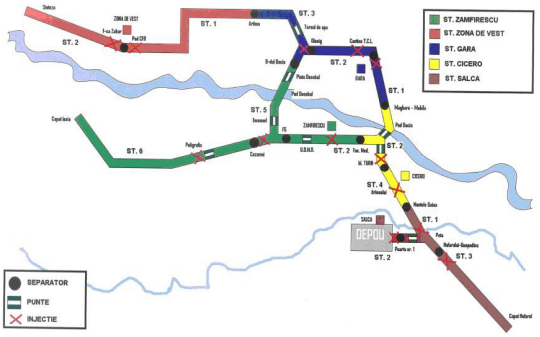

Fig. 10. Power substations and their supply network

Analysis of system obsolescence as the tram (rail infrastructure and annexes) requires a review of the viability of this type of transport. The most relevant in relation to the entire number of users TPU in Oradea, reflecting a more than ¾ of passengers use the tram prefer

(77.12%) [12]. Founded in 1906, the system has undergone many changes from the original 19.3 km 39.86 km have today, but in 1957 we had 11 tram lines over a length of 71.2 km, which included the industrial lines municipal. Freight transport has been affected by obsolescence of this type of transport or economic reorganization of recent decades has seriously affected the length of the rails in FIG. 10. The lines are played during demolition.

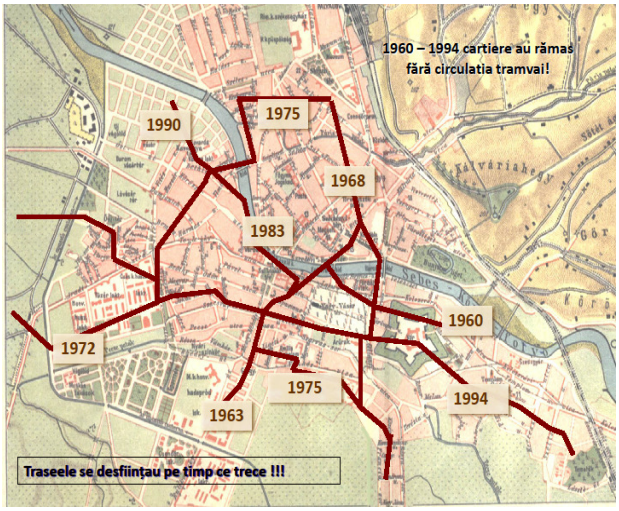

Fig. 11. Chronology of tram network demolishing

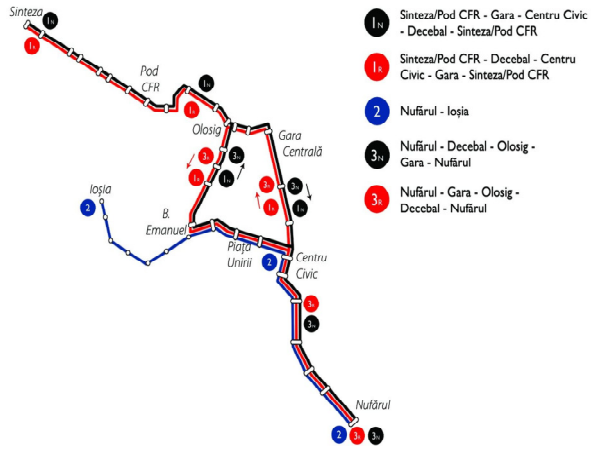

Fig.12. Present tram network- 2015 (5 lines)

The current infrastructure has a major vulnerability in absence of the degree of freedom of the node Arad Decebal-Hall, the possible cause of the emergence of obsolescence tram through this defect remediation method and delay the development of stage unwanted obsolescence can be ensured by maintaining the state The maximum level technical standard of safety and reliability, possible expansion on the south and west can provide an increased attractiveness of this type of urban public transport.

The investments of the last decade (over 10 million) contributed to the possibility of modernizing the service by purchasing new vehicles. Trams in Oradea during the decade were different types, from Siemens SSW 1920's, during the years 1950-1980 trams Romanian production (IT Bucharest, Craiova and UMT Timisoara Electroputere), followed in the 1990's trams to arrive secondhand -TATRA sale in Germany, as in 2008-2009 to acquire modern trams Siemens ULF151 [4].

Fig.13. Siemens SSW works until end of 70's

Fig.14. TATRA T4D arrived from Germany after 1995

Fig.15. Siemens ULF151, the same as in Vienna...

The tram PT as a subset of the main electric traction product is designed as a very long-planned life cycle of at least 25-30 years, but obsolescence of vehicles does not necessarily mean scrapping them until it is possible to ensure traffic safety during operation may extend their operation even to extremes over 45-50 years. TATRA trams endowment Oradea Transport Local SA manufactured between 1974 and 1982 with an average age of 38 years are able and very good operating conditions. Oradea, the first city in Romania to purchase

new trams in recent decades by the procedure launched in 2007 by accessing a loan from the European Investment Bank located Luxembourg Bank DEXIA based in Brussels totaling 33 million euros for the purchase of 10 trams and 20 buses. Assign leads to the introduction of electric transport system SIEMENS ULF151 Oradea model. The concept lowest floor tram (17 cm) was launched in 1991, following the development of the prototype was approved in 1995 as the first trams to operate in Vienna since 1997/1998. The model is one of the most daring technological challenges, motors being arranged directly on the wheel vertical system scalability tram portal allows folding ensuring the transport requirements in the various sizes.

Global indicators of availability of the types of equipment OTL SA [4] indicates a major advantage of trams us. Although obsolescence of old trams is indisputable premise data for establishing a profitable and intent of the redesign and modernization of these vehicles. Based on statistical data, with reference to trams were determined parameters TA and NC. Monthly reports and analyzes presented at OTL [9], can define characteristic parameters, global indicators and can be represented diagrams "c-t" for each type of tram [4]:

ΔC_{ID} - tram unavailable due to defects (TD);

ΔC_{IMP} - tram works unavailable due to perform preventive maintenance (PM);

ΔC_{IR} - tram unavailable due to capacity reductions forced or willful transport system (CST);

ΔC_{IAS} - tram unavailable due to malfunction during standby;

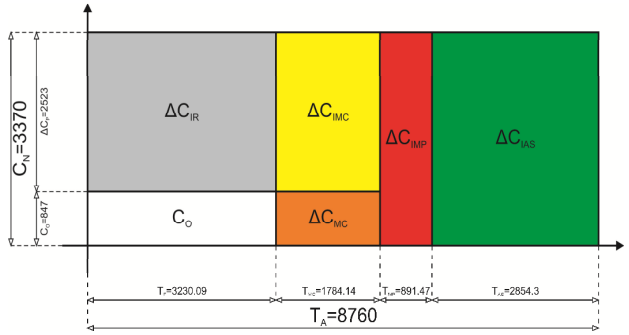

Fig. 16. Diagrams "c-t" for TATRA T4D

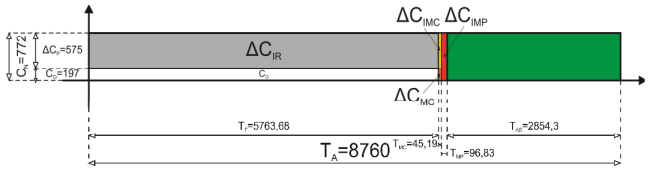

Fig. 17. Diagrams "c-t" for SIEMENS ULF

As can be inferred from the results of the graphs in the above figures, the unavailability of TATRA trams multiple of 4.3 times the trams SIEMENS (3370 h <=> 772 hours). Besides unavailability studied or performed measurements and evaluations with regard to trams reflects net superiority in terms of energy type ULF trams versus T4D in Table 1 .

Table 1. Energy performances of TATRA and SIEMENS

Tram type	ULF	T4D
Power input on empty P_0 [kW]	16,99	33,06
Efficiency η [%]	77,5	65,8

The price of a used TATRA T4D is between 7-15000 euro in running acceptable. One modernization, redesign (change actuating motors, energy recovery braking, exterior design face-lift, air conditioning and passenger comfort standards salon, automatic doors, etc ...) is performed at an average of 250-300000 euros. A new tram, as ULF SIEMENS, may be between 1.7 to 2.5 million euros depending on equipment and related services. Tram fleet in the ideal case would be composed entirely of new trams, a dream impossible to achieve in the foreseeable term budgets available. The only option for improving the endowment of trams is often used procurement of modernized trams in cities in Western Europe or upgrading, redesigning the endowment. Obsolescence of type TATRA was caused reasons:

a.) lack access disabled (no low-floor);

b.) insufficient energy efficiency (motor drive current with the rheostat to change speed of a drive inverter motors and brake energy recovery);

c.) the excessive cost or a lack of parts

d.) Reduced tram comfort (no air conditioning, Folding doors outmoded, etc ..)

To counterbalance the shortcomings listed propose a feasibility study for the modernization of Tatra tram, which is supported and their usage statistics. In the OTL SA of TATRA trams 63 and 10 SIEMENS, every day at peak out 45 dishes. Taking into account the existence in Romania of over 1,300 trams worn old kept running, of which over 600 are TATRA (T4 and T6), it is clear that the only option for increasing the attractiveness of transport with trams by offering comfortable will adapt fleet renewal strategies, in particular by modernizing the endowment. Obsolescence in this case will not be removed but will be reduced to an amount that will prove the expected return on investment.

For upgrading suitable type TATRA trams and T4D + B4 kT4D provided. Replacing the power-braking resistor voltage variator ("Chopper"), as a minimal solution reduces power losses in power-braking system (ΔWA) and recovered part of the braking energy. [10] We appreciate that the losses chopper approx. 70% of the resistor power losses and that the recovery rate is 12%, compared to min. 24% given by the manufacturer, if ULF trams.

In these conditions would obtain a 16% reduction in power losses on the electrical components of the tram and reduce the power consumption of empty tram and the tram -at sracină with 7.36 kW kT4D and respectively 8.03 T4D tram kW. Energy Balance of Electricity (BEE) for the two categories of powers trams are presented in Table 2.

Table 2. Power components for Oradea's tramway system

Power component \ Tram type	kT4D	T4D
P_a [kW]	98.42	98.8
ΔP_M [kW]	10.35	10.11
ΔP_A [kW]	5.58	6.94
ΔP_{mec} [kW]	11.15	10.52
ΔP [kW]	27.08	27.57
PU [kW]	71.34	71.23
η [%]	72.5	72.1

For an average day and fleet of trams energy into the electricity sub tramway will 17,046.07 kWh, which means a saving of electricity energy (EE) approx. 40.4 kWh/day for each type kT4D tram and T4D. Accordingly, it reduces energy losses in transformers, rectifiers and mains (value approx. 11.54 kWh) [4]. EE annual savings for a tram (type kT4D or T4D) by mounting chopper is:

δ (ΔWaMT) year = (40.4 + 11.54) x 365 = 18958.1 kWh/year

In RON (Lei), EE savings for a tram equipped chopper has the value:

18958,1 x 0,46 = 8720,7 lei

Admitting dimmer continuous price, including installation of the tram 60,000 lei, during recovery yield of this investment TVTC:

TVTC = 60000 / 8720.7 = 7 years

The duration of the payback may be reduced due to tram maintenance savings that will equip you with the chopper. In the above conditions such investment is feasible for trams that remaining life of at least 9 years. Obsolescence by modernization drive improves, must take into account technical obsolescence of the other parts that define the remaining life cycle of the tram.

4. CONCLUSIONS

In order to maintain UPT system with electric traction in Oradea it is necessary to increase the attractiveness of trams. In terms of infrastructure obsolescence is not endangered in the near future, there are emerging changes in mobility of citizens, which adversely affect demand for tram lines, on the contrary, it requires extension on the south and west of the rails. Power stations can be upgraded by changing the diode rectifiers with thyristor controlled rectifier, with the possibility of connecting the remote monitoring and remote (centralized dispatch). Depot "Salca" must be redesigned and optimized for efficiency (automated switches, softwer planning and management inputs/outputs,special signs, other maintenance,facilities...).

The tram, the major element of an integrated UPT has facilities specifically for travel information (indications), fleet management (by GPS) and validators (E-ticketing, RFID cards) defining the control and maintenance of UPT. Strategies and procedures currently applied are consistent Sustainable Urban Mobility Plan (SUMP), obsolescence will treat system level assemblies.

Trams as basic UPT vehicles in Oradea have a history of over 109 years, the constant development of technology allowed us to performance vehicles. In order to ensure continuity of service in the comfort and safety required and desired transport company will have to implement improvement measures outlined by SUMPs, electricity periodically audit or other feasibility studies.

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