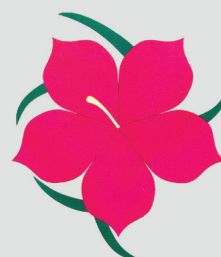


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PODGORICA



“THE GOOD OLD” WORKING MODEL vs IT/VR/AI/etc.

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SYNOPSIS

Key words:

Working model,
IT,
new technologies,
interactivity.

The rapid development of information technologies, characteristic of the 21st century, and the broad range of possibilities and methods of application that this progress brings have certainly influenced contemporary museology, particularly museum presentation. Various digital tools and technological innovations are now widely used in communication between museums and their audiences, and the number of scholarly papers dealing with this topic is growing daily. There is no doubt that the use of information technologies in museum presentation offers certain benefits: it improves the way museums communicate with visitors and even, one might say, redefines the methodology of presentation, exhibition design, and the very purpose of the museum object.

Nevertheless, in the case of a technical museum such as the Nikola Tesla Museum, whose presentation is fundamentally based on working models, one may ask whether too much emphasis and attention have perhaps been given to the use of information technologies in museum display. Drawing on decades of experience with both approaches within the Museum's highly developed exhibition activities, it is possible to open a discussion (if not reach a conclusion) about the advantages and/or disadvantages of various digital technologies when compared with, so to speak, classic working models and exhibits.

SINOPSIS

„Stari, dobri“ radni model protiv IT/VR/AI/ITD

Ključne riječi:

Radni model,
IT,
nove tehnologije,
interaktivnost.

Ubrzani razvoj informacionih tehnologija, karakterističan za 21. vek, i čitava paleta različitih mogućnosti i metoda upotrebe koje razvoj te oblasti donosi, svakako su uticali i na savremenu muzeologiju, a posebno na muzejsku prezentaciju. Različiti digitalni alati i tehnološke inovacije uveliko su u upotrebi kada je u pitanju komunikacija na relaciji muzej-publika, a broj naučnih radova koji se bavi ovom tematikom raste svakodnevno. Nema sumnje da upotreba informacionih tehnologija u muzejskoj prezentaciji donosi određene benefite, unapređujući način komunikacije muzeja sa publikom pa čak, može se reći, i redefinišući metodologiju prezentacije, dizajna izložbenih postavki i osnovne svrhe muzejskog predmeta.

Ipak, na primeru i praksi jednog tehničkog muzeja kakav je Muzej Nikole Tesle, koji osnovu prezentacije bazira na radnim modelima, može se postaviti pitanje da li je možda ipak preveliki akcenat i pažnja data upotrebi informacionih tehnologija u muzejskoj prezentaciji. Na decenijskom iskustvu upotrebe i jednih i drugih alata u okviru izrazito razvijene izložbene delatnosti Muzeja Nikole Tesle, može se otvoriti tema (ako ne i zaključak) o prednostima i/ili manama različitih digitalnih tehnologija u kontekstu poređenja sa, uslovno rečeno, klasičnim radnim modelima/eksponatima.

Introduction

The history and development of technical museums are linked to the 19th and early 20th centuries and are directly connected, on the one hand, to the rapid growth of industry and technology and, on the other, to the great world exhibitions, which influenced not only the expansion of museum objects within

collections but also the increasing popularity of such museums among the public. At the same time, it can be said that the history and evolution of working models in museology paralleled the history of technical museums precisely because of the very nature of these objects, which demonstrated specific technological processes to visitors—perhaps making

the first step toward removing the barrier between the museum object and the visitor and, indeed, marking the beginnings of interactivity (Maroević 1993, p. 38).

The great world exhibitions of the late 19th and early 20th centuries accompanied the industrial revolution and technological progress. The role of working models as demonstrators of industrial processes and technological advancement was both educational and promotional. It was precisely during this period that major technical museums were established, such as the Deutsches Museum in Munich, founded in 1903, whose exhibitions were based on working and educational models (Hudson 1987, p. 31). At the same time, this was also the period in which Nikola Tesla (1856–1943) lived and worked. Tesla both visited and participated in world exhibitions, presenting his inventions and using demonstration models and analogies in his expositions and lectures (Jovanović 2014).

The Founding of the Nikola Tesla Museum

After the death of Nikola Tesla on January 7, 1943, the legal custodian of his estate became Sava Kosanović, the son of Tesla's sister Marica. Through Kosanović's efforts, Tesla's entire legacy was transferred from New York to Belgrade in 1951. By the decision of the Council for Science and Culture of the Government of the Federal People's Republic of Yugoslavia (FPRY), a Commission for Opening the Legacy of Nikola Tesla was established on July 9, 1952. On October 29 of the same year, a resolution was passed to arrange and classify Tesla's legacy according to the nature of the materials. Acting on the proposal of the Council for Science and Culture, the Government of the FPRY issued a resolution on December 5, 1952, founding the Nikola Tesla Museum. The document was signed by the President of the FPRY Government, Josip Broz Tito. Professor Veljko Korać of the Faculty of Philosophy in Belgrade was appointed as the Museum's first director. Between 1952 and 1955, an extensive process of classifying the materials and preparing and realizing the first permanent exhibition was carried out with the expertise and dedication of specialists from various fields and institutions. The concept for the inaugural permanent display, dedicated to Tesla's discoveries, was developed by a team of professors from the Faculty of Electrical Engineering together with Professor Korać. The Nikola Tesla Museum officially opened to the public on October 20, 1955 (Smiljanić 2003, p. 17).

From its very inception, the Nikola Tesla Museum

focused on presenting Tesla's inventions through working models. The task of designing the permanent exhibition dedicated to Tesla's discoveries was entrusted to engineer Jovan Surutka, who prepared the technical documentation for the production of the working exhibits. The first permanent exhibition featured 15 (or 16) working exhibits, most of which were created by a team of experts at the Institute of the Serbian Academy of Sciences for the study of electrical phenomena, as well as by the "Nikola Tesla" Radio Industry, the Military Technical Institute of the Yugoslav Army, and the Faculty of Electrical Engineering. Most of these exhibits are still part of the Museum's permanent display today (Radić-Kalderon & Civrić 2003, p. 135).

Over the next three decades, the condition and number of working models and scale replicas remained almost unchanged, with the exception of a panel dedicated to the Tesla unit—whose exact date of creation is unknown but is presumed to have been made when the unit was defined within the SI system (1960)—and a panel from the Niagara hydroelectric power plant generator, which was donated to the Museum in 1976.

Through the efforts of Professor Ilija Volčkov, several new working exhibits were produced in 1986 (or 1982, according to some sources). These were intended both to expand the traveling exhibition *The Life and Work* of Nikola Tesla, originally prepared in 1963, and to create a number of models that were donated to other institutions, including the Polytechnic Museum in Moscow, the Technical Museum in Vienna, the Science Museum in London, the National Museum of American History within the Smithsonian Institution in Washington, D.C., and the Technical Museum in Budapest. Between 1963 and 1996, this exhibition was presented in around one hundred locations and cities across the former Yugoslavia and in about fifteen foreign countries (Civrić 2003, p. 189). During the 1990s, despite the poor economic and political situation caused by the wars in the former Yugoslavia, the number of exhibition items nevertheless increased. Additions included scale models of Tesla's laboratories in Colorado and Long Island, a model of the Adams hydroelectric power plant at Niagara, as well as several new working models. After 2000, both the number of exhibits and the Museum's exhibition activities grew rapidly; from 2000 to the present, the collection has nearly doubled in size, creating conditions for the establishment of a dedicated museum collection.



Photo 1: Tesla Oscillating Transformer 500 kV.



Photo 2: Induction motor with Egg shaped rotor.

Collection T:21

The collection of working models and scale replicas of the Nikola Tesla Museum today numbers around 100 inventory items. To provide a clearer overview of the collection and its objects, as well as to better understand the collection's function—primarily in relation to exhibition activities, which represent the main purpose of these items—I will attempt to define its structure through several classifications.

The structural division of objects within Collection T:21 can be determined according to several parameters:

1) Division by time of creation,

The exhibits can be categorized into two groups according to the period in which they were created: those produced at the time of the Museum's founding and before its opening to the public, and those created afterward, from 1955 to the present day. As previously mentioned, for the Museum's first permanent exhibition, from its establishment up to its public opening, 15 working models were produced—16 exhibits in total, since the Model of the Spiral Secondary of a High-Frequency Transformer, which was part of the permanent display's scenography, was included in the collection when it was formally established in 2014. The second category comprises exhibits that were produced (or acquired) from the Museum's opening to the present. These items are closely tied to the needs of exhibition activities beyond the Nikola Tesla Museum itself and reflect the development of such activities over the years. It can also be said that the growth in the number of these exhibits has been proportional to the expansion

of these activities as well as to the increasing global popularity of Nikola Tesla.

2) Division by location,

The division of exhibits according to their location also separates the objects into two categories: those displayed in the Museum's permanent exhibition and those kept in the storage facilities of the Nikola Tesla Museum, including items that are loaned for the Museum's traveling exhibitions. This classification is important in practical terms because it reflects the operational logic of the Museum's exhibition activities. The current permanent exhibition, designed in 2016 by Dr. Branimir Jovanović and still in place today with only minor modifications, retains a large portion of the working models from the original permanent display.¹ In this sense, the location-based division partially overlaps with the time-based division. However, this overlap is only approximate, as the permanent exhibition also includes exhibits produced after 1955. It is also worth noting that for working models displayed outside the Museum, namely at traveling exhibitions, a system of control switches has been introduced to operate the devices. These switches are connected to time relays that regulate the operating periods and pauses of each exhibit, allowing visitors to directly activate the working models themselves. By contrast, in the Museum's permanent exhibition the devices are operated by a demonstrator, who simultaneously

¹ The only exceptions are the exhibits Mechanical Analogy of the Rotating Magnetic Field, Four Circuits in Resonance, Radio-Controlled Boat, and Oil-Filled Transformer, which have been removed from the permanent exhibition (the first two are used for the Museum's traveling exhibitions).

explains their function. While this provides a higher-quality mode of presentation, such a guided-tour concept—and even the presence of a demonstrator—cannot always be ensured at traveling exhibitions.

3) Thematic division

The thematic division of exhibits refers to the aspect of Tesla's life and scientific work to which they are related. Nikola Tesla's scientific work can broadly be grouped into three main areas: The System of Production, Transmission, and Use of Alternating Current, High-Voltage, High-Frequency Currents, and Mechanical Engineering. To these three scientific categories a fourth, more informal group can be added—“Other”—which includes replicas of Tesla's personal belongings, items related to his social life, copies of documents, and similar materials. This thematic division is significant because it defines the actual number of exhibits available for use, given that many objects have duplicates. The growing demand for traveling exhibitions after 2000, and especially after 2015, created a need for the production of new exhibits. The increasingly frequent requirement to organize more than one exhibition at the same time led to the replication of certain working models. As a result, the collection contains multiple copies of models such as the Egg-Shaped Rotor Induction Motor, Tesla Oscillating Transformer, and various scale models and replicas. Consequently, the total number of inventory units does not correspond to the number of items that can be displayed in a single exhibition. Rather, this division indicates the availability of objects for simultaneous displays. This approach has proven highly practical given the growing popularity and demand for traveling exhibitions. At present, the Nikola Tesla Museum is able to organize three different exhibitions simultaneously, in addition to maintaining its permanent display

Analyzing the history of the Nikola Tesla Museum's exhibition activities and taking into account the thematic division of the exhibits, it can be concluded that certain Tesla inventions—and the working models corresponding to them—can serve as representatives of each thematic area. Accordingly, the induction motor represents the first theme (the system of production, transmission, and use of alternating current), the Tesla oscillating transformer represents the theme of high-voltage, high-frequency currents, and the Tesla pump represents the field of mechanical engineering. It follows that these three working models form the conceptual foundation for a large number of the Museum's exhibitions and for the broader presentation of Tesla's work, which

has indeed been the case. The further development of new working models can thus be defined as the supplementation of each of these thematic areas, modeled on the original permanent exhibition. For this reason, all three types of induction motors presented in the permanent display have been produced (induction motor with a disc-shaped rotor, “Egg of Columbus”, and induction motor with a squirrel-cage rotor), along with various models of Tesla transformers, Tesla pumps, and other models corresponding to these thematic areas, as well as scale models and replicas that also follow the same themes.

Requirements of working exhibits

Unlike scale models or static objects, working exhibits are by their very nature prone to malfunctions and require regular maintenance. This need was formally recognized in 2011, when an agreement was signed with engineer Radomir Putnik for regular (and emergency) maintenance of the Nikola Tesla Museum's working exhibits. The Museum also collaborates with engineers Velimir Mrđen and Velibor Zlatanović, who have created some of the working models, as well as with other specialists. There remains an ongoing need for inter-institutional cooperation in this field.

Working models also impose visitor safety requirements. Over years of practice, the Museum has continuously improved this aspect, introducing various measures to protect both visitors and the exhibits themselves. This includes collaboration with the Laboratory for the Study of the Effects of Ionizing and Non-Ionizing Radiation at the Department of Physics, Faculty of Sciences, University of Novi Sad.

Information Technologies in the Nikola Tesla Museum

The growing global popularity and interest in Tesla—especially after the commemoration of the 150th anniversary of his birth—and the proportional increase in demand for more traveling exhibitions at the beginning of the new millennium have brought new challenges for museum presentation and the need to design new themes and exhibits. At the same time, museum presentation methods worldwide have been undergoing modernization and exploring different forms and modes of communication with audiences. Between 2016 and the present, the Nikola Tesla Museum has organized more than 30 traveling exhibitions both in Serbia and abroad. Some of the most visited were held in Shanghai (over 300,000 visitors), Milan (over 70,000), Barcelona (over 150,000 visitors), and Madrid (over 100,000 visitors). This period was also marked by the rapid development

of information technologies and the diverse tools they provide. As early as 2003, the Nikola Tesla Museum began using the possibilities of information technology and animation to create animated content that demonstrates the operation of various Tesla inventions—both those already represented by working models and those for which the Museum does not possess an appropriate working model.

Another milestone, the 160th anniversary of Nikola Tesla’s birth, brought a further surge of popularity and public interest in Tesla, and consequently new demands for presentation. The Museum’s permanent exhibition was updated, and the concept of traveling exhibitions was raised to a higher level through the inclusion of professional designers and the adoption of various IT technologies, such as mapped projections, animated content on touch screens, and similar innovations. In addition, the permanent exhibition was enriched with new content developed in collaboration with the Digital Mind studio, employing the latest technologies of the time. One notable feature was the VR application “Doživi Teslu” (“Experience Tesla”), which allowed visitors

to attend a lecture by an animated Tesla in a digital virtual space on various topics. A similar project was created in cooperation with the Faculty of Electronic Engineering in Niš: a VR application of Tesla’s famous Long Island laboratory enabled visitors, using VR equipment, to explore a digitized version of this laboratory. This application was used as supplementary content for some traveling exhibitions and other organized programs of the Nikola Tesla Museum². More recently, the growing popularity of social media has created a need for the continuous production of content tailored to these platforms. In response, the Museum has increasingly turned to animated content and embraced the advantages of the rapidly developing AI technologies—a development that can justifiably be described as a “revolution.” AI technology will undoubtedly continue to reveal both its potential and its shortcomings, the latter being particularly evident during the developmental stage we are currently witnessing.

² This technology was discontinued during the COVID-19 pandemic and has never been reintroduced into the program, as it was deemed impractical under the prevailing conditions.



Photo 3: VR application “Doživi Teslu”.

The “match” result?

Summarizing all of the above—the Museum’s extensive experience with presentation methods and traveling exhibitions, together with the availability of various new technologies—one can conclude that working models ultimately hold a significant advantage over IT technologies, which is also my personal impression. Field experience has shown that audiences are far more interested in

and fascinated by the “live” working model than by animations, VR, or similar digital features. Within the permanent exhibition of the Nikola Tesla Museum, Tesla’s oscillating transformer with an output voltage of 500 kW, built in 1954, remains the most popular exhibit. This suggests that, no matter how advanced new technologies may be, they are accessible in everyday life, whereas working models are something visitors rarely have the opportunity to

encounter. Another reason may lie in the fact that, regardless of technological progress, a boundary between the real and the virtual world persists—and visitors consistently seem to prefer reality. When considerations of cost-effectiveness are added—namely, that all new technologies require significant

financial resources and quickly become obsolete—the outcome of this “match” clearly favors the working models, while information technologies assume only a supporting role that is not indispensable.

REFERENCES:

- Civrić, Z. 2003: *Izložbena, izdavačka, javna i obrazovna delatnost Muzeja Nikole Tesle u Muzej Nikole Tesle: 1952-2003*. Beograd: Muzej Nikole Tesle
- Hudson, K. 1987: *Museum of Influence*. Cambridge University Press, 228pp.
- Jovanović, B. 2014: *Teslin čudesni svet*. Beograd: Vulkan, 320pp.
- Maroević, I. 1993: *Uvod u muzeologiju*. Zagreb: Zavod za informacijske studije Odsjeka za informacijske znanosti Filozofski fakultet Sveučilišta u Zagrebu, 286pp.
- Radić-Kalderon, J. Civrić, Z. 2003: *Stalna postavka Muzeja Nikole Tesle u Muzej Nikole Tesle: 1952-2003*. Beograd: Muzej Nikole Tesle.
- Smiljanić, D. 2003: *Muzej Nikole Tesle u Muzej Nikole Tesle: 1952-2003*. Beograd: Muzej Nikole Tesle.

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