

THE ROLE OF INDUSTRIAL DESIGN IN THE PROCESS OF MODERNISATION OF RAILWAY VEHICLES

Abstract: *The present paper shows the role of industrial design in the process of modernisation of railway vehicles, illustrated through a study case – personal experience. The collaboration with the “Electroputere VFU Pașcani” factory, specialized in reparations, modernization and building railway items, led to a work experience along with engineers, as well as learning the particularities of working in a factory, of turning a design project into reality. Besides from the specific steps of the design process, an important aspect is represented by the communication with the producer, in order to know all technologies and materials which can be used during the fabrication process. The obtained product must offer originality through shape and colour, fully responding to the beneficiary’s needs.*

Key words: *industrial design, personalised design, tram, public transport, urban aesthetics, dynamics of urban environment, urban mobility, aesthetics of industrial product.*

1. INTRODUCTION

The development and the enlargement of great urban centres, followed by the traffic growth, as well as the considerable distances to the passenger’s working place or to other interest points represent modifications generated by economical, social and political factors in the last two decades, alterations which impose the rehabilitation of the public transportation system. The usage of public means of conveyance represents a good option from a respectful point of view towards the urban and natural environment, as well as from an economical point of view. The efficiency of the electric public transport, especially the one ensured by trams, sustained by the advantages offered to the passenger – the running speed, the big capacity of transport, the low noise pollution, and on the other hand, to the transport operator – the low energy needs or the low maintenance costs, gradually led to the extension of tram railways and to the growth of the number of Europeans using public transport, and not their personal cars. The care for the environment by using public means of transport determined a reduction of the number of traffic jams, the growth of the running speed, the protection of the environment and the reduction of individual costs in transportation. The ideal of urban conduct was seen in countries such as France, Germany, Austria or Spain, where large amounts of money were invested in the infrastructure and new state-of-the-art vehicles, which are suited for people of any age and those having locomotion problems.

Despite all of these, public transport societies from the Czech Republic, Slovakia, Latvia, Lithuania, Poland and not only, managed to adapt the existing vehicle park, through modernisation and partial reconstruction, to the nowadays requirements of comfort, safety and aesthetics.

2. THEORETICAL INFORMATION

In Romania, in the last 20 years, a big decline of public transport in the big cities was registered. The lack of funds for rebuilding the terrestrial infrastructure, the

electrical network and the damaged means of conveyance led to the breaking up of tram railways in cities such as Braşov, Constanţa, Reşita, Sibiu, and of trolleys in Iaşi, Sibiu, Slatina, Vaslui, Suceava, all being replaced by diesel buses. Despite the negative economical context between 1992 and 1997, on a national level, there were modernised 24 V2A trams in Nicolina – Iaşi, 30 Timiş wagons in Electroputere Craiova (1994) and over 500 vehicles Tatra TR4, V2A and V3A in URAC Bucureşti. Also, in Bucharest, Timişoara, Arad, Brăila, Iaşi, Oradea and Craiova there are still some rehabilitation processes of the tram railways, this being the first step to a civilised transport with new vehicles. Oradea is the first city in Romania which bought 10 new units, ULF Siemens, in 2009, with the price of 2,7 million euros/piece, city followed by Cluj, which bought in 2012, 4 Pesa Swing trams for 1,47 million euros/piece and Arad, which bought in 2014 and 2015, 6 Imperio units, produced by “Astra Vagoane Călători Arad” factory, for 1,38 million euros/piece. Due to high costs, but also to the partially rehabilitated railway, the purchase of new trams by the transport systems in Romania is not possible. This is why the modernisation of the existing vehicle park remains a good option for a civilised, modern transportation, for a low price.

In the context of a transition towards a public transport of modern standards, presenting the perspectives and tendencies of its development in a university and cultural European centre, in Iaşi, beginning with 2011, an ambitious modernisation project of a GT4 tram was developed, both technically, as well as aesthetically. The GT4 trams were bought on a second-hand regime, between 1997 and 2012, by the public transport operator in Iaşi [1]. This type of wagons, 106 nowadays, have proven its viability on the hills and tight curves in Stuttgart. The articulation design is unique: both bogies being connected through a chassis, on which the two body modules are mounted, allowing a higher flexibility than a non-articulated tram, or articulated, but with 3 bogies (GT6). In Iaşi, standard GT4 trams were bought, as well as in different types of modernisation. The physical and moral wear left its print,

especially on the standard wagons, their retirement being a matter of the near future. The difficult financial context excludes the possibility of buying trams to answer the current aesthetic and technical needs. The modernisation and rebuilding of public means of conveyance represent the ideal solution, combining the two requirements for a good price.

3. CASE STUDY

In 2010, at the initiative of “Electroputere VFU Pașcani” company, specialised in reparations and modernisation of railway items, the decision to modernise and rebuild a GT4 tram was taken. The objective was that it should correspond to current standards from a functional, aesthetical and ergonomic point of view, an important aspect being the correlation of the new vehicle with the urban aesthetics of Iași [3]. The following interventions would have been made on the vehicle:

- remodelling the front and back area by replacing the terminal modules with new parts;
- the enlargement of the windows in order to broaden the view of the environment and to emphasize the architectural and artistic patrimony of the city;
- adopting a digital display system (front, lateral back);
- adopting a video surveillance system (exterior, interior);
- raising the protection degree for the passengers in case of a front impact;
- creating an efficient network of holding bars;
- reconfiguration of the seats in the interior of the tram for a more efficient interior movement and comfort;
- adopting an efficient and economical fluorescent lighting system;
- creating a special place for people with locomotion problems, with bikes and strollers;
- adopting an AC system (wattman’s cabin, interior);
- creating an ergonomic driving space;
- adopting new washable materials for the interior which are resistant to wear;
- adopting electronic, traction and breaking equipments, suitable for current field standards.

Thus, in 2011, the GT4M (M – modernised) project came to life – exterior/interior design study: Silviu Teodor-Stanciu, (fig. 1).

The method used for this theme is based on theoretical and practical (on field) research. Investigating the main interest fields such as talking to the producers, transporters and passengers, and researching the other markets have allowed approaching this current topic, important both for the urban environment, as well as from a social and economic point of view.

From an aesthetic point of view, GT4M has a compact general aspect, refined, in full harmony with elements belonging to neoclassic architecture from the central area of Iași. The structural simplicity and the visual order, offered by the symmetry and proportions, ensure the assimilation of the new parts in the general aesthetics of the vehicle’s body. The oblique lines from the front side of the tram offer a touch of dynamism and

their association to the round shapes and the carefully established connection between metal and glass sustain the vehicle’s integration in the new built areas of the city. The reverse aerodynamics of the front area marked by the windshield’s withdrawal angle to the base, offers grandness and dynamism to the vehicle. The chosen solution sustains the edginess of Iași, of a city of national premieres. The oblique lines, shaped as a “V”, look like an open book, symbol of the city’s cultural and university character. The coherent shape of the body, as well as the wide windows, sustained by the green colour, create the illusion of the vehicle’s detachment of nature, GT4M becoming a “friendly” mean of conveyance, not only functionally, but also aesthetically.

The tram’s interior has 30 seats with a hemp tapestry, disposed in the shape of “1+1”, offering more space to the place. The fluorescent lighting system is situated in the centre, on the ceiling, thus the light being distributed in all directions, offering safety and comfort to the passengers. The AC system is flanked by superior side panels, above each window ventilation grill existing, which maintains at all times the window dry, ensuring a constant climate in the interior. The supporting bars have a curve shape, dynamics which offer space to the interior. In the front and the middle sides there are digital information panels for the passengers, the vehicle also having an info point, ideal for tourists.

From a chromatic point of view, the furniture and the interior’s elements are adapted to the unique colour scheme applied to the vehicle’s exterior. Thus, the green colour can be seen on the upholstery of the seats and on the rubber carpet on the floor and the decorative panels from the side walls have green insertions. In order to offer the feeling of space and light, the decorative panels on the ceiling and on the side walls has light colours [2].

The constitutive landmarks of the new vehicle were redesigned by the design department of “Electroputere VFU Pașcani” in collaboration with VRG Bistrița agency, having as base the no.4 design study (author: Silviu Teodor-Stanciu). During the entire design process, a close connection between the designer and engineers was kept, through various meetings taking place every one-two weeks. The modernisation process began in 2011, designing new modules and disassembling and preparing the wagon for reconstruction. During the disassembly and sandblasting procedures of the body, the engineers from “Electroputere VFU Pașcani” have analysed the technical documents of the GT4 tram, as well as the evolution throughout time, developing an important database for the modernisation process. The experience gathered throughout the train wagons modernisation projects has led to conceiving certain exceptional solutions regarding the wagon’s revamping according to current standards and requirements, offering it a life duration of over 14 years. For building the prototype, “Electroputere VFU Pașcani” established collaboration relationships with prestigious railway equipments companies, such as Electroputere Craiova, Hanning & Kahl, Schunk and not only. After the sandblasting procedure was finalised, the body’s corroded surfaces were replaced with zinc metal sheets.

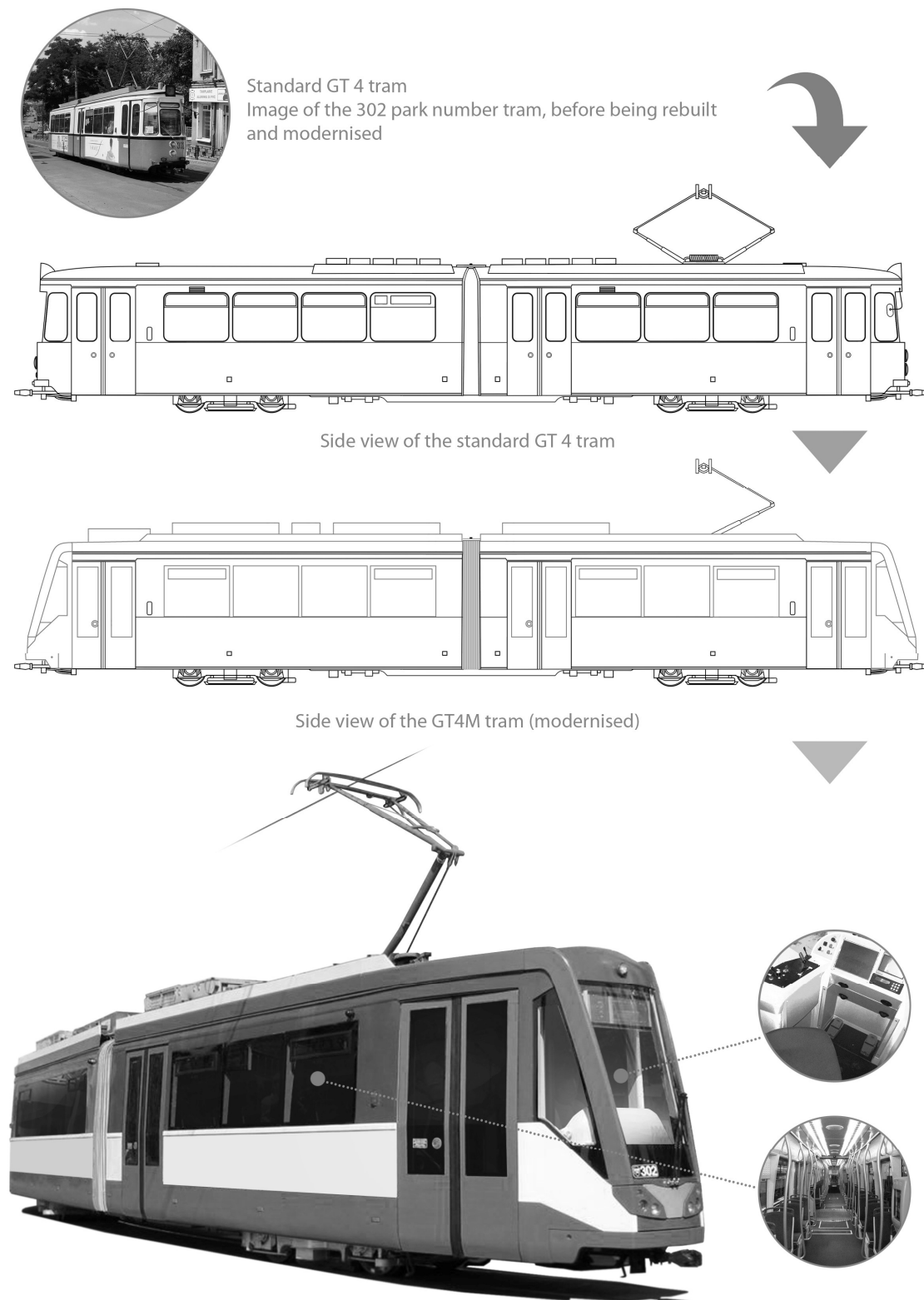


Fig. 1 GT 4 Tram Modernisation Process.

Also, the vehicle's roof was scrapped, the entire metal being replaced. On the superior surface of both modules, flattening and cutting were made in order to attach AC devices. Due to the superior setting of the new devices, the consolidation of lateral pillars was needed, thus being created the frames of future windows. The

lack of impermeability of the old articulation imposed its redesigning. Thus, a new solution masked by the double bellows (exterior/interior) was used. For its fitting the body was modified by flattening and enlarging the fixing surfaces. The modernisation of the GT4 wagon meant improving its technical and aesthetic features up to the

standard of a modern tram. Besides the state-of-the-art technical equipments, it was decided that the front and back sides should be replaced with new modules. In this way, the wagon's identity was redesigned, its specific elements being reinterpreted in a modern manner, according to the design project. For this operation, the metal ends of the wagon were removed. Both the chassis and the supporting pillars were reinforced in order to ensure a solid support for the new components, especially to the devices placed on the wagon's roof. After all these technological procedures, the wagon's body was treated with primer to prevent corrosion, both outside and inside.

The execution drawings of the new components were given to their own workshops, but also to the external collaborators. Also, the necessary procedures were made for getting the pre-made modules such as seats, exterior lighting lamps, side mirrors, pantograph and not only. Step by step, the new vehicle began to be put together. The front and the back segments of the tram were made out of light resin materials which have on the inside a metal structure, effective in case of impact. Also, this offers various fixing points on the body's central side. The 80% glass doors, the pantograph, the AC installation, the electric and electronic equipments were fixed on the vehicle's body, part of them already being internally tested. The asynchronous motors, of Romanian production (Electroputere Craiova) have received good qualifications after the first tests. In the same time as the fixing of the technical equipments, the factory also received the components destined for the interior fitting of the wagon. In order to underline the ecological feature of the vehicle, the interior had a green colour, both in case of the seats and the side panels and the linoleum. The curved shape of the side pillars and of the supporting bars, as well as the white superior decorative panels offers space and light to the interior. The interior lighting installation is made of economical and at the same time effective LEDs. The wattman's cabin, with its ergonomic dashboard offers, along with the wattman's seat, safety and comfort.

The modernisation process of the tram was finalised in 2012, in July the wagon being delivered to the transportation system in Iași. The tram was tested inside the depot, various software modifications being made, on what concerns the command and traction equipments, with the help of the specialists from Hanning & Kahl Company and of ICPE-SAERP Bucharest. Once the perfect functioning parameters were achieved, according to the specific of the routes of Iași, the tram was tested from a dynamic point of view, in order to be tested and to receive the homologation of AFER (Romanian Railway Authority). At the end of the year, the tram received the required homologations in order to enter a normal usage program. The GT4M tram was publicly displayed on the 27th of June 2013, afterwards being introduced into the public transportation system in Iași.

Although at the core of the project it remained a vehicle designed over 5 decades ago, after the modernisation it had state-of-the-art technical equipments, with an improved functionality of the inside space and a modern exterior aesthetics. The GT4M project has represented a good example for the authorities of Timișoara. Thus, the decision of modernising 2 GT4 Wegmann wagons, trams built between 1973 and 1977, was taken in Timișoara. The modernisation process began in 2014, the design and the reconstruction of the wagons being made by the factories "Electroputere VFU Pașcani" and "Astra Vagoane Arad". The project had 5 different variants of exterior design (author: Silviu Teodor-Stanciu), from which the second variant was chosen, conceived according to the urban aesthetics of Timișoara. The project entitled "Armonia" is in development even nowadays, 12 modernised units being in use.

4. CONCLUSION

The entire process of industrial design represents the result of a long research process regarding the history, the technological and aesthetics evolution of the products, research followed by the making of multiple colour and volumetric studies, market studies, surveys, technical experiments. The technological capacity of the producers must not be neglected, a close collaboration with them being necessary from the first stages of the design. The obtained product must be an original one through shape and colour, integrating itself in the aesthetics of the market segment it belongs to, through functionality, by using ecological fabrics, all of these "dressed" in an ergonomic manner according to the beneficiary's direct needs.

REFERENCES

- [1] Albu Cristina L., Czech Radu D. (2013). *Monographie of public transport in Iasi 2008-2013 (Monografia transportului public de calatori din municipiul Iasi 2008-2013)*, Public Transport System Iasi.
- [2] Hosey Lance. (2012). *The Shape of Green: Aesthetics, Ecology and Design*, Island Press.
- [3] Pralea, Jeni. (2009). *Design in the context of the industrial product (Designul in contextul proiectarii produsului industrial)*, ARTES, Iasi.

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