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Türk Organoloji Dergisi Hakkında

Türk Organoloji Dergisi (TOD) (e-ISSN: 3023-7890), müzik aletlerinin özellikleri, sınıflandırılması, tarihsel gelişimi, etimolojisi gibi konular üzerinde araştırmaların yayınlandığı, ücretsiz, açık erişim, hakemli ve bilimsel bir dergidir. Dergide çift-kör hakemlik sistemi uygulanmaktadır. TOD, öncelikle bölgesel, sonrasında ise dünyada organoloji alanında yayın yapan ilk ve tek dergi olması sebebiyle, bu akademik disiplinin gelişiminde önemli bir platform olmayı hedeflemektedir. TOD, organoloji alanındaki araştırmacıların bilimsel yazma becerilerini, teknolojik araç kullanımını, müzik enstrümanı yapımı, tasarımı ve revizyon ustalığı gibi yetkinliklerini geliştirmeyi teşvik eder. Yayın dönemi Mart ve Eylül aylarıdır. Türk Organoloji Dergisi'nin yayın dili Türkçe ve İngilizce'dir.

Yayın Alanı

Türk Organoloji Dergisi'nin (TOD) kapsamı, organoloji alanındaki akademik araştırma konularıdır. Bunun yanında organoloji ile ilgili disiplinler arası konulara da yer verir. TOD; araştırma makaleleri, derleme makaleleri, kitap incelemeleri ve röportajlar şeklinde makaleler yayınlar. TOD'un kapsamı, müzik aletlerinin özellikleri, müzik aletlerinin tarihî gelişimi ve etimolojisi, müzik aletlerinin yapımı ve tasarımı, müzik aletlerinde revizyon ve geliştirmeler ile müzik aletleri üzerine disiplinler arası çalışmaları içerir.

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Editörden

Değerli Organoloji Araştırmacıları,

Türk Organoloji Dergisi'nin (TOD) 2(2) sayısını araştırmacıların dikkatine sunmaktan memnuniyet duyuyoruz. Organoloji alanında hem bölgesel hem de uluslararası düzeyde özgün katkılar üretmeyi hedefleyen dergimizin bu sayısı, geleneksel çalgı yapım ustalığından yenilikçi enstrüman tasarımlarına, kültürel mirasın korunmasından zanaatkârlık pratiklerinin belgelenmesine uzanan dört nitelikli çalışmadan oluşmaktadır. Her bir makale, müzik aletlerinin kültürel, teknik ve akustik boyutlarına dair değerli bilgiler sunmakta; organoloji literatürünün gelişimine anlamlı katkılar yapmaktadır.

Bu sayıda yer alan ilk makale, **Memmedeli Mirel Memmedov** tarafından kaleme alınan *"Tar müzik aletinin onarımı sırasında dikkat edilmesi gereken hususlar ve tar parçalarının görevleri"* başlıklı çalışmadır. Yazar, Azerbaycan tarının yapısal özelliklerini, malzeme seçimini, eşik ve perde sistemlerini, gövde–sap ilişkisini ve membran bakımı gibi kritik teknik süreçleri ayrıntılı biçimde ele almaktadır. Tarın her bir parçasının akustik işlev açısından taşıdığı önemi ortaya koyan çalışma, geleneksel tar yapım ve onarım uygulamalarının bilimsel temellerle aktarılmasına hizmet etmektedir. Bu yönüyle hem uygulamalı çalgı yapımcıları hem de organoloji araştırmacıları için temel bir başvuru niteliği taşımaktadır.

Sayının ikinci makalesi, **Bekim Ramadani** tarafından hazırlanan *"Arnavut halk müzik aletleri zanaatkârlığında geleneksel perspektifler ve yenilik: Gostivar'dan Usta Salla Shabani'nin atölyesi örneği"* başlıklı çalışmadır. Makale, Arnavut halk müzik aletleri üretim geleneğini etnografik bir çerçevede incelemekte; usta Salla Shabani'nin atölyesini örnek olay olarak ele alarak zanaatkârlığın kültürel kimlik, ritüel pratikler ve modernleşme süreçleriyle ilişkisini analiz etmektedir. Çalışma, geleneksel zanaat bilgisinin korunması ve gelecek kuşaklara aktarılması bakımından önemli bulgular sunmaktadır.

Üçüncü makale, **Orçun Çalkap** ve **Kibele Kıvılcım Çiftçi** tarafından kaleme alınan *"Birleşik Kanun: Türk ve Batı organolojisi perspektifinden yeni bir çalgı modeli"* başlıklı özgün bir çalışmadır. Yazarlar, iki kanunun tek bir gövdede birleştirilmesiyle tasarlanan "Birleşik Kanun"u organolojik, terminolojik ve icra teknikleri açısından kapsamlı biçimde incelemektedir. Hem Türk müzik kültüründe geleneksel adlandırma pratikleriyle hem de Hornbostel–Sachs sınıflandırma sistemindeki "combined/unified" yaklaşımıyla uyum sergileyen bu yeni model, organoloji literatürüne önemli bir yenilik ve tartışma alanı kazandırmaktadır.

Bu sayının dördüncü makalesi, İranlı luthier **Morteza Salimian Rizi** tarafından yazılan *"The art of crafting Iranian Tar and Setar: Personal experiences"* başlıklı çalışmadır. Makale, İran tarı ve setarının yapım sürecine ilişkin uzun yıllara dayanan ustalık deneyimini belgeler. Malzeme seçimi, gövde–sap oranları, ses tahtasının işlevi, boynuz ve ağaç tiplerinin tonal karakter üzerindeki etkileri gibi konular uygulamalı bir yaklaşımla ele alınmaktadır. Bu çalışma, İran çalgı yapım geleneğinin teknik inceliklerini bilimsel bir çerçevede aktarması bakımından hem bölgesel hem de uluslararası organoloji literatürüne değerli katkılar sunmaktadır.

Bu sayının beşinci makalesinde **Serkan Çolak**, elektronik müzik enstrümanlarının geç 19. yüzyıldan 1980'li yıllara uzanan gelişim sürecini organoloji perspektifinden ele almaktadır. Çalışma; Telharmonium'dan Theremin ve Ondes Martenot'ya, modüler ve entegre sentezleyicilerden dijital sentez ve MIDI teknolojisine kadar uzanan geniş bir tarihsel çerçeve sunmaktadır. Makale, elektronik müzik enstrümanlarının yalnızca teknik yenilikler olarak değil, çalgı kavramını dönüştüren dinamik ve yaşayan bir organolojik kategori olarak değerlendirilmesi gerektiğini vurgulaması bakımından alana önemli bir kuramsal katkı sağlamaktadır.

Türk Organoloji Dergisi'nin bu özel sayısının, geleneksel çalgıların yapım, tasarım, yenileme ve kültürel işlevlerine dair disiplinler arası araştırmaları teşvik edeceğine inanıyoruz. Katkı sunan tüm yazarlarımıza ve hakemlerimize teşekkür eder, organoloji alanındaki yeni çalışmalara ilham olmasını dileriz

Saygılarımızla,

Türk Organoloji Dergisi Editörlüğü

From the Editor

Dear Organology Researchers,

It is a pleasure to present the second issue of Volume 2 of the *Journal of Turkish Organology* (JTO) to our readers. Aiming to contribute to the growth of organology both regionally and internationally, this issue brings together four scholarly articles that explore traditional instrument-making, innovative instrument design, cultural heritage preservation, and contemporary craft practices. Each contribution offers valuable insights into the technical, cultural, and acoustical dimensions of musical instruments, thereby enriching the field of organology with new and significant perspectives.

The first article in this issue, authored by **Memmedeli Mirel Memmedov**, titled *"Tar müzik aletinin onarımı sırasında dikkat edilmesi gereken hususlar ve tar parçalarının görevleri"*, provides a comprehensive examination of the Azerbaijani tar. The study details the instrument's structural components, materials, string and fret systems, soundboard membrane, and maintenance techniques. Emphasizing the acoustic functions and mechanical significance of each component, the article serves as a substantial reference for both instrument makers and researchers working in the field of organology.

The second article, written by **Bekim Ramadani**, *"Arnavut halk müzik aletleri zanaatkârlığında geleneksel perspektifler ve yenilik: Gostivar'dan Usta Salla Shabani'nin atölyesi örneği"*, explores traditional perspectives and contemporary innovations in Albanian folk instrument craftsmanship. Focusing on the workshop of master craftsman Salla Shabani from Gostivar, the study employs ethnographic methods—interviews, observations, and field data—to analyze the cultural, ritual, and historical relevance of instrument-making within Albanian identity. The article highlights the importance of safeguarding traditional craftsmanship and transmitting artisanal knowledge to future generations.

The third contribution, by **Orçun Çalkap** and **Kibele Kıvılcım Çiftçi**, titled *"Birleşik Kanun: Türk ve Batı organolojisi perspektifinden yeni bir çalgı modeli"*, introduces an innovative instrument model known as the Unified Kanun. Designed by integrating two kanuns into a single body, this new instrument expands the technical possibilities of the traditional kanun, enabling novel performance techniques and multi-octave mandal manipulation. The authors contextualize the instrument within both Turkish naming traditions and the Hornbostel–Sachs classification system's category of "combined/unified" instruments, positioning it as a valuable contribution to contemporary organological discourse.

The fourth article, *"The art of crafting Iranian Tar and Setar: Personal experiences"*, written by Iranian luthier **Morteza Salimian Rizi**, documents more than a decade of professional expertise in constructing the Persian tar and setar. The study provides an applied perspective on material selection, soundboard integration, neck curvature, tonal shaping, and structural features that influence resonance. By combining traditional craftsmanship with personal experimentation, the author offers rich insights into the preservation and sustainable transmission of Iranian instrument-making heritage.

In the fifth article of this issue, **Serkan Çolak** examines the development of electronic musical instruments from the late nineteenth century to the mid-1980s through an organological perspective. The study presents a broad historical framework ranging from the Telharmonium to the Theremin and Ondes Martenot, and from modular and integrated synthesizers to digital synthesis and MIDI technology. By approaching electronic musical instruments not merely as technical innovations but as a dynamic and evolving organological category that reshapes the very concept of the musical instrument, the article offers a significant theoretical contribution to the field.

We believe that this issue of the *Journal of Turkish Organology* will stimulate interdisciplinary research on the construction, design, restoration, and cultural significance of musical instruments. We extend our sincere thanks to all authors and reviewers who contributed to this volume and hope that these works will inspire further scholarship in organology.

With kind regards,

Journal of Turkish Organology Editorial

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Research Article

Traditional perspectives and innovation in Albanian Folk musical instrument craftsmanship: the case study of Master Salla Shabani's Workshop in Gostivar

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Abstract

This study focuses on the analysis of traditional perspectives and innovation in Albanian folk musical instrument craftsmanship, with a particular emphasis on the workshop of master Salla Shabani from Gostivar. Using a wide range of methodologies, including detailed interviews, observations, and other field sources, we examine the history of musical instrument craftsmanship and its role in the context of Albanian culture. Furthermore, we analyze the impact of this craftsmanship on ceremonies, historical events, and the cultural identity of Albanians. In addition, we explore the effects of traditional musical instrument production techniques and innovation in this field, including the role of contemporary technology. By creating a complete portrait of Salla Shabani's biography, the aim of this study is to accurately understand the connection between craftsmanship, musical identity, and the dissemination of Albanian culture. In particular, we discuss the role of craftsmanship in preserving cultural diversity and promoting intercultural dialogue, and suggest possible steps for the continued preservation and promotion of the traditional musical instrument-making art in the future.

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Introduction

Craftsmanship (handicrafts) is a profession that requires special skills. From a historical perspective, it refers to non-industrial, small-scale production. Craftsmanship has a long history in many cultures and societies, extending from ancient times to the present. Artisans have specialized through techniques and skills transmitted from generation to generation.

An analysis of the historical development of folk musical instrument craftsmanship within Albanian culture forms a fundamental part of this study, as it provides the necessary historical and cultural context for understanding the role and evolution of this craft over time. In this section, the development process of folk musical instruments in Albanian culture will be examined in light of significant historical periods and cultural events that have influenced it. The analysis will begin with traditional musical instruments unearthed in the ancient and medieval periods in present-day Albanian territories.

There is considerable evidence concerning the musical culture of the Illyrians. Information about this culture appears in the works of Aristotle, Plutarch, Titus Livius, Cicero, Athenaeus, Thalloczy, Calenus, and Pliny, and most notably in the Bible, considered the oldest document. The Bible notes that the instrument known as *Sirta* was widely used from

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Babylon to Illyria in the ancient Babylonian Kingdom (4000 BCE), which possessed a deeply rooted culture. It is also recorded that "the Illyrians sang war songs accompanied by flute and bagpipe" (Thalloczy, 1916) and performed war dances with swords. The renowned French author and abbot Pierre Bauron (1888, p. 350) also emphasized the courage, patriotism, and peaceful relations of their ancestors with their neighbors in his works.

Furthermore, Aristotle (*Politics*, VII) advised his fellow citizens not to develop melodies played in the Phrygian mode (a modal scale consisting of two symmetrical tetrachords with a semitone between the 2nd–3rd and 6th–7th degrees), as this mode was considered one of the characteristics of Illyrian music and was performed on an instrument called *Bicurelja* (Gr. *Phrygian auloi*; Lat. *Tibiae phrygias*) (Ramadan Sokoli & Piro Miso, 1991, pp. 29–30).

In the 5th century, it was reported that Archbishop Jerome (Jerome) referred to dancers and rhythmic accompaniment using small metal instruments (*çamparet*) (Ankica Vitanova & Bekim Ramadani, 2014). The Runic Ocarina, a wind musical instrument from the Neolithic period, is considered the oldest musical instrument ever found in Kosovo. This artifact is a unique archaeological discovery not only for Kosovo but also for the entire region and beyond (Kraja, 2018, p. 1211).

One of the most significant instruments for Albanians from the Middle Ages to the present is the string instrument *lahuta*, used by highlanders to accompany epic songs from the *Kreshnikët Cycle*. During this period, Albanians also used other musical instruments such as idiophones (hammer, bell, cymbal, stone, tray), membranophones (drum, tambourine, pot, etc.), and aerophones (leaf, flute, *zurna*, etc.).

In ethnomusicology, a musical instrument is always evaluated with two distinct functions: as a tool for producing sound and as a tool for making music (Bose, *Ethnomusicology*, 2019, p. 91). Sound is the most important element in expressing the national code. For example, even if one plays motifs from Schubert's symphonies on a *çifteli*, the timbre will still possess an authentically Albanian resonance (Ramadani; Adnan Aliu, renowned maker and performer of aerophone folk musical instruments, 2019, p. 30).

The Albanian people have inherited numerous musical instruments from their ancestors, remarkable in terms of craftsmanship, origin, usage, and expressive capabilities (Sokoli, 1991, p. 1). Many historical factors—migrations, the Ottoman occupation, and cultural interactions with other communities—have significantly influenced the formation and diversification of musical instruments. Before the Industrial Revolution (18th–19th centuries), craftsmanship was the primary mode of production. An exception to this was the manufacture-based production carried out with a more massive and organized division of labor, marking the transition from individual craftsmanship to the industrial era. Therefore, part of the blame for the disappearance of traditional crafts in our country may be attributed to this revolution (Репер, 2013).

In the late Ottoman period, many instruments such as *primi*, *karadyzeni*, *bugaria*, *gajda*, *surle*, and *davul* emerged. During the *Rilindja* (National Awakening) period, additional instruments such as *çifteli*, *sharki*, and various flutes were introduced.

In the 20th and 21st centuries, when examining the transformations and challenges faced by folk musical instrument craftsmanship in the context of globalization and general modernization, it becomes evident that Western-origin instruments such as mandolin, guitar, clarinet, *llautë*, violin, and accordion were incorporated into folk music ensembles. This development endowed Albanian folk music with both a new appearance and new content.

All these instruments, which have been part of Albanian folk musical culture for centuries, have undergone numerous transformations and changes in terms of construction, structure, timbre, and performance, adapting to the changing social and technological contexts.

The Role of Musical Instrument Craftsmanship in the Cultural Identity, Ceremonies, and Cultural Events of Albanian Regions

An essential part of this study aims to understand the impact of musical instrument craftsmanship on the cultural and social life of Albanians through history and traditions. Some of these impacts include:

Fulfilling ritual and ceremonial needs: Traditional Albanian musical instruments are an important part of various ceremonies and rituals in community life. For example, the *lahuta* often accompanies war songs and other ceremonial events, creating depth and a unique atmosphere.

Promotion of culture and cultural heritage: Artisans who meticulously produce traditional instruments such as *lahuta*, *çifteli*, and *sharki* preserve ancient knowledge and ensure its transmission to future generations.

Cultural identity and sense of belonging: Traditional musical instruments are powerful symbols of Albanian identity. Their use in ceremonies and cultural events strengthens the sense of belonging and cultural bonds.

Preservation of traditional skills: The continuation of traditional manufacturing techniques helps preserve an important part of cultural heritage.

Musical instruments have played a vital role in human life throughout history and have been an inseparable part of warfare. A well-known anecdote illustrates this: Prince Nikola of Montenegro asked General Mark Milani, “How is it that you cannot defeat Malësia (the Highland region)?” Milani replied, “The Highlanders are very strong, very sensitive, very patriotic, and they are determined to defend their land at any cost. But there is something else... Their allies are the mountains and the *lahuta* players.” When Nikola asked, “Why the *lahuta* players?” the general responded, “Because when I kill one of their Highlanders, a *lahuta* player composes a song for him, and these songs inspire hundreds of other Highlanders to join the war” (as recounted by *lahuta* player Jonuz Delaj, Mema, 2018).

Music, song, dance, entertainment, weddings, etc., performed with traditional instruments have a stronger impact on both performers and listeners. What would a wedding be like without music? The original lyrics of the famous song *Bjeri gajdes gajdexhi* also convey this importance:

Nuk ka dasëm o, pa daulle, nuk ka valle o, pa valltar, ju këndoni edhe vallëzoni, sot kjo dasëm mos të pushoj! (Gazeta Telegraf, 2021)	There is no wedding, oh, without the drum, there is no dance, oh, without the dancer, you sing and you dance, may this wedding never stop today!” (Gazeta Telegraf, 2021)

Musical instruments have also played a significant role in lament songs, from which *kaba*, a typical Albanian musical form, was born. According to legend, a dying woman asked her husband not to weep for her but instead to let the clarinet weep at the head of her coffin.

On the other hand, the *davul* (drum) and *surle* (shawm) have become indispensable components of weddings, celebrations, cultural events, and social gatherings. They are present at all types of assemblies, including sporting events. Therefore, the production of musical instruments contributes to the promotion and preservation of Albanian cultural heritage while reinforcing the sense of belonging and cultural identity.

Techniques, Skills, and Tools in Traditional Musical Instrument Making

The production of traditional musical instruments involves specialized techniques, skills, and tools aimed at creating high-quality instruments with beautiful timbres. Some of these include:

Material Selection: The materials used in musical instruments are of vital importance in terms of their quality and sound. Artisans carefully select wood, metal, or other materials suitable for the type of instrument they intend to craft. For example, to make a traditional *lahuta*, it is essential to choose strong and high-quality wood such as walnut, cherry, ash, maple, or olive.

Shaping and Carving: Artisans possess specialized carving skills to shape materials into appropriate forms and sizes. This process involves using traditional wood or metalworking tools to create the instrument’s form and details.

Detail Work: Musical instrument production also includes adding traditional motifs, decorations, or personal details to the instrument. These embellishments enhance the instrument’s aesthetic value (e.g., serpent figures, goat motifs, portraits of Skanderberg, or the national flag).

Assembly and Fitting: Once the instrument is shaped and detailed, artisans assemble all the necessary components to make it functional. This involves installing strings, bridges, pegs, bows, rods, vibrating components, and other essential elements.

Testing and Refinement: After completion, artisans test the instrument's quality and sound. If necessary, they make minor adjustments to ensure the instrument produces a pleasing and satisfying sound.

Tools Used

Burgija (hand drill): for drilling wood.
Sakica: for cutting wood into different shapes.
Keser (adze): for cutting and carving wood.
Small hand saw: for more precise cutting and carving.
File: to make the wood more aesthetic and smooth.
Rakon: similar in function to a file, used for simpler shaping.
Sandpaper: for polishing and smoothing wooden products.
Tuning device: to determine the tuning and pitch range of the instrument.
Wood-cutting machines, specialized carving machines, engraving and decoration machines, etc.

Innovations in Musical Instrument Craftsmanship

Innovation in musical instrument craftsmanship refers to the use of technology, new materials, and other methods to improve quality, performance, and user experience. Some examples include:

New Materials: Using modern materials instead of traditional ones. For example, alongside wood, lighter and more durable materials such as synthetic fiber or hard plastic may be preferred.

Modern Technology and Equipment: Modern devices such as CNC (Computer Numerical Control) machines allow for more precise carving and the creation of complex details.

Innovation in Design and Form: Original instruments can be designed in different shapes or with personalized details.

Improving Performance and Sound Quality: Sound quality can be enhanced by using special materials and acoustic techniques for components such as strings, bridges, pegs, vibrating parts, skins, and mouthpieces.

Customization and Adaptation: Offering users the ability to choose materials, shapes, and design details according to their preferences and needs.

Traditional Musical Instrument Repertoire

The repertoire of traditional musical instruments belonging to the Albanian people is remarkably rich and diverse, manifesting itself across a wide spectrum of musical and social contexts. Through these instruments, three musical genres are expressed: epic, epico-lyric, and lyric—namely, epic and historical songs, love songs, songs of migration (*gurbet*), military songs (*nizam*), anniversary songs, and more. These instruments are also used to perform instrumental melodies such as *nibete* and *kaba*. Folk dances are likewise performed with their accompaniment. Imagine what the songs of the *Kreshnikët* epic, ballads, historical rhapsodies, songs of the *majekrahu* type, and various traditional festivals would mean without folk musical instruments!

The use of traditional musical instruments belonging to the Albanian people varies according to musical style, genre, and cultural context. In some cases, these instruments are played solo, sometimes in pairs, and sometimes within ensembles to convey melodies and rhythms. Their repertoire can encompass a wide range of traditional songs and folk dances, as well as free improvisations that reflect the richness of Albanian folk music. Moreover, these instruments can be used in modern musical genres, adapting to styles such as pop, rock, or jazz. Thus, the repertoire of these instruments is vast and diverse, offering not only a rich variety of sounds and musical expressions but also a wide range of emotions.

Research Aim

This research aims to determine the role and importance of Albanian folk musical instrument craftsmanship in our culture by analyzing both traditional perspectives and innovation in this field. To this end, the workshop of master craftsman Salla Shabani from Gostivar is examined, focusing on the traditional production techniques of folk musical instruments, the impact of innovation, and their place in the cultural identity of the Albanian people.

Research Questions

- What is the role of folk musical instrument craftsmanship in preserving Albanian cultural identity?
- What are the traditional production techniques of folk musical instruments in Albanian culture?
- What is the impact of innovation on the production and development of folk musical instruments?
- How can the history of folk musical instrument craftsmanship in the Gostivar region be defined?
- What are the unique characteristics of master Salla Shabani's workshop?
- How has Salla Shabani's craftsmanship influenced the production and promotion of folk musical instruments?
- How have folk musical instruments been used in ceremonies, historical events, and cultural activities in the Gostivar region?
- What are the challenges and opportunities for the future of folk musical instrument craftsmanship among Albanians?
- How can folk musical instrument craftsmanship contribute to intercultural dialogue and the promotion of cultural diversity in Macedonia?

Method

Interview with Master Salla Shabani

A fundamental part of this study consists of a detailed interview with Salla Shabani, a renowned craftsman in the production of traditional Albanian folk musical instruments. This interview provides a detailed understanding of production processes, traditional techniques, and innovations in craftsmanship.

Observation and Analysis of Other Sources

In addition to the interview, this study also includes the observation and analysis of other sources related to folk musical instrument craftsmanship in Albanian culture. These sources include previous research, documents, and online databases on local craftsmanship.

Findings

Biography of Salla Shabani

Salla Shabani was born on February 9, 1947, in the village of Strajan in Gostivar. It would be impossible to grow up in a home where song and authentic folk music flowed like an inexhaustible source and not preserve the treasure of folk culture. He began his involvement in folkloric music activities at the age of seven, first by playing the *kaval* and immersing himself in the melodies of folk music.

Photo 1. Salla Shabani interview video

The place where Salla Shabani was born is known as a cradle of folk music, where traditional musical culture has been preserved for centuries. His father, grandfather, great-grandfather, and many other family members across generations were producers of folk instruments. At the age of 8–9, he began playing the *çifteli* and *sharki*; at 10–11, he started playing the *kaval* and *gajda*. At 12–13, he attempted for the first time to produce some wind instruments (*kaval* and *gajda*), and from the age of 14, he began making *çifteli*, *sharki*, and *kaval*. He inherited all these instrument-making skills from his father Lazami and his uncle Fejzulla Shabani, who were considered living legends of the *kaval* at the time.

YouTube

Video 1. Salla Shabani, Master of Musical Instruments (Flaka, 2017, November 6)

He continued producing folk instruments until 1968, when he migrated to Germany for work and became a construction master. However, his love for folkloric music never diminished; in foreign lands, he invented a *kaval* titled *gırnata*. A few years later, he developed a side-blown *kaval* with two scales that could be played from both ends. Until 1976, he both worked in construction in Germany and produced original folk instruments.

In 1976, he returned to his homeland and continued his craftsmanship. His passion for folk music did not end after returning from abroad; on the contrary, it continued with new inventions. In 1977, he invented a five-function *kaval* with additional components; in 1978, another *kaval* that could be played both as a *kaval* and a *gajda*. In 1979, he developed a wind instrument combining a *kaval* and a whistle-flute that could be played in the same scale. In 1980, he created a *kaval* with a whistle for beginners and a two-tone *kaval* with three scales; and in 1981, he developed a double-ended *kaval* with eight functions and additional components.

He continued producing these instruments until 1992, when he invented four types of curved-end *kaval*. He also developed a double-ended, dual-function cane. In 1994, he created a four-function, double-ended cane, and in 1998, a *kaval* with additional notes made from *gırnata* parts. He continued producing traditional folk instruments until 2012, when he invented a six-function tempered *çifteli*.

As a producer of wind and string instruments (*çifteli*, tempered *çifteli*, *sharki*, *prima*, *karadizena*, all types of *kaval*, side flutes, whistle flutes, double-tone flutes, ocarinas, *surle*, double-tone *zurna*, *gajda*, *rake-take*, *gëreza*, *rëkeza*, etc.), Salla Shabani opened a new chapter in Albanian organology. In his own words, musical folklore is the strongest and most meaningful source of inspiration in his life (Bekim Ramadani & Florent Iseini, 2016).

Salla Shabani has performed with the following artists: Shefket Ismani (2020, 2022, Topestrada TV Tetova); Rizvan Sinani (2016, 2020, Alb Sound Production); Adnan Aliu (2012 Red Media, 2013 Uskanaify, 2017 Muzikë & Film Shqip); Emin Xhaferi (2013, 2022 Muzikë & Film Shqip); Hanife Sejfulla Reçani (2014 R.I.P.); Vëllezërit Dervishi (2004, 2013 BeniProduction); Vëllezërit Sejdiu (2014); Rovena Hoti (2016); Izmit Salihu (2018 Televizioni Globi); Revajete Fazliu (2016); Lumturie Axhami (2016); Vëllezërit Limani (2014); Arif Madana (2016); Sevdi Malsia (2016); Mejreme Kurti (1993 and 2014).

Participation in Television Programs

Salla Shabani has participated in various television programs, including:

- *Oda Kërçovare* (MUZIKE & FILM SHQIP, 2021) (BeniProduction, Vëllezërit Dervishi - Shkurte Vogel [Oda Kërçovare, TV Gurra] | *Këngë Kërçovare*, 2013)
- *Nga tradita* (TOPESTRADA TV Tetova, 2017; 2019; 2021 [twice])
- *Rreth oxhakut* (*Iso iso*, 2021)
- *Rrënjët tona* (Media, *Melodi me Gajde* - Salla Shabani, 2012) (Media, Salla Shabani - *Melodi me Kavall*, 2012) etc.

Awards, Honors, and Diplomas

Over the past 25 years, Salla Shabani has been highly active in folk music festivals and has been recognized with numerous awards, honors, and diplomas.

- In 2002, he received the "Veteran of Folklore" award at the Kaçanik Festival.
- In 2004, he was awarded a diploma for his valuable contributions at the national festival held in Gjirokastër.
- In 2006, he received a diploma for Best Melody at the "Sharri Këndon" festival.
- In the same year, he was honored with the "Golden Plaque" award on the 35th anniversary of the AKVP "BESA" organization in Gostivar.

Artistic Activities

His intense artistic activities are also connected with the ensemble AKVP "BESA" in Gostivar, with which he has participated in various performances, presentations, events, and festivals. With this ensemble, he was awarded the "Career Diploma" at the "Sharri Këndon" Festival in 2007, and in 2008 he received the diploma for "Best Performer on the Kaval" in the "Malësia e Madhe" region of Montenegro. In July 2010, he won the "Best Melody of the Festival Performed with the Kaval" award at the "Këngë Jeho" Festival in Struga. In May 2011, he participated in the "Hasi Jehon" Folklore Festival in Kosovo and was recognized as a "Distinguished Instrumentalist." In June 2011, he received the "Most Original Performer" award at the traditional "Sharri Këndon" folklore festival.

On July 16, 2011, he participated in the "Shepherds' Festival" in Galiçnik, and on August 31, 2011, he was named "Best Artist with the Kaval" at the "Kandilat e Bajramit" Festival in Skopje. On November 26, 2011, at the "Besa" Folk Songs and Dances Ensemble in Gostivar, he received the title "Veteran of Folklore" on the occasion of its 40th anniversary. On June 8, 2012, he was awarded "Best Instrumentalist on the Kaval" at the "Pece Atanasovski" Festival held in the city of Prilep (Dollnen). In the same month, he participated in the "Sharri Këndon" festival and, together with his ensemble, won the "Best Orchestra of the Festival" award. On April 13–14, 2013, he participated in the national typological folklore festival held in Lezhë and won the award for "Best Performer on the Kaval and Ney."

On July 7, 2013, he received two awards at the 39th "Pece Atanasevski" National Festival held in Prilep: the "19th Century Plaque" for his invention of the six-function *çifteli* and the "Career Diploma on the Kaval." From May 22–29, 2013, he participated in the "Revyal Festival De Saint – Florent Le – Vieil" International Traditional Festival in Paris, France. From August 16–18, 2013, he participated in the "Rapsha 2013" National Folklore Festival in Montenegro and was awarded the "Career Diploma." In 2014, he once again won first place at the "Pece Atanasevski" Festival, earning the title of "Best Musician."

In 2015, he participated in the National Folklore Festival held in Gjirokastër from May 10–16, where he presented his three-function cane and double-tone *kaval*, and received the "Career First Prize" for his significant contributions to innovation, production, and craftsmanship in folk musical instruments. In the same year, he won the "Diploma and Pece Atanasovski Statue" awards at the "Pece Atanasevski" Festival. He also participated in the "Rreze Mali" - Bistër Festival, Argjiro Fest-On (*Gazeta Shqip*, 2015), and the national typological folklore festival in Lezhë (*Gazeta Metro*, 2016).

In July 2024, during the 50th anniversary of the "Pece Atanasovski" Festival of folk instruments and songs held in Prilep and Dollneni, he received two awards ("Plaque" and "Certificate of Appreciation"). In August 2024, he received a "Certificate of Appreciation" from Valbon Limani, Mayor of Gostivar, and Namik Durmishi, President of the Municipal Council, for his "long-term work and dedication to Albanian ethno-organology."

Salla Shabani continues to contribute to the production and performance of musical instruments through technical and tonal innovations. His talent is not limited to wind instruments but also extends to string instruments. He possesses extraordinary talent in the field of traditional culture. His activities also encompass the pedagogical field, as he has lovingly passed on the art of playing the *kaval* to four *kavalists* — Hanif Demiri, Emin Xhaferi, Adnan Aliu, and Valon Aliu — who are interested in folk music and follow in his footsteps. These musicians have also participated in many folk music festivals (Flaka, 2017).

Conclusion

The analysis and interpretation of the research findings offer a profound perspective on the impact of musical instrument craftsmanship on Albanian culture, addressing the fundamental questions of the study and reflecting on the conclusions drawn. The following key points have emerged:

Impact on Cultural Identity

The research demonstrates that musical instrument craftsmanship has played a crucial role in the formation of Albanian cultural identity. The creation and performance of these instruments have been a fundamental aspect of the life of the Albanian people, instilling in them a deep sense of connection with their cultural heritage.

Creation of Cultural Bonds

Musical instrument craftsmanship has contributed significantly to the establishment and preservation of profound cultural bonds between generations. Through the transmission of traditional knowledge and techniques, masters such as Salla Shabani have facilitated the preservation of cultural heritage and promoted intergenerational dialogue.

Role in Festivals and Cultural Events

Traditional musical instruments produced by masters like Salla Shabani have become an integral part of festivals, museums, and cultural events. As representatives of cultural heritage, these instruments have contributed to the promotion of Albanian culture on both local and international stages.

Impact of Innovation and Technology

The findings reveal that musical instrument craftsmanship is in a constant state of evolution, incorporating innovations in production techniques and the use of modern technology. While these developments have led to changes in the characteristics and performance of musical instruments, they have also enabled the preservation of authenticity and cultural heritage.

Contribution of Salla Shabani

The analysis of the findings demonstrates that Salla Shabani's contribution to the field of musical instrument craftsmanship is extraordinary. By blending traditional knowledge with innovation and a passion for culture, he has profoundly influenced the development of this field and left a lasting mark on Albanian art and cultural history.

The summary of the results obtained in this study provides a broad perspective on the core findings and significant conclusions presented. Some of these results include:

The Role of Craftsmanship in Preserving Cultural Heritage

As presented in this study, musical instrument craftsmanship occupies an extremely important place in preserving and promoting Albanian cultural heritage. Through the practices of masters such as Salla Shabani, traditional techniques and cultural knowledge are transmitted from generation to generation.

The Impact of Innovation in Traditional Craftsmanship

The introduction of innovation and modern technology has influenced musical instrument craftsmanship in terms of production techniques and the materials used. However, these changes are not contrary to tradition; rather, they contribute to the preservation and development of the craft.

The Role of Craftsmanship in Cultural Identity

Albanian folk musical instruments are an integral part of the depth of Albanian cultural identity. These instruments not only shape traditional music but also represent an essential part of cultural identity and national history.

Salla Shabani's Individual Contribution and Dedication to Cultural Heritage

Salla Shabani's biography represents a remarkable journey in the field of musical instrument craftsmanship. His contribution to the creation and preservation of this cultural heritage is extraordinary and serves as a model for the future. One of the individuals who continues this craft with great dedication is undoubtedly his compatriot Adnan Aliu (Ramadani, 2019, pp. 29–42).

The Importance of Establishing a Museum

It is important that these instruments be exhibited within or near a cultural institution, such as a museum. Additionally, preparing catalogs containing photographs and descriptions of each instrument would be particularly valuable.

The Importance of Field Research and Cultural Collaboration

To fully understand musical instrument craftsmanship, it is essential to conduct field research and establish close collaboration between masters and local communities. This enables a deeper understanding of traditional practices and their influence on local culture and identity.

The results of this study present a clear and detailed summary of the main findings and conclusions, making a significant contribution to the field of ethnomusicology and cultural studies.

Biodata of Author

Dr. **Bekim Ramadani** was born in 1970 in the village of Orashje, near Tetova. He completed his primary and secondary education in his hometown. In 2001, he graduated from the Faculty of Music at Tetova State University. He completed his master's degree in Musicology in Tirana in 2006 and earned his PhD in Ethnomusicology in Skopje in 2018. He is currently a faculty member at the Faculty of Music, University of Tetova, where he teaches courses related to folk music and music cognition. For over twenty years, he also worked as a music teacher at the "Kiril Pejçinoviq" High School in Tetova and successfully directed the school choir.As an active member and artistic director of the "Xheladin Zeqiri" folk dance ensemble in Tetova and as a co-founder of the group "Margaritarët," he has contributed to the promotion and preservation of Albanian folk music both locally and internationally. His research focuses on the documentation, transcription, and analysis of Albanian traditional music, as well as the cultural role of music in contemporary society. He has presented at numerous academic conferences and published articles in scientific and cultural journals. As the author, co-author, or translator of more than 20 books in the fields of ethnomusicology, traditional music, and music education, he has made significant contributions to the preservation and transmission of Albanian musical folklore. **Email**: b_ramadani@yahoo.com **ORCID**: 0009-0007-6108-1851 I**nstitution**: Faculty of Music, University of Tetova, Tetova, North Macedonia

Selected Publications:

- *Dasma shqiptare në nota – 100 këngë të dashurisë dhe të përjetësisë* (*The Albanian Wedding in Notes – 100 Songs of Love and Eternity*), Tetova: BIR, 2024.
- *Ajri Ismani dhe dëshmia e jetës së tij në krijimtarinë folklorike* (*Ajri Ismani and the Testimony of His Life in Folkloric Creativity*) (co-author), monograph, Tetova: BIR, 2024.
- *Hanife Sejfulla – Reçani dhe Shahindere Bërlajolli – Stafai: Dy zërat e paharrueshëm të këngës shqipe* (*Hanife Sejfulla – Reçani and Shahindere Bërlajolli – Stafai: The Two Unforgettable Voices of Albanian Song*), monograph, Tetova: BIR, 2023.
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- *Tradita e muzikës popullore shqiptare në Tetovë dhe rrethinat e saj* (*The Tradition of Albanian Folk Music in Tetova and Its Surroundings*), Tetova: BIR, 2020.
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Research Article

Repair of the tar musical instrument: points to consider and functions of tar parts

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Abstract

This article comprehensively examines the structure, components, material properties, and maintenance-repair methods of the tar, one of Azerbaijan's most important national musical instruments. The tar consists of a large and a small bowl carved from mulberry wood, a neck and head made of walnut wood, and fret and bridge systems reinforced with durable materials such as ebonite and capron. The cow heart membrane (skin) used on the bowl's surface plays a critical role in sound production. The simgir, a hook system, is designed to secure the strings and contains 11 tongues. The article details the impact of the bridge (xərək) structure and material choice on string vibration quality, the advantages of making the plectrum from ebonite, and the contribution of tying the frets with capron thread to playing comfort. It also describes the adjustment of the angle between the neck and the body, methods for correcting neck bends, techniques for attaching strings to the pegs, and the bird bridge system that ensures proper string passage. Protection methods to extend the life of the membrane, such as fish-skin patches, soft leather coverings, and the use of çiriş or RVA adhesives, are also discussed. In conclusion, each component of the tar is of great importance in terms of dimensional ratios, material selection, and assembly technique. Skilled craftsmanship and regular maintenance are essential for preserving sound quality and ensuring the instrument's longevity. This technical knowledge serves as an invaluable resource for preserving the traditional art of tar-making and passing it on to future generations.

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Introduction

The tar musical instrument is one of the masterpieces of the Azerbaijani people, and our nation approaches this instrument with great respect and affection. In general, our national musical instruments are an integral part of our people's culture. Reflecting the daily life, history, and social life of our nation, these national musical instruments serve as evidence of the richness and magnificence of our national music.

A turning point in the development of our national musical instruments began in the second half of the 19th century. It should be noted that development work is still ongoing today at the Scientific Research Laboratory of the Azerbaijan National Conservatory (ANC).

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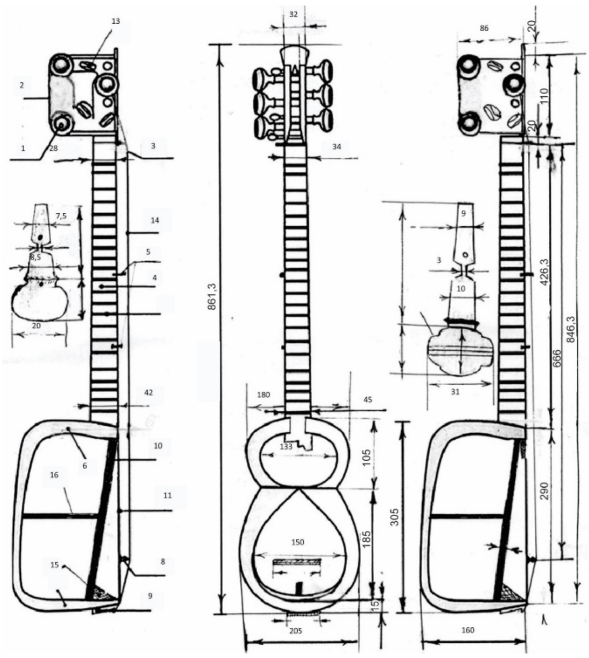

Figure 1. General structure of the *tar* musical instrument – body, neck, and head sections

Photo 1. The body (*bowl*) of the *tar* musical instrument – small and large bowl sections

In this article, we will discuss the repair of the *tar* musical instrument and the functions of its parts.

Body (Bowl): The body of the *tar* is usually made from mulberry wood. It consists of two parts: the small body and the large body.

Photo 2. Adjustment of the angle between the neck and the body (*tar fork*)

The part of the small body that connects to the neck is protruding. This projection is made to ensure a stronger connection between the neck and the body.

The total length of the body is 29 cm (290 mm), and its height is 160 mm. The length of the large body is 185 mm, while the length of the small body is calculated as 290 mm - 185 mm = 105 mm.

One important point is that the thickness of the back part of the body should be 2–3 mm thicker than the wall thickness where the small body connects to the neck. Otherwise, when adjusting the inner neck and the *tar fork* (the angle between the neck and the body), it would not be possible to adjust the angle due to the thinness (weakness) of the back wall of the body. In other words, the neck cannot be moved up or down using the adjustment lever.

Photo 3. Bowl surface – bovine heart membrane (*membran*)

The surface of the body (*membrane*) is made from the membrane of a cow's heart (Photo 3). The most important point to consider when stretching the membrane over the body is that there should be no depression in the center of the membrane. In other words, when the membrane is stretched over the body, it should form a perfectly flat surface.

The membrane is a tensioned, vibrating surface used in some musical instruments to produce sound. More precisely, when we touch different areas of the membrane with our fingers, we should feel the same level of tension.

A "simgir" (hook) is attached to the back of the body (Photo 4). The function of the simgir is to hold the attached strings. The simgir consists of 11 tongues.

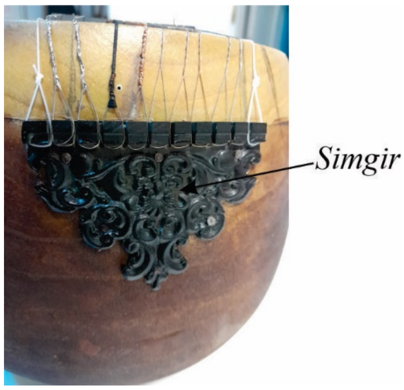

Photo 4. *Simgir* (hook) – the part where the strings are attached

To keep the bridge free, rods are inserted into the right and left tongues (Photo 5), while the remaining nine tongues are used to attach the strings.

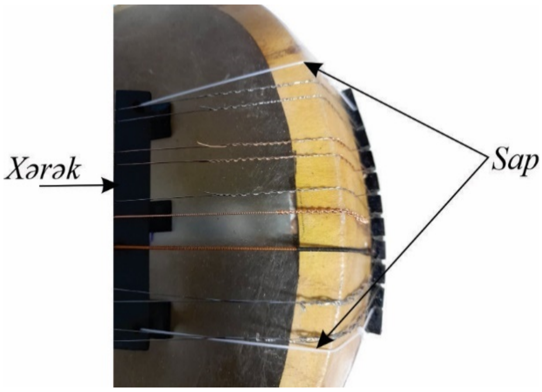

Photo 5. Bridge (***xərək***) – three-legged structure, parts where bass and treble strings rest

The bridge consists of three legs. The distances between the legs differ. The distance (between the legs) where the bass (*zeng*) strings rest is smaller than the distance between the legs where the treble (*ağ*) strings rest, because the pressure of the bass strings is greater (Photo 5).

The height of the bridge is about 16 mm (Photo 5). The angle between the neck and the body is greater than 180 degrees. If this angle is larger or smaller, the height of the bridge may vary. The length of the bridge is approximately 70–75 mm. The bridge is made of ebonite material.

Before using the body surface membrane (*perde*), it must first be cleaned of surface oils (fat layer) and excess tissue. It is recommended to soak the membrane in clean water for 8–10 hours so that any blood stains are completely removed. To make it more shiny (transparent), it should be washed with soap and dried with a very clean cloth. After this, glue is first applied to the part of the large body where the membrane will be attached, and then the membrane is glued onto the large body. The same procedure is then applied to the small body.

When the *tar* is played with a plectrum (*mızrap*), the plectrum slides from the string and strikes the membrane, causing the membrane on the body surface to tear prematurely. The plectrum is also made of ebonite, a material with high density (Photo 6).

Figure 6. Plectrum (***mızrap***) – playing tool made of ebonite

For this reason, the performer is often forced to replace the membrane (*perde*). To eliminate this problem, a patch made of fish skin is applied to the area where the plectrum continuously strikes; this allows the membrane to be used for a much longer period (Photo 7).

In another case, the area of the body where the wrist comes into contact during performance is exposed to sweat. As a result, the membrane becomes wet, which leads to its rapid deterioration.

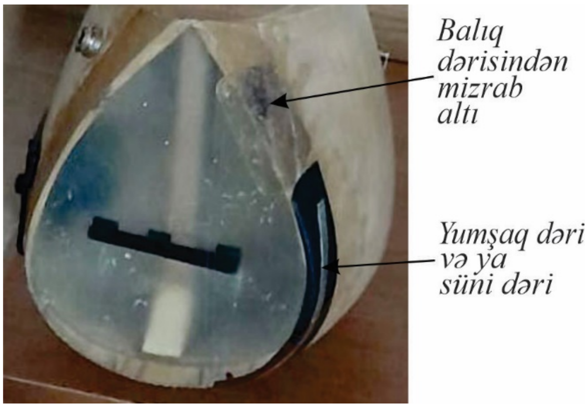

Photo 7. Fish-skin patch – protecting the area where the plectrum strikes

To solve this problem, a piece of soft leather or thin and flexible synthetic leather is glued to the relevant area. This method prevents the membrane (*perde*) on the body surface from wearing out quickly. Glue or RVA-type adhesives are generally preferred for attaching the membrane to the body. High-quality glue obtained from the *çiriş* plant is commonly used in our country to secure the membrane of the tar instrument.

After the membrane is glued onto the body, damp paper is placed over the adhesion points. This ensures that the body surface dries slowly from the glued areas. Otherwise, if the surface dries too quickly, excessive tension and slipping may occur along the glued edges, which can cause the membrane on the body surface to loosen.

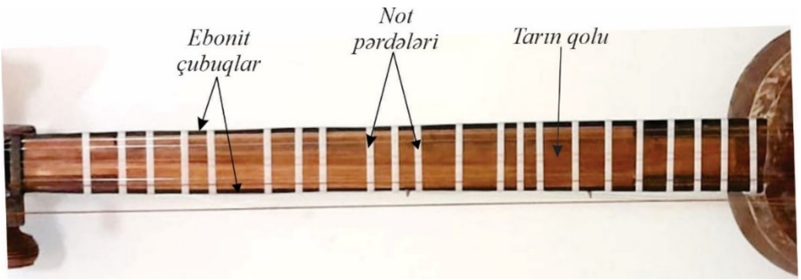

Photo 8. Professional tar neck – ebonite rods and fret ties

The length of the neck of a professional tar is 1.47×290 mm=426.3 mm1.47 \times 290\ \text{mm} = 426.3\ \text{mm}1.47×290 mm=426.3 mm and it is made of walnut wood. Ebonite rods are inserted along the edges of the neck to allow the fret ties on the neck to slide easily (Photo 8). There are 22 fret ties on the neck, made of capron (*jilka*) material. The number of windings is usually 7–8 turns, and the diameter of the capron string is 0.4–0.5 mm. Some performers may increase the number of frets according to their performance requirements. At the point where the neck connects to the body, its width is 4.5 mm and its height is 42 mm.

At the head of the neck, the width is 34 mm and the height is 28 mm. At the junction between the neck and the head, there is a "top nut" (sometimes called a "bird nut"), named so because its shape sometimes resembles a deer's or bird's head (Photo 9). The function of this nut is to guide the strings coming from the tuning pegs and direct them parallel over the neck to the body. The distance between the strings exiting the bird nut and the neck should be minimal to avoid putting excessive pressure on the fingers during performance. The cross-section of the neck is triangular in shape (Photo 10).

Photo 9. Bird nut (*quş xərək*) – the component that adjusts the distance between the neck and the strings

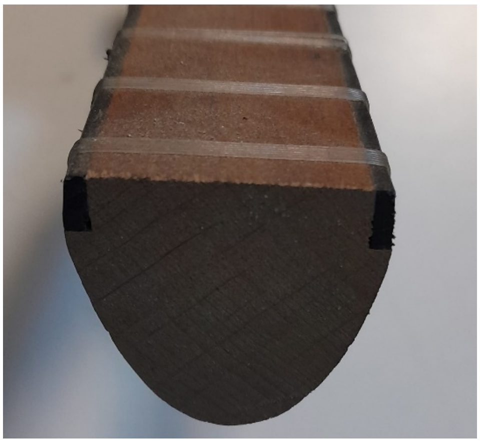

Photo 10. Triangular cross-section of the neck

The cross-section is shown in Photo 10. From the part where the neck connects to the body, a protrusion (tongue) extends toward the direction of the small body (Photo 11).

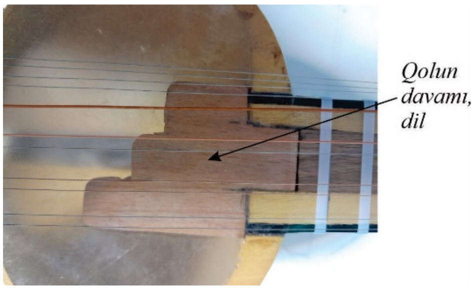

Photo 11. The tongue of the neck extended toward the small bowl

The length of the tongue may vary. In some cases, it extends all the way to the large body. The purpose of this extension is to increase the instrument's tonal range.

Eliminating the weakness between the neck and the body (Figure 2).

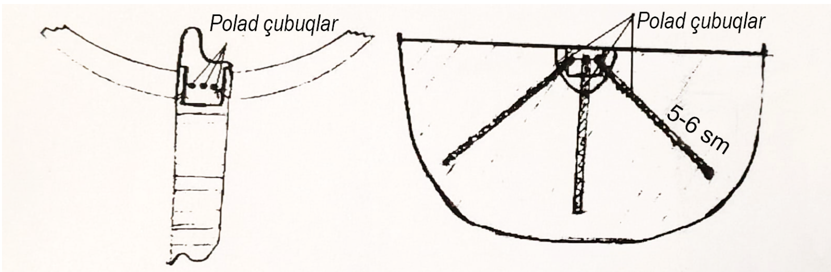

Figure 2. Method of eliminating the weakness between the neck and the body (bowl)

Eliminating problems that may occur in the neck (Figure 3)

In some cases, the neck of the tar instrument may become warped. To correct this curvature, we have developed a mechanism. This system is very important for both plain and mother-of-pearl (*sedef*) tar instruments. Previously, when the neck of a mother-of-pearl tar bent, we had to remove the inlays, plane the neck to straighten it, and then reinstall the inlays.

With this new system, the neck curvature can be corrected without removing the inlays. If one or two inlays become dislodged during the correction process, they can be reattached with adhesive afterward.

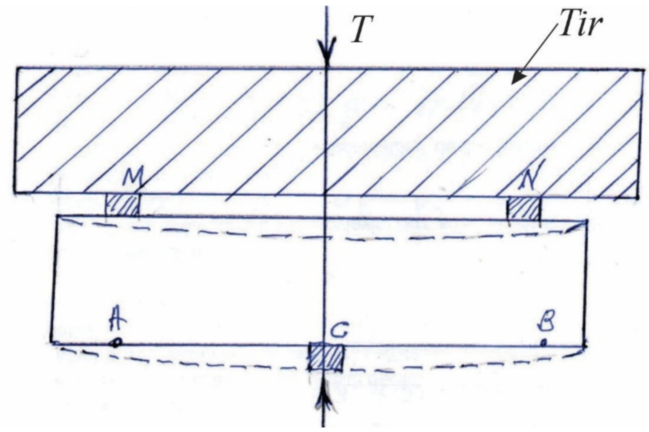

Figure 3. Mechanism for correcting neck curvature

First, the distance between points (A) and (B) is moistened (Figure 3). Then, wooden cushions (M) and (N) are placed on the neck. On top of these cushions, a beam thicker than the neck itself is positioned. Cushion (C) is placed on the back side of the neck and tightened in the direction of (C, T). The tightening process continues until the curvature is observed to shift in the opposite direction. The instrument should remain in this state until the neck dries completely. This process may take about 2–3 days. The head of the tar instrument is made of walnut wood (Figure 12).

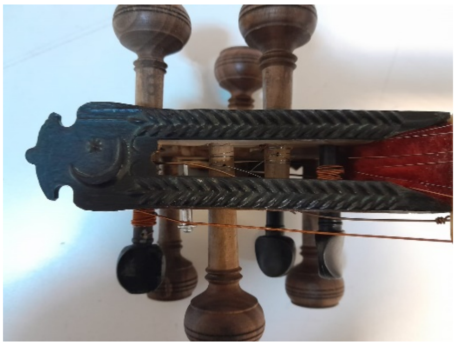

Figure 12. Tar head – front surface covered with ebonite, made of walnut wood

The head consists of two parts: the right and left sides (Figure 4). The protrusions at points (A) and (B) are designed to connect the neck and the head more securely.

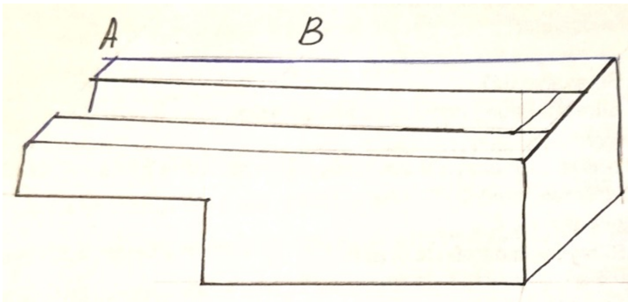

Figure 4. Tar head – structure and connection of the right and left parts

Both sides of the head are fixed together from three directions using walnut wood to ensure that there is no movement between the parts when the tuning pegs are installed (Photo 14). The tar's head contains a total of 9 tuning pegs: 6 large ones and 3 small ones. Two of the large pegs are used to adjust the *zeng* (bass) strings, keeping 4 strings in tune (Photo 13).

Photo 13. Securing the head body – structure reinforced with walnut pieces

The strings are wound onto the tuning pegs via the string wire (*tros*). See Figure 5.

- In case (A), the string passes through a hole drilled in the string wire and then goes to the *simgir* (hook).
- In case (B), the string passes over a pulley (*rolik*) placed at the end of the string wire before reaching the *simgir*.

Tuning the strings is much easier in option (B), because in case (A), the strings become deformed, making the tuning process more difficult. In option (B), the string slides smoothly over the pulley, allowing for easy tuning.

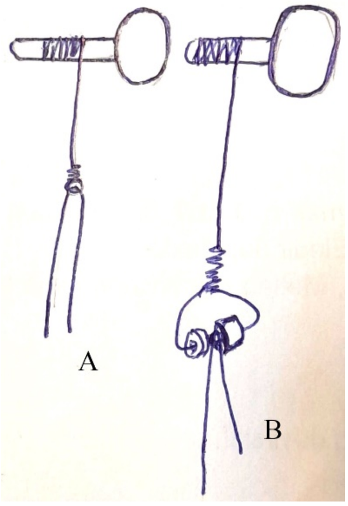

Figure 5. Methods of attaching the strings to the tuning pegs (Type A and Type B connections)

The strings are threaded through the holes prepared at the ends of the string wires, passed under the frets of the neck, and secured to the *simgir* (hook) on the back of the body by passing over the *zeng* (bass string) bridge. The tapered diameters of the tuning pegs are 10–9 mm for the large pegs and 8.5–7.5 mm for the small pegs.

To ensure the strength of the right and left sides of the head, pieces made of walnut wood are used (Photo 14).

Photo 14. Fixing the head body – structure reinforced with walnut pieces

The front surface of the tar's head is decorated with ebonite material to give the head an aesthetic appearance (Photo 12). This decoration can also be made from mother-of-pearl, bone, or plastic materials. The conical shape of the tuning pegs must match the conical shape of the holes drilled in the head to ensure a monolithic connection between the head and the pegs. This way, when the strings are tightened or loosened via the tuning pegs, the tension force of the strings is reliably maintained.

Some notes:

- The bird bridge (*quş xərək*) should hold the tone string at such a height that the strings coming from the *zeng* (bass) string bridge do not come into contact with each other during vibration.
- As the tone string exits the tuning pegs, it rests on top of other pegs, which causes interference during tuning. For this reason, a tone string adjuster is installed (Photo 15), allowing the tone string to pass freely and without obstruction through the bird bridge and the upper bridge of the body before being attached to the *simgir* (hook).

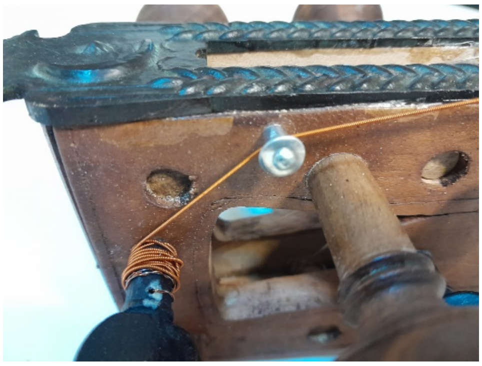

Photo 15. Tone string adjuster – a mechanism that allows the strings to pass through the bird bridge (quş xərək) without obstruction

- A channel with a depth and width of 1 mm is carved on the front side (soundboard) of the neck to make it easier to wrap the fretting ties (note frets) around the neck.
- The distance between the plane of the body and the plane of the neck should be 4–5 mm.

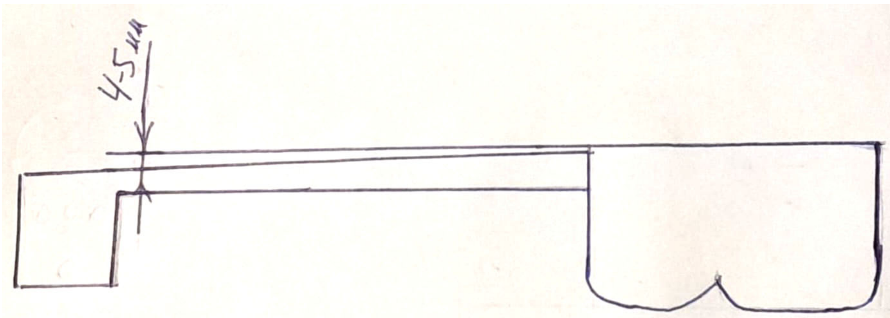

Figure 6. Passing the strings under the neck frets and attaching them to the simgir

Conclusion

The tar is one of Azerbaijan's most valuable national musical instruments, structurally requiring high craftsmanship and delicate workmanship. In this study, through visuals from Figure 1 to Figure 15 and Diagram 1 to Diagram 6, the main components of the tar, the materials used in its construction, assembly techniques, and maintenance-repair methods have been examined in detail. The large and small sections of the bowl carved from mulberry wood, the membrane (pərde) that determines sound quality, and the simgir that holds the strings all have their own specific dimensions and material characteristics. The design of the bridge (xərək) directly affects the tension and vibration quality of the strings, while the plectrum made of ebonite contributes to both durability and tonal color.

The walnut wood used in the neck, the ebonite rods, and the kapron frets provide long-lasting structure while increasing playing comfort. Special parts such as the bird bridge (quş xərək) ensure proper string alignment and reduce finger pressure during performance. Various techniques shown in the diagrams have been developed to eliminate weaknesses between the neck and the body, correct neck warping, and ensure proper string attachment. Additionally, methods such as applying a fish skin patch, using soft leather protection, and selecting suitable adhesives are employed to extend the lifespan of the membrane.

In conclusion, every part of the tar is of great importance in terms of material selection, dimensional proportions, and assembly techniques. Master craftsmanship and regular maintenance are the main factors that determine both the sound quality and the longevity of the instrument. This technical knowledge serves as an indispensable guide for preserving traditional tar making and passing it on to future generations.

Biodata of Author

Dr. **Mamedali Mirali Mamedov**, music researcher and musical instrument restorer. Since 2010, he has been working as the head of the "Improvement of National Musical Instruments" (*Milli Musiqi Alətlərinin Təkmilləşdirilməsi*) research laboratory at the Azerbaijan National Conservatory (*Azərbaycan Milli Konservatoriyası*). Over the years, 64 of Mamedali Mamedov's scientific works have been registered with the Copyright and Intellectual Property Agency (*Müəllif Hüquqları və İntellektual Mülkiyyət Agentliyi*), and dozens of scientific articles and conference materials have been published. The ensemble "In the Footsteps of Time" (*Zamanların İzində*), consisting of ancient musical instruments, was founded by Mamedali. Mamedali Mamedov has created a four-cornered drum (*dördguşəli nağara*), a square drum (*kvadrat nağara*), and a "chovgan" (*çovqan*, conductor's baton) for the National Military Band (*Milli Hərbi Orkestr*). In addition, he has developed new musical instruments that produce sounds at different registers and registered them in the database of Azerbaijani musical instruments in collaboration with the Copyright Agency. In 2018, the book "Improvement of Azerbaijani Folk Musical Instruments" (*Azərbaycan Xalq Musiqi Alətlərinin Təkmilləşdirilməsi*) was published.

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Research Article

Unified Kanun: A new instrument model from the perspective of Turkish and Western organology[1]

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Abstract

This study focuses on a new instrument model developed within the framework of Turkish musical culture and the science of organology, called the Unified Kanun. Designed by integrating two kanuns into a single body, this instrument transcends the performance possibilities of the traditional kanun, offering expanded technical capacities. This article examines in detail the rationale behind the emergence of the Unified Kanun, the patenting process, and findings based on academic research. The fundamental feature of the Unified Kanun is that the playing responsibility of both hands can be undertaken by a single hand, while allowing simultaneous modification of levers (mandals) in different octaves. This innovation facilitates polyphonic performance and makes it possible to play works from diverse musical disciplines, including guitar and piano repertoires. From the perspective of Turkish organology, the naming of the Unified Kanun aligns with traditional naming practices observed in instruments such as the Yaylı Tanbul and the Cümbüş. From the perspective of Western organology, it corresponds to the "combined/unified" instrument approach described in the classification system of Curt Sachs and Erich von Hornbostel. In this regard, the Unified Kanun maintains terminological accuracy in both local and universal contexts. The Unified Kanun is not only a technical innovation but also an original model that contributes to the literature of organology. This article thus introduces a novel approach with the potential to enrich both Turkish musical culture and the international field of organological studies.

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Introduction

This study represents a significant breakthrough in the field of organology both in Türkiye and worldwide. It is noted that national inventions in the field of music in Türkiye began in 2002, and there were 20 inventions between 2002 and 2018. According to the information presented in the light of statistical data, the scarcity of studies conducted in the field of organology is noteworthy (Şakalar, 2024: 44). Based on the fact that any kind of organological research will contribute to the field, a new instrument was created through a physical and technical innovation applied to the *kanun* instrument.

The attempt to use a different playing technique on the *kanun* and the consideration of its organological structure to suit this technique can be regarded as the reason and justification for the emergence of this new instrument. In the intended technique, the new instrument was expected to allow both hands to change levers (*mandals*) in different octaves. Moreover, this instrument was designed with the idea that a single hand could perform the tasks normally

[1] This study is derived from the first author's doctoral dissertation

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carried out by both the right and left hands. The inability of the traditional *kanun* to provide this capability and to meet these needs made such a structural change necessary. Accordingly, a new instrument was designed by connecting two *kanuns* via the bottom block.

The technical work on the "Birleşik Kanun" (*Unified Kanun*) began in 2004, and its patent was obtained in 2017. In Çalkap's (2019) master's thesis related to this instrument, five expert *kanun* performers (academics and State Artists) were selected. Three pieces (*Rast Saz Semaisi* by Benli Hasan Ağa, *Nihavent Sirto* by Göksel Baktagir, and the *Carmen Habanera* section by Georges Bizet) were recorded and shown to the experts. No technical details on how the instrument was performed were provided, and no exercises were demonstrated. The videos were shown to the experts, questions were asked, and the answers were analyzed.

In this thesis study, the name "Useful Model Kanun," registered at the patent institute, was used, and no additional name was assigned. In this article, however, a new model different from the initial prototype is presented. Over time, the organological shortcomings and errors identified in the first prototype were corrected, and this new instrument was rebuilt with the desired structure.

Organological Basis of the Term "Birleşik Kanun"

From the Perspective of Turkish Organology

In the Turkish organological tradition, it is observed that structural innovation in newly developed instruments is directly reflected in their names. For example, *Yaylı Tanbur* is a version of the classical *tanbur* played with a bow, and *Cümbüş* is a hybrid instrument born from the combination of the *ud* and the *banjo*. Similarly, the term "*birleşik*" (*unified*) has been used in models such as the "*Birleşik Ney*," which emerged from the combination of *neys* of different sizes.

In this context, naming the new instrument — which emerged from the organological integration of two *kanuns* into a single body — as "Birleşik Kanun" (*Unified Kanun*) can be considered a consistent approach in line with the Turkish organological tradition.

From the Perspective of Western Organology

In Western organology, one of the fundamental references is the classification system *Systematik der Musikinstrumente* (1914), developed by Curt Sachs and Erich Moritz von Hornbostel. In this system, instruments are classified as "simple," "composite," and "combined/unified."

For example, in cases like the *double harpsichord* or *combined lutes*, where multiple instrument structures are integrated into a single body, the terms "combined" or "unified" are used to describe them (Sachs & Hornbostel, 1914). Thus, the term "Birleşik Kanun" (*Unified Kanun*) is also compatible with the terminology of Western organology.

The Importance of the Term "Birleşik Kanun"

The name "**Birleşik Kanun**" represents an approach that integrates both the naming tradition seen in Turkish organology and the classification terminology of Western organology. This name clearly and scientifically reflects:

- Its organological innovation (the combination of two *kanuns*),
- Its patent and utility model background,
- Its terminological compatibility recognized in international literature.

In this respect, "Birleşik Kanun" stands out as an appropriate term that can be used in both local and global organological literature.

The Necessity of the "Birleşik Kanun" Instrument

The *kanun* instrument, with its polyphonic structure and the advantage of using ten fingers, makes the performance of many different musical genres possible. With this advantage, the *Birleşik Kanun* introduces an even richer organological structure compared to the traditional form. The developed *Birleşik Kanun* has been designed to be suitable for a wide range of repertoires, from guitar literature to piano repertoire and many different genres and disciplines of music.

The dual-use nature of the instrument allows lever changes in different octaves to be performed simultaneously. Along with this feature, the *Birleşik Kanun* provides significant convenience and advantages, such as reading double treble clefs, performing certain piano works, and incorporating some stylistic characteristics of *bağlama* playing techniques.

Organology of the Birleşik Kanun

In the instrument classification introduced by Curt Sachs and Erich von Hornbostel, the founders of organology and pioneers of instrument classification, the kanun is categorized under chordophones, specifically composite chordophones and plucked chordophones (Zeitschrift für Ethnologie, 1914: 554–590). The kanun model proposed in this study, due to its physical structure formed by the combination of two kanuns, belongs to the group of instruments in which the strings, the way they are held, the materials used to pluck them, and their integration with a resonator or soundbox are considered together. Therefore, the proposed Combined Kanun is thought to belong to the same group as the traditional kanun in the instrument classification by Curt Sachs and Erich von Hornbostel.

In this study, which presents the physical structure and technique of the Combined Kanun in detail, the physical structure of the Combined Kanun will first be described. With its physical structure, the Combined Kanun is clearly distinguished from the traditional kanun at first glance. Unlike the traditional kanun, the Combined Kanun is an organological structure formed fundamentally by connecting two kanuns to each other with a single membrane and a single bridge, with their inner cavities left open and facing one another.

Photo 1. The first prototype made for experimental purposes in 2004 (Çalkap, 2019, p. 10)

The first double-kanun prototype shown in Photo 1 was protected by obtaining its patent on 21/07/2017 and its design registration certificate on 15/06/2016.

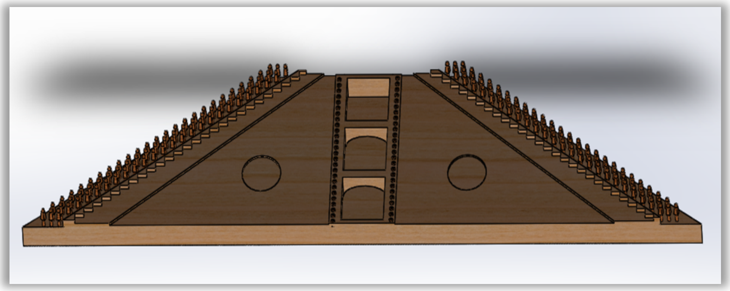

Photo 2. 3D drawing of the Unified Kanun instrument

The 3D drawing shown in Photo 2 differs from the first prototype. With a time span of thirteen years between the first prototype and the Unified Kanun, the instrument has been tested in every aspect organologically, measured, and redesigned in accordance with the possibilities of the developed techniques and the dynamic structure of the instrument. For this reason, there are changes in the 3D drawing shown here compared to the drawing in the patent document of the first prototype. The Unified Kanun was built based on this newly designed 3D model.

Photo 3. Final version of the Unified Kanun instrument

Photo 3 shows the designed and completed final form of the Unified Kanun.

Photo 4. Skeleton form of the Unified Kanun during the construction stage

Photo 4 shows the skeleton form of the Unified Kanun, where the pegboards of both kanuns are fixed to the upper and lower edges together with the internal braces.

Photo 5. Unified Kanun with the back cover attached

As seen in Photo 5, the internal braces are carved in such a way that sound can be transmitted into the sound chambers of both kanuns. This allows the sound to be distributed evenly from both instruments.

Photo 6. Close-up view of the Unified Kanun with the back cover attached

As seen in Photo 6, both kanuns are connected to each other through internal braces. In the construction of the Unified Kanun, two long longitudinal braces were added to these internal supports to increase structural strength.

Photo 7. Unified Kanun with the top boards attached and the tuning peg boards glued

In the Unified Kanun shown in Photo 7, there is a plywood panel covering the area where the skin will be stretched, creating a raised section. This part is designed to be more durable, as it is where the strings will be attached and the pegs will be seated.

Photo 8. Final state of the middle section of the Unified Kanun before drilling the pegs

As seen in Photo 8, the Unified Kanun is designed with three sound holes. It can also be designed with four sound holes, depending on preference. This variation changes according to the sound color the player wishes to achieve on the instrument.

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Photo 9. Close-up view of the pegs through which the strings pass in the Unified Kanun

The pegs shown in Photo 9 are made of fiber material, and holes have been drilled in them for the strings to pass through. These cylindrical pegs have a notch or an incomplete circular gap on the side facing the tuning peg area after the strings are inserted. The purpose of this feature is to allow the peg to be easily removed from its position, enabling it to be lifted and taken out of its slot without difficulty.

Photo 10. Glued and painted leather part of the Unified Kanun

In Photo 10, the leather of the Unified Kanun is shown after being glued and varnished. Following this stage, the positions of the pegs will be marked and drilled, the tuning peg holes will be opened, and the strings will be attached and tuned. Once the tuning of the kanun is fully stabilized, the installation of the levers (mandals) will begin.

Photo 11. Drilled area for the placement of plugs in the Unified Kanun

In Photo 11, the area where the plugs will be placed has been reinforced and elevated with a plywood section to ensure durability and structural strength.

Photo 12. The drilled area where the plugs will be placed in the Unified Kanun

In Photo 12, the area designated for the plugs has been reinforced and elevated with a plywood section for durability.

Photo 13. Close-up view of the right side of the Unified Kanun

In Photo 13, the close-up image of the right side of the kanun shows the state of the plug areas before drilling. Additionally, the painted and leather-covered Unified Kanun is visible.

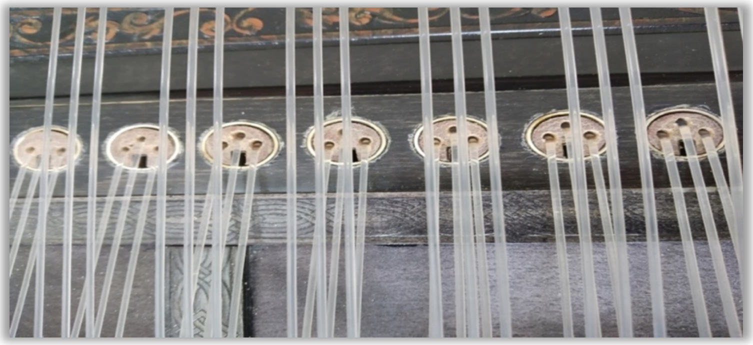

Photo 14. Strings attached to the plugs on the Unified Kanun

In Photo 14, the string connection plugs leading to the kanun on the left side are shown. To make the plug areas more durable, rings have been inserted into the plug holes. This application has created a more resistant area against the pulling force of the plugs.

Photo 15. Strings attached on both sides of the Unified Kanun

In Photo 15, the strings on the right and left sides of the kanun pass through each other at the same level as they cross the bridge. The bridge of the Unified Kanun is designed to be thicker than that of the traditional kanun. It is a bridge built to withstand the weight and pressure of the strings attached from both sides.

Photo 16. The pegs and strings attached on the right side of the Unified Kanun

In Photo 16, a close-up image of the pegs on the right side of the Unified Kanun is shown. In addition, the levers (mandals) have been installed, tuned, and the instrument has reached a playable condition.

Photo 17. The levers and strings attached on the left side of the Unified Kanun

In Photo 17, the levers on the left side of the kanun are shown installed using a six-lever system. This system is the same as the lever mechanism used in the traditional kanun instrument.

Photo 18. The levers and strings attached on the right side of the Unified Kanun

In Photo 18, the levers on the right side of the kanun are shown installed using a six-lever system. This system is the same as the lever mechanism used in the traditional kanun instrument.

Photo 19. Close-up view of the central part of both sides of the Unified Qanun

Photo 19 shows a close-up view of the final version of the Unified Qanun, constructed with three membranes and interconnected inner chambers. The produced Unified Qanun uses a pin system. Without using the pin system, end blocks can be placed on both sides of the central part, allowing the strings to exit from the back. In such a system, the inner chambers would remain more enclosed, making the instrument more suitable for use as an electro-acoustic system. Although the acoustic sound level would be relatively low, magnetic pickups placed on the bridges would allow the instrument to produce a sound close to an acoustic tone through the connected amplification system.

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Photo 20. Close-up of the Strings Intersecting Each Other in the Unified Qanun

In Photo 20, it can be seen that the strings of the qanun on the right and the strings of the qanun on the left pass through each other as they cross the bridge. This method of application differs from the first prototype. In the arrangement created in the first prototype, there was a 3 mm distance between the corresponding strings of the right and left qanuns. In the Unified Qanun, this distance was precisely calculated, and the strings of both qanuns were prepared at the same distance, running parallel to each other. As a result, the Hüseyni pitch on the right qanun and the Hüseyni pitch on the left qanun are aligned along the same axis.

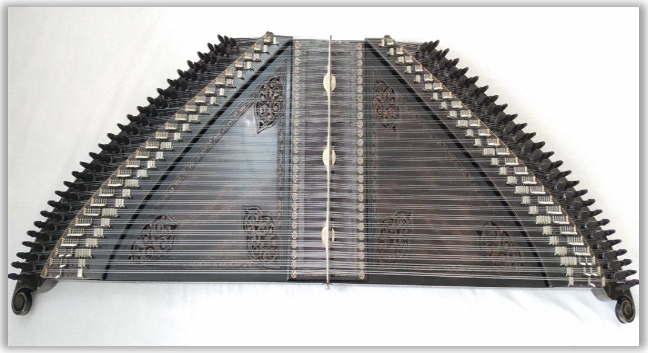

Photo 21. The Completed Form of the Unified Qanun

In Photo 21, it can be seen that the Unified Qanun has a significantly high volume level, meaning its sound intensity is quite strong. Elements such as the string attachment points, the evenly distributed sound, the use of the bridge, the shared bridges inside the soundbox, and the shortening of string lengths in the lower registers all contribute to an organological structure that differs from the traditional qanun.

Conclusion

This study introduces a remarkable innovation in the field of organology, both in Turkey and internationally. The "Unified Qanun," which represents an important example of the increasing number of national musical inventions since the 2000s, is an instrument created by combining two separate qanuns into a single body from an organological perspective. This innovation is of great significance as it enables the performer to change levers (mandals) in different octaves simultaneously, thereby expanding the traditional performance limits of the qanun.

The documentation of this instrument through the patent process and academic theses demonstrates that it is not merely an individual experiment but a contribution to the field of organology. The name "Unified Qanun" aligns with the naming tradition in Turkish organology (e.g., Yaylı Tanbur, Cümbüş, Birleşik Ney) and also corresponds to the "combined/unified" terminology used in the Sachs and Hornbostel classification system in Western organology. This shows that the naming of the instrument is based on both local and universal foundations.

The findings of this study indicate that the "Unified Qanun," with its adaptability to various musical genres—especially guitar and piano repertoires—can open new horizons in performance practice. With its polyphonic structure and technical advantages, this instrument offers a creative breakthrough in Turkish musical culture and makes a significant contribution to the development of organology. In conclusion, the "Unified Qanun" is not only an instrumental innovation but also an original model that can be evaluated within the context of musical performance and the theoretical framework of organology.

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Research Article

The art of crafting Iranian Tar and Setar: Personal experiences

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Keywords
Acoustic wood
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Iranian music
Luthiery
Setar
Tar

Abstract

This article presents the personal craftsmanship experience of Morteza Salimian Rizi, a master luthier and founder of Sapp Saz, an independent Iranian instrument workshop in Zarrin Shahr, Iran. Drawing on more than a decade of professional practice, Salimian Rizi documents the complete process of crafting two central instruments of Persian classical music: the Tar and the Setar. The study explores the careful selection of materials such as mulberry wood, specialized construction techniques, and structural decisions that affect tonal quality and resonance. It analyzes the organological differences between the Tar's double-bowl, six-string design and the Setar's lighter, four-string structure, addressing challenges such as neck curvature and soundboard integration. Combining traditional craftsmanship with innovative approaches, Salimian Rizi reflects on how personal experimentation enhances sound production and contributes to preserving Iran's musical heritage. This work aims to transmit valuable artisanal knowledge to future generations, enrich the academic field of organology, and support the cultural sustainability of Persian musical traditions.

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Introduction

Since childhood, I have been a passionate player of the Iranian Tar, always captivated by its structure and sound. At the age of 25, I met a master luthier whose craftsmanship inspired me to transition from playing to making instruments. This article narrates my journey from a dedicated musician to a skilled luthier specializing in Tar and Setar, including detailed insights into the materials, tools, and techniques involved in this art.

Early Experiences in Tar Making

The first time I stepped into the master's workshop, I was fascinated by the variety of tools and types of wood. Despite my lack of experience, the master encouraged me to give instrument-making a try. In just 20 days, I crafted my first Tar—a feat that even surprised my teacher. Later, I rented a small workshop and sold my first semi-finished instrument before it was completed, which motivated me to continue. Over the next decade, I honed my craft and gained recognition in my hometown.

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Figure 1. Raw mulberry wood prepared for carving

Figure 2. First stage of Tar body carving

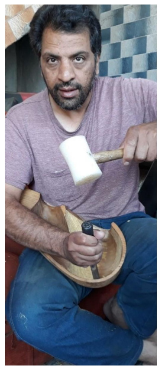

Figure 3. Finishing work with hand tools

Transition to Setar Making

Driven by curiosity, I ventured into Setar making despite the lack of formal training. I started experimenting with minimal tools and tested various woods including walnut, spruce, maple, and eventually mulberry—traditionally used for its exceptional resonance. Setar making proved to be even more challenging and rewarding than Tar due to its acoustic sensitivity and craftsmanship standards.

Key Considerations in Setar Making

Wood Selection: Primarily mulberry and walnut for their acoustic and durable qualities.
Soundboard Material: Mulberry wood is used traditionally for its high resonance capability.
Essential Tools: Chisels, hammers, bending irons, and sanding tools are essential. Precision and patience are crucial.

Technical Features and Differences between the Iranian Tar and Setar

The Iranian Tar and Setar, while closely related, differ in their construction, acoustic qualities, and performance roles:
Body (Bowl): The Tar has a larger double-bowl body traditionally made of mulberry, with a thin animal skin stretched over its top. The Setar, by contrast, has a smaller single-piece bowl, usually carved from mulberry or walnut, with a wooden soundboard. Strings: The Tar is strung with six strings arranged in three pairs. The Setar has four strings—two single strings and one pair—giving it a softer, more intimate tone. Sound and Tone: The Tar produces a powerful, resonant, and vibrant sound, making it suitable for large performances and ensemble playing. The Setar, however, is valued for its subtle, delicate, and meditative timbre, often used in solo or spiritual contexts.
Function in Music: The Tar is considered the "mother of Iranian instruments," representing strength and versatility in Persian classical music. The Setar, by contrast, has long been associated with mysticism and personal expression. These distinctions not only highlight the diversity of Iranian luthiery but also demonstrate the cultural and musical roles of the instruments within Persian music tradition.

Challenges and Rewards

Crafting these instruments requires balancing artistic intuition with technical understanding. It demands patience, deep knowledge of materials, and constant refinement. The greatest reward is hearing musicians bring these instruments to life on stage.

Based on my personal experience, mulberry wood has always been the most pleasant and aesthetically suitable choice for crafting both the Tar and the Setar. For centuries, the people of Iran have listened to the sound of these instruments resonating from the heart of mulberry wood. I have also crafted custom Tars from walnut wood, which, although visually more attractive than mulberry, showed a noticeable difference in tonal quality and beauty compared to Tars made from mulberry.

In the case of the Setar, however, with some tolerance, many makers—including myself—sometimes use other woods for the body, such as walnut, maple, padauk, or rosewood, and occasionally a combination of different woods to enhance the visual appeal. Nevertheless, for the soundboard of the Setar, mulberry remains the standard choice because of its superior resonance.

The most challenging part of Setar-making is achieving the ideal sound quality through years of trial and error. It is commonly said among luthiers that "it should sound like a Setar, not like a Dotar or a Tanbur." The same is true in Tar-making, where a master luthier gradually learns through countless attempts how to adjust the thickness of different parts of the bowl. For example, I have often taken the carving process of a Tar's body to the final stage, only to see the bowl crack due to the slightest impatience or lack of precision, losing several days of work.

Equally important in both Tar and Setar construction is the joint between the neck and the body, which we call the "neck angle." Without exaggeration, half of the instrument's beauty and tonal quality depends on this factor, and luthiers achieve mastery when they can produce tones that are both soft and powerful. In the adjustment stage (reglaj), there is little difference between Tar and Setar, since both have necks of similar length and share similar fret arrangements.

Among Iranian instruments, the Tar is regarded as the most majestic—indeed, many consider it the "mother of Iranian instruments." Without undue bias, I share this belief. The Setar, on the other hand, is a companion for solitude and introspection, a friend to both maker and player. It is no coincidence that many prominent musicians, such as Kayhan Kalhor, who is best known for his Kamancheh, also play the Setar.

The years I have spent crafting the Tar and Setar have been the sweetest period of my life. In moments of despair, it is the scent of wood and the sound of chisels and planes that encourage me to continue. A voice from within tells me that music is eternal, and that I, too, am a small part of it.

Conclusion

This journey from musician to luthier is a story of passion, tradition, and expertise. Sharing this path helps safeguard Iranian musical heritage and may inspire new generations to embrace this noble craft.

Biodata of Author

Master Luthier and Iranian String Instrument Maker, **Morteza Salimian Rizi** is a founder of Sapp Saz, an independent platform promoting handcrafted Iranian musical instruments. With over a decade of experience, he specializes in crafting Tar, Setar, and other stringed instruments. He holds official certifications in luthiery from the Iranian Technical and Vocational Training Organization. Affiliation: Sapp Saz (Independent Workshop for Iranian Musical Instruments), Zarrin Shahr, Iran. Email: Mortezasalimian83@gmail.com

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Research Article

A historical and organological analysis of early electronic musical instruments

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Keywords
Digital transformation
Electronic musical instruments
Magnetic tape
Organology
Synthesizer history

Abstract

This study aims to explore early electronic musical instruments developed between the late 19th century and the mid-1980s within the frameworks of both the history of technology and organology. The research examines six main developmental phases: from electromechanical systems to vacuum tube technologies; from magnetic tape-based studio practices to voltage-controlled modular synthesizers; and from the era of digital synthesis to the MIDI era. Employing a qualitative and historical-descriptive research design, the study is conducted through secondary sources drawn from the literature on the history of electronic music, sound technologies, and instrument design. Instruments such as the Telharmonium, Theremin, Ondes Martenot, Hammond organ, RCA Mark II, Moog and Buchla systems, as well as the Minimoog, Prophet-5, Synclavier, Fairlight CMI, and Yamaha DX7, are analyzed through case studies with regard to their technical features, performance interfaces, aesthetic approaches, and organological characteristics. The findings reveal that the historical development of electronic musical instruments is not merely a linear sequence of technical innovations, but rather reflects a profound transformation in the very concept of what constitutes a musical instrument. During the electromechanical era, the definition of the instrument expanded to encompass entire buildings and their transmission infrastructures. The vacuum tube era introduced novel possibilities for touchless performance and hybrid interface designs. In the era of magnetic tape-based studios, the instrument evolved into a spatial structure that extended across the entire studio environment. The emergence of voltage-controlled synthesizers and integrated systems reshaped the relationship between performer and instrument, emphasizing real-time, performative control. With the advent of digital synthesis and MIDI technology, the physicality of the instrument progressively gave way to software-based interfaces and digitally defined configurations. In conclusion, this study demonstrates that examining early electronic musical instruments through the lens of organology not only enriches discussions on instrument classification and the history of music technology but also offers a framework for reconceptualizing the term electronic instrument as a living, evolving, and dynamic organological category.

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Introduction

The emergence of electronic musical instruments occurred during a pivotal period at the intersection of music and technological history, beginning in the late 19th century. This period was shaped by a historical context in which the scientific and technological advancements accelerated by the Industrial Revolution had transformative effects on forms of artistic expression. Following the revolutionary outcomes of the use of electricity in communication devices such as the telegraph and telephone, the idea of producing, controlling, and transmitting sound by electronic means emerged as a new and experimental field of possibility that attracted the attention of inventors and avant-garde composers alike (Holmes, 2008, p. 18). These developments profoundly transformed the ways in which music was produced, performed,

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and experienced. They not only enabled the creation of previously unheard sonic textures, but also brought the composer's control over sound materials to an unprecedented historical level. Furthermore, they redefined the concept of the "instrument," reshaping the boundaries of the term within the field of organology.

This study aims to examine the historical development of electronic musical instruments through an analytical approach that considers both their technical and aesthetic dimensions, within a chronological framework extending from early electromechanical devices to the onset of the digital revolution. In academic discourse, the term *electronic musical instrument* is defined as "a device in which periodic electric currents, selectively generated or controlled by a performer for the purpose of producing music, are converted into sound" (Miessner, 1936, p. 1429). This comprehensive definition encompasses significant technological and organological diversity, bringing together under a single overarching concept a wide range of systems—from those that amplify mechanical vibrations through electrical means to fully electronic circuits and digital data protocols.

Therefore, the study of electronic instruments involves not only tracing a narrative of technological advancement, but also following a continuous transformation in terms of the instrument's physical structure, performance interface, spatial configuration, and the performer–instrument relationship. This classification highlights the necessity, within the expanding scope of the discipline of organology, of examining instruments not only through their material and acoustic properties but also through their electrical and digital principles of operation.

The body structures of electronic instruments (e.g., large-scale mechanisms occupying entire buildings or portable synthesizer housings), their sound production mechanisms (electromechanical, vacuum tube, transistor-based, digital), performance interfaces (touchless control, keyboard, sequencers, performance control surfaces), and usage contexts (studio, stage, home studio, etc.) offer a unique and multilayered field of analysis from a contemporary organological perspective. Therefore, the historical development of electronic instruments should be understood not merely as a series of technical innovations, but as an organological process involving the transformation of musical aesthetics, performance practices, and the very concept of the instrument itself.

Accordingly, this study aims to systematically investigate the development of electronic musical instruments from Thaddeus Cahill's *Telharmonium*, noted for its centralized and large-scale architecture, to early vacuum tube-based instruments such as the *Theremin* and *Ondes Martenot*, followed by the magnetic tape-based approaches of *Musique Concrète* and *Elektronische Musik*. The scope then extends to the emergence of voltage-controlled modular synthesizers, the widespread adoption of integrated and polyphonic models such as the *Minimoog* and *Prophet-5*, and finally, the digital revolution characterized by FM synthesis, sampling technologies, and the establishment of the MIDI standard.

The central thesis of this study asserts that each of these historical phases corresponds to a gradual yet profound redefinition of the instrument in terms of its physical embodiment, performance interface, spatial configuration, and the performer–instrument relationship.

This chronological framework seeks to illuminate the technological evolution that begins with early experimental ventures into the use of electricity as a musical medium and culminates in the digital systems that form the foundation of contemporary music production. The initial steps of this trajectory were marked by electromechanical devices that embodied the concept of electrically produced music, yet faced various limitations in terms of practicality, portability, and sustainability. Over time, these early experiments were reinterpreted and refined both technically and aesthetically, enabling electronic musical instruments to become central components of contemporary musical culture. From an organological perspective, these instruments have significantly expanded the conceptual boundaries of what constitutes a musical instrument.

In this context, the study seeks to answer the following research question: *How did the design of electronic musical instruments between 1876 and 1985 transform the instrument in terms of body, interface, spatiality, and the performer–instrument relationship?*

This study aims not merely to summarize the frameworks of prominent scholars such as Holmes and Jenkins—frequently referenced in the literature on the history of electronic music—but to engage in a critical dialogue with them from an organological perspective. While Holmes primarily interprets the period in question as a succession of technological innovations, this study repositions the same chronological trajectory as an organological re-reading that explores how the concept of the "instrument" was transformed in terms of its physical body, performance interface, spatial configuration, and the performer–instrument relationship.

Similarly, Jenkins's approach, which focuses on the role of synthesizers in popular music culture, is here reconsidered not only in terms of the sonic ideals associated with popular music but also in relation to how these instruments have expanded the very notion of the instrument family. In doing so, this study places electronic musical instruments at the intersection of music technology and organology, establishing them as a focal point for interdisciplinary inquiry.

Within this framework, the central claim of the study is that the historical development of electronic musical instruments should not be read merely as a linear sequence of technical innovations, but rather as an ongoing organological negotiation that continually redefines the ontological boundaries of the instrument. Departing from the technology-centric narratives offered by authors such as Holmes and Jenkins, this article foregrounds organological categories—such as body, interface, spatiality, and the performer–instrument relationship—to reinterpret the evolution from the architectural scale of the *Telharmonium*, through the "expanded instrument" paradigm of the studio era, to the shift toward data protocols marked by the advent of MIDI and digital synthesis.

Thus, the study seeks to move beyond a linear narrative of progress, and instead conceptualizes the history of electronic instruments as a multilayered process of organological transformation—one that is continuously reconstructed along the axes of embodiment, space, and control.

Methodology

This study is structured as a historical-descriptive research that investigates the historical development of early electronic musical instruments and the reflections of this process on musical aesthetics, performance practices, organological classification, and the history of technology. The primary data sources of the study consist of secondary literature produced in the fields of electronic music history, sound technologies, instrument design, and contemporary organology. In particular, Holmes's comprehensive study on the history of electronic music (Holmes, 2008), Jenkins's work examining the relationship between synthesizer culture and popular music (Jenkins, 2007), and various compilations containing technical documentation on early instruments are used as main reference sources. This approach aligns with the historical-descriptive research design and document analysis method defined within the scope of qualitative research in the social sciences (Yıldırım & Şimşek, 2021).

Within the scope of this research, the development of electronic musical instruments is analyzed along two axes: chronological and thematic. The chronological axis is structured around six main periods spanning from the late 19th century to the mid-1980s:

- The Electromechanical Era (1876–1930)
- The Vacuum Tube Revolution (1920–1940)
- The Age of Magnetic Tape and Studio Production (1940–1960)
- The Voltage Control Paradigm and Modular Synthesizers (1960s)
- Integrated Synthesizers and Mass Dissemination (1970s)
- The Digital Revolution and New Synthesis Paradigms (1975–1985).

This historical framework not only outlines key technological turning points but also aims to reveal the impact of these transitions on musical aesthetics, performance practices, and instrument design from an organological perspective.

The thematic axis is structured around three main focal points:

Technological Paradigm: The transition from electromechanical systems to vacuum tube technologies, followed by voltage control and digital synthesis; the transformation of sound production mechanisms.

Performance Interface and Musician–Instrument Relationship: The influence of touchless control mechanisms, keyboard-based structures, sequencers, and performance-oriented control surfaces on instrumental performance and perception.

Aesthetic Orientation and Musical Context: The philosophical distinctions between *Musique Concrète* and *Elektronische Musik*, interactions with popular music, the shift from studio-centered production to stage-centered performance, and the reflections of these transformations on debates within organological classification.

In this context, each period is examined through a case study approach, focusing on prominent instruments. Devices such as the Telharmonium, Theremin, Ondes Martenot, Hammond Organ, RCA Mark II, Moog and Buchla systems, as well as the Minimoog, Prophet-5, Synclavier, Fairlight CMI, and Yamaha DX7 are analyzed through a descriptive approach in terms of their technical features, performance interfaces, usage contexts, and organological positioning. Each case study explores the specific transformations indicated in the dimensions of instrument body, interface, spatiality, and performer–instrument relationship (Holmes, 2008; Jenkins, 2007). In addition, primary sources such as manufacturer catalogs, patent documents, and period-specific magazine articles related particularly to instruments like the Minimoog, Prophet-5, and Yamaha DX7 have been reviewed and evaluated to clarify the historical context concerning their technical specifications and intended user profiles.

This study does not rely on quantitative data sets and does not employ statistical analysis; instead, it utilizes qualitative content analysis and historical interpretation methods. Within this framework, intertextual comparisons are used to identify commonalities and divergences across different periods, highlighting the reciprocal interaction between technological innovations and organological discussions related to musical aesthetics, performance practices, and instrument design. Moreover, themes such as the philosophical differences between the *Musique Concrète* and *Elektronische Musik* schools, the ways in which voltage-controlled modular systems transformed the roles of composers and performers, and how the production–performance dichotomy was redefined with the digital revolution are discussed based on existing literature (Holmes, 2008, pp. 35, 56, 154, 227, 265, 325; Jenkins, 2007, pp. 50, 65, 73–75). This methodological approach enables the historical development of electronic musical instruments to be understood not merely as a sequence of technical innovations, but as a multilayered process encompassing transformations in musical thought, aesthetic perception, performance practices, and criteria for organological classification—thus offering an analytical framework aligned with the principles of qualitative historical research (Yıldırım & Şimşek, 2021).

The study is structured around six main periods within this analytical framework. It begins by examining the progression from electromechanical eras to early electronic instruments based on vacuum tube technology. This is followed by a discussion of the age of magnetic tape and studio production, voltage-controlled modular systems, and integrated analog synthesizers within an organological context. In the final section, the transformation shaped by digital synthesis, sampling, and the MIDI standard is evaluated in terms of both the technical foundations of modern music production and the emerging forms of the instrument concept intertwined with digital protocols.

Results

In this section, the findings obtained in accordance with the method detailed in the previous section are organized and presented along the axis of the historical periodization adopted in the study. Each period is examined through its prominent instruments; the technological characteristics, aesthetic positioning and cultural contexts of these instruments, as well as the implications they bear in terms of organological classification, are analysed together. In this way, the historical development of electronic musical instruments is articulated from a holistic perspective, with particular attention to the period-specific turning points and to how these ruptures are reflected in instrument design and musical practices.

The Discovery of Electricity in Music and Early Instrument Experiments (1876–1930)

The late 19th and early 20th centuries mark a period during which the first experimental applications demonstrating the potential of electricity as a musical medium and creative agent emerged. This period also represents a stage in which the tension between technological idealism and the practical and technical limitations of the era became increasingly evident. Early devices—often described as "electromechanical giants"—were developed around visionary concepts such as transmitting music through telephone lines, ideas that were remarkably forward-looking within their historical context (Holmes, 2008, p. 12; Collins et al., 2013). However, the extremely large physical scale, high costs, and various technical shortcomings of these systems signaled that the future of electronic sound production would likely depend on decentralized, smaller-scale, and more accessible systems. These early examples made it clear that electricity could serve not only as an auxiliary medium for amplifying acoustic instruments but also as a creative component capable of generating sound from scratch.

The origins of this period lie in experimental work conducted in parallel with the development of telephone technology. In 1876, Elisha Gray demonstrated that the frequency—and thus the pitch—of a sound could be controlled using a self-vibrating electromagnetic circuit, a discovery that led him to develop the *Musical Telegraph*, an instrument whose primary function resembled that of a monophonic oscillator. In this device, the vibration of steel reeds was maintained by electromagnets, and the resulting electrical signal was transmitted over telephone lines. Gray later incorporated a simple loudspeaker system featuring a diaphragm vibrating within a magnetic field to increase audibility, thereby creating a closed structure in which electrical oscillations were directly converted into audible sound. Although the *Musical Telegraph* was originally conceived more as a technological invention than as a musical instrument, it is widely regarded as one of the earliest concrete examples demonstrating that electric current could be transformed directly into musical sound (Holmes, 2008, pp. 8–10). From an organological perspective, the device represents an early prototype that radically redefined the instrument's body, sound-generation mechanism, and performance modality, marking a distinctive threshold that foreshadowed the later trajectory of electronic instrument design.

When this initial period is evaluated as a whole, it becomes evident that the instrument's physical body expanded into large-scale industrial mechanisms, its sound production shifted toward electromagnetic circuitry, and its spatial dimension was extended through the concept of "remote listening" via telephone lines. Yet the cumbersome structure and limited sonic capabilities of these systems underscored the need for more compact, flexible, and directly controllable solutions to unlock the musical potential of electricity. This recognition laid the groundwork for a transition from such large-scale experiments to more abstract electronic designs based on vacuum tubes, as exemplified by Thaddeus Cahill's *Telharmonium*. The experimental nature of these early electromechanical systems represents not merely a technical step, but an organological rupture in which the conceptual boundaries of what constitutes a musical instrument were actively questioned (Collins et al., 2013).

Thaddeus Cahill's Telharmonium: An Early Electromechanical Sound Machine

The first large-scale and most ambitious attempt at electronic sound production materialized with the *Telharmonium*, developed by Thaddeus Cahill. Considering the technological and infrastructural vision behind it, as well as its physical scale and cost, the *Telharmonium* stands out as a remarkable project for its time. Weighing approximately 200 tons and measuring 18 meters in length, this colossal apparatus resembled an industrial generator more than a traditional musical instrument. With a construction cost of around \$200,000—equivalent to several million dollars today—it was one of the most expensive technological investments of its era. Installed in New York's *Telharmonic Hall*, the system occupied nearly an entire floor of the building for over two decades, and could only be transported using a specially designed setup involving 30 railway cars (Holmes, 2008, p. 12).

This massive physical scale reveals that Cahill's ambition was not simply to invent a new musical instrument, but to establish a centralized music distribution system capable of delivering performances to subscribers via telephone lines. From an organological perspective, this indicates that the *Telharmonium* should be conceptualized not merely as a sound-producing object, but as a comprehensive musical technology system designed together with its own distribution infrastructure.

The *Telharmonium* was based on a sound generation system involving electromechanical tone wheels—an early and large-scale implementation of the principle of additive synthesis (Holmes, 2008, p. 13). Signals derived from tone wheels generating fundamental sine waves were combined to create more complex timbres rich in harmonic content. This approach would later inspire Laurens Hammond's *Hammond Organ*, which achieved significant commercial success. The *drawbar* system in the *Hammond Organ* can be seen as a more compact, cost-effective, and performer-accessible version of the additive synthesis model first realized in the *Telharmonium*. In this sense, the *Telharmonium* represents a foundational link in the organological lineage of subsequent electromechanical organs.

However, the *Telharmonium* had notable limitations, both musical and technical. Cahill's forward-looking keyboard design—featuring 36 notes per octave—posed significant challenges for performers accustomed to the 12-tone equal-tempered system. This unusual layout made consistent practice and repertoire development difficult. On a technical level, transmitting music over telephone lines led to several problems related to signal strength and fidelity. Each additional subscriber diminished the overall volume, and bass frequencies in particular suffered from distortion described as “growling,” which negatively impacted the listening experience. These issues were among the main reasons why the *Telharmonium* failed to achieve commercial viability (Holmes, 2008, pp. 14–15).

Despite these shortcomings, the *Telharmonium* made a significant contribution to the history of music and technology by materializing the concept of electronic sound production in a functioning system. With an instrument body large enough to fill an entire building, performance space became an integral part of the instrument itself. While the interface was operated via a keyboard, the sound was transmitted across telephone lines to distant locations. This created a unique example in which the body, space, and distribution network merged into a single “instrument system” from an organological standpoint.

The limitations of the *Telharmonium* underscored the need for smaller, more localized instruments focused on the performer’s direct interaction. This recognition paved the way—both theoretically and practically—for a transition toward more compact designs, such as the *Hammond Organ*, shifting the focus of electronic instrument design from centralized infrastructure to individual performance contexts.

Overall, this period represents a stage in which, although electronic sound production had not yet become economically or practically sustainable, the instrument–space–infrastructure relationship was opened to radical organological reconsideration. Devices like the *Telharmonium* conceptualized the instrument not as a self-contained body, but as an integrated technical-economic system involving tone generators, telephone lines, and listening spaces. In contrast to later compact and performer-centered instruments, the *Telharmonium* exemplified a centralized, infrastructure-dependent model. Consequently, these electromechanical giants served not merely as technical "failures," but as initial paradigms to be transformed—paradigms from which future designers learned what to avoid and how to innovate in terms of scale, energy requirements, and distribution logic.

This early organological legacy made visible the tension between centralization and decentralization, magnitude and portability, institutional infrastructure and individual expression. This tension would resurface in various forms throughout subsequent phases of electronic music history (Collins et al., 2013; Holmes, 2008, pp. 15–18).

Electromechanical giants like the *Musical Telegraph* and the *Telharmonium* demonstrated the feasibility of using electricity for musical sound generation. However, their massive scale, infrastructural demands, and limited timbral flexibility prevented them from becoming part of everyday musical practice. This tension increasingly highlighted the need for solutions offering more compact circuitry, portable bodies, and richer sonic possibilities—ultimately preparing the ground for the next phase marked by vacuum tube technology and abstract electronic circuit design.

While the *Telharmonium* was technologically advanced, it proved economically and practically unsustainable. It thus served as a kind of “negative blueprint” for later designs. The *Hammond Organ*, with its portable body, lower cost, and user-friendly interface, can be understood as a systematic response to the limitations of Cahill’s project. In this regard, the *Telharmonium’s* commercial “failure” became a key threshold, revealing how success criteria in organological terms—such as scale, accessibility, and usage context—were being redefined. It indirectly shaped the trajectory of later electromechanical instrument design by exposing the conditions under which new instruments could be viable, performative, and musically relevant.

The Emergence of Abstract Electronic Sound and New Performance Interfaces (1920–1940)

The widespread adoption of vacuum tube technology in the 1920s marked a significant paradigm shift in electronic instrument design—from bulky, mechanically driven systems based on direct physical vibration to more abstract, flexible, and relatively compact electronic circuits. This transformation not only made instruments more functional in terms of size, portability, and installation but also expanded the range of producible sounds, increased timbral diversity, and enabled the emergence of novel performance interfaces that redefined musician–instrument interaction.

Vacuum tube-based circuits facilitated the exploration of new sound production techniques—such as the heterodyning oscillator principle—that were unfeasible with prior acoustic or electromechanical constructions. As a result, continuous pitch transitions, touchless control, and timbral expressions unfamiliar to traditional musical practices of the time became part of the musical vocabulary (Holmes, 2008, p. 19; Battier, 2020). From an organological perspective, this period represents a critical threshold in which the physical relationship between instrument and performer was fundamentally redefined, prompting a reconsideration of concepts such as contact, corporeality, motion, and control.

Within this framework, instruments such as the *Theremin* and *Ondes Martenot* exemplify a loosening of the distinction between the instrument's body and its interface. They introduced performance paradigms in which physical contact was replaced by body–field interactions or hybrid configurations. While the *Telharmonium* had merged the instrument's physical body with its distribution system into a single industrial structure, instruments of this period demonstrated a trend toward miniaturization, with an increasing emphasis on the visibility and intimacy of the performer's bodily engagement (Schnell & Battier, 2002). This shift forms a conceptual bridge to the later reconceptualization of the studio environment as an "expanded instrument."

The Theremin: Touchless Performance, Electronic Timbre, and Body–Field Interaction

The most iconic and innovative instrument of this period was the *Theremin*, developed in 1920 by Russian inventor Leon Theremin (Lev Termen). Distinguished by its radical departure from all previous musical instruments in terms of both working principle and performance interface, the *Theremin* is considered a major turning point in the history of electronic music. It operates through the combination of two high-frequency radio oscillators via the heterodyning method. One oscillator remains fixed, while the other is connected to a vertical antenna. The distance of the performer's hand from this antenna modulates the variable oscillator's frequency via capacitive body effect, and the frequency difference between the two oscillators produces an audible signal that determines pitch. A second, loop-shaped horizontal antenna controls amplitude in a similar fashion, allowing the performer to manipulate both pitch and volume simultaneously using hand gestures—entirely without physical contact.

This resulted in a completely unprecedented performance technique in music history (Holmes, 2008, p. 19; Jenkins, 2007, p. 48; Battier, 2020). The *Theremin's* unique interface generated a strikingly visual performance aesthetic while enabling continuous pitch transitions and microtonal expressions—musical gestures for which no direct analogue existed in the conventional music language of the time. From an organological standpoint, the *Theremin* occupies a singular position in that it redefines the concept of the "instrument" from a handheld or touch-based object to one defined by the body's interaction with an electromagnetic field (Schnell & Battier, 2002).

Following its invention, the *Theremin* gained significant cultural visibility. When exhibited at the Moscow Industrial Fair in 1920, it reportedly captured the attention of Vladimir Lenin, who not only tried the instrument himself but also ordered hundreds to be produced and toured across the Soviet Union. After Theremin emigrated to the United States in 1927, the instrument was manufactured commercially in the 1930s. During the 1940s and 1950s, it became a characteristic sonic element in science fiction and suspense films—particularly associated with Alfred Hitchcock's *Spellbound* (1945) (Holmes, 2008, p. 23). In popular music, the *Theremin's* most recognizable appearance is in The Beach Boys' 1966 hit *Good Vibrations*.

Nonetheless, despite its innovative design, the *Theremin* was often perceived primarily as a device for generating effects. This perception limited its recognition as a "serious" concert instrument at the institutional level. Organologically, this is significant: the radical nature of the *Theremin's* operation and performance paradigm makes it difficult to categorize within traditional instrument families. While the instrument's body was reduced to a small cabinet and two antennas, its true "instrumentality" was embodied in the performer's interaction with the surrounding electromagnetic field. In this sense, the *Theremin* became a pioneering example of electronic instruments that emphasize corporeal gesture and performative visibility.

Particularly in the science fiction films of the 1940s and 1950s, the *Theremin's* sound came to signify the alien, the uncanny, and the otherworldly—establishing the instrument not only as a technological innovation, but also as a sonic icon evoking specific affective and imaginative dimensions within popular culture (Holmes, 2008, pp. 23–25; Battier, 2020).

The Ondes Martenot and Other Innovations: Hybrid Interfaces, Electromechanical Organs, and Early Experiments in Synthesis

As an alternative to the touchless performance paradigm introduced by the *Theremin*, French cellist and radio telegraphist Maurice Martenot developed a different approach. With his 1928 invention, the *Ondes Martenot*, Martenot sought to create an electronic instrument more familiar to orchestral musicians, in contrast to the *Theremin's* unconventional and alienating interface. In early models of the instrument, pitch was controlled via a string attached to a ring worn on the finger, which was moved horizontally. Later versions incorporated a traditional keyboard, thereby offering a hybrid interface that allowed for both continuous pitch glides, similar to the *Theremin*, and discrete pitch control akin to keyboard instruments (Holmes, 2008, p. 24; Gil Noé, 2015). From an organological perspective, this hybrid structure served as an aesthetic and practical "bridge," facilitating the integration of electronic instruments into traditional orchestral contexts.

Another significant instrument developed during this period, which quickly gained widespread use, was the *Hammond Organ*. Inheriting the technological legacy of the *Telharmonium*, the *Hammond Organ* incorporated the principle of additive synthesis and an electromechanical tonewheel system into a more compact and cost-effective body—making it suitable for use in homes, churches, and concert venues. The contrast between the *Telharmonium* and the *Hammond Organ* clearly demonstrates the evolution of electronic instrument design from centralized, large-scale systems to portable formats appropriate for everyday musical practice. Although both instruments relied on similar sound-generation principles, the *Hammond Organ* allowed for more flexible and performer-friendly control of timbral components through its "drawbar" system (Holmes, 2008, pp. 26–27).

Given the *Telharmonium's* approximately 200-ton structure and its requirement for industrial-scale infrastructure, the portable body and commercial success of the *Hammond Organ* highlight how two instruments based on the same synthesis principle can occupy radically different positions in terms of body architecture, performance context, and practical application. While the *Telharmonium* represented a centralized, broadcast-oriented "system instrument," the *Hammond Organ* became a widely used instrument addressing individual performers and local communities.

Other notable instruments from this period include the *Trautonium*, developed by Dr. Freidrich Trautwein and later extensively used by composer Paul Hindemith and virtuoso Oskar Sala. Similarly, the *Coupleaux–Givelet Organ* was conceived as an electronic replacement for pipe organs, though it failed to compete commercially with the *Hammond Organ*. Meanwhile, the *Novachord*—which supported polyphony up to 72 notes—was significant for incorporating early examples of functions like envelope control, which would later become standard in modern synthesizers (Holmes, 2008, p. 28; Collins et al., 2013). From an organological perspective, these instruments exemplify the need to reconceptualize the notion of the instrument family not only through acoustic parameters but also through the architecture of electronic circuits and the nature of control interfaces.

In general, the vacuum tube era substantially expanded the sonic palette of electronic music and provided composers with expressive possibilities previously unattainable. However, most instruments from this era were designed primarily for live performance, often monophonic, and tailored toward immediate, real-time interaction. This created a growing tension with the emerging compositional need to record, manipulate, layer, and reconstruct sound over time. That tension laid the groundwork for magnetic tape-based studio production, shifting the concept of the instrument from a singular body toward the broader system of recording and editing equipment—the foundation of the "studio instrument" model.

The instruments developed during the vacuum tube era demonstrated how flexible the relationship between instrument body and performance interface could become. In the *Theremin*, the instrument transformed into an "invisible" interface by positioning the performer's body within an electromagnetic field; the *Ondes Martenot*, through its hybrid design, offered a transitional solution that embedded electronic timbres into traditional orchestral practice. The *Hammond Organ*, in turn, redefined the industrial-scale body of the *Telharmonium* in a compact form suitable for personal and communal use. This period thus reveals a continuity ranging from radically experimental interfaces to hybrid solutions approximating conventional instrument families—showing how the concept of the instrument was both expanded and rescaled according to different usage contexts.

Despite these innovations, the dominant instruments of this period remained primarily monophonic, live-performance-oriented, and designed for real-time interaction. They proved insufficient for addressing composers' growing need to record, edit, fragment, and recompose sound in multilayered structures. This demand directly catalyzed the emergence of magnetic tape technology and a studio-centered mode of production (Holmes, 2008, pp. 28–30; Collins et al., 2013; Schnell & Battier, 2002).

Instruments such as the *Theremin*, *Ondes Martenot*, and *Hammond Organ* brought electronic timbre into both the concert hall and popular music culture. Through touchless performance, hybrid interfaces, and electromechanical organ structures, they fundamentally redefined the instrument–body–space relationship. However, their design emphasis on monophonic, real-time performance could not meet the emerging demands for recording, fragmentation, reorganization, and multi-layered sonic construction. This limitation became one of the key drivers behind the shift toward the magnetic tape era, in which sound itself came to be treated as an autonomous "object" and the studio environment was reconceptualized as an expanded instrument in its own right.

The Studio Era: Magnetic Tape, the Sound Object, and Early Programmable Synthesizer Prototypes (1940–1960)

The widespread adoption of magnetic tape following World War II brought about a fundamental transformation in the ontological status of music. During this period, music was no longer conceived solely as a transient, real-time performance, but rather as a tangible *sound object*—something that could be cut, spliced, reversed, slowed down, accelerated, and restructured in multilayered ways. Although invented in 1928, magnetic tape technology did not gain widespread use outside of Germany until after 1945 (Holmes, 2008, p. 35; Terrio, 2005). This technology redefined the figure of the composer—not merely as someone who writes scores, but as a "sound sculptor" who works directly with recorded material and shapes sound as a plastic medium.

This paradigm shift laid the foundation for the emergence of specialized studio environments in cities such as Paris and Cologne, where two distinct philosophical approaches to electronic music took form: *Musique Concrète* and *Elektronische Musik*. From an organological standpoint, this period witnessed a redefinition of the concept of the "instrument"—no longer restricted to a single physical object, but rather understood as an *expanded instrument system* encompassing the entirety of the studio environment (Schnell & Battier, 2002; Battier, 2020).

The *Musique Concrète* approach, centered in Paris, was developed by French radio engineer and composer Pierre Schaeffer. In this tradition, environmental and acoustic sounds—such as train noise, doors, and human voices—were used as primary musical materials. Schaeffer aimed to construct abstract compositions by detaching these "sound objects" from their original contexts and manipulating them through techniques such as cutting, looping, reversing, and speed variation. This practice gave rise to a new musical thought process focused not on the source of sound, but on its perceptual and auditory characteristics (Holmes, 2008, pp. 56–58; Terrio, 2005).

In contrast, the *Elektronische Musik* movement based in Cologne—led by composers such as Herbert Eimert and Karlheinz Stockhausen under the auspices of West German Radio (WDR)—adopted purely electronically generated sine waves as their point of departure. In this approach, core musical parameters such as pitch, duration, timbre, and intensity were organized systematically according to serial principles. The resulting compositions embodied a highly abstract, rational, and mathematically structured aesthetic (Holmes, 2008, p. 56; Terrio, 2005).

The opposition between these two approaches formed the core of early aesthetic debates in electronic music. On one side stood a concrete orientation grounded in the manipulation of found and recorded sounds; on the other, an abstract orientation based on the serial organization of entirely synthetic tones. From an organological perspective, *Musique Concrète* redefined the instrument as a system composed of recording and editing devices, whereas *Elektronische Musik* conceptualized the instrument as a modular structure comprising oscillators, filters, and other studio-based electronics.

In this way, the concept of the instrument expanded beyond physical objects to include the technological infrastructure of the studio itself, reshaping the relationship between tool, medium, and instrument (Schnell & Battier, 2002; Battier, 2020).

During this era, the instrument extended beyond a singular body to encompass the entire studio space, while the figure of the performer merged with that of the composer, technician, and editor. However, this model posed significant limitations—high cost, institutional dependency, and restricted real-time performance capabilities—making it difficult for electronic music to reach a broader community of performers. These constraints, in turn, gave rise to major programmable synthesizer projects such as the *RCA Mark II* and *Siemens Studio* systems. At the same time, they helped pave the way for the next generation of performance-oriented, voltage-controlled synthesizer designs.

RCA Mark II, Siemens System and Programmable Synthesizers

One of the most notable developments of the studio era was the emergence of large-scale synthesizer prototypes that combined sound generation, various forms of sound transformation, and sequencing functions within a single system. Typically funded by universities or large institutions, these systems were produced in limited quantities and often used only in specialized studios at certain centers. One of the most striking examples in this context is the RCA Mark II Synthesizer, installed in 1957 at the Columbia-Princeton Electronic Music Center with support from the Rockefeller Foundation.

Known as "Victor," this system occupied an entire room and consisted of thousands of vacuum tubes in an extremely complex structure. Its most distinctive feature was its programmability via punched paper tape. Composers encoded parameters such as pitch, duration, timbre, and envelope for each note onto the tape using a binary coding system, thereby enabling composers — especially serialists like Milton Babbitt — to design intricate and precise structures that would have been practically impossible for human performers to execute. Organologically, the RCA Mark II can be regarded as an example in which the performer is largely excluded from the system and the composer assumes the role of "programmer," representing a radical reorganization of the performer–instrument relationship.

However, the RCA Mark II had significant practical limitations: its range of timbres remained relatively limited, and the programming process was laborious and non-intuitive. Moreover, in its early years, sound recording was done on media older than magnetic tape, which reduced the system's flexibility and narrowed its field of application.

A similar approach was developed at the end of the 1950s within the Siemens Studio for Electronic Music in Munich. In the Siemens system, compositions were programmed via rolls of four parallel punched tape strips. These strips controlled the four fundamental parameters of sound: pitch (octave and note), volume (graded scale), duration, and timbre (filter settings). The system directed sound sources such as sine-wave and square-wave generators via this programmable structure.

Although both the RCA and Siemens systems aimed — at a theoretical level — to provide composers with complete control over sound, their non-intuitive interfaces, highly indirect and time-consuming composition processes, and unsuitability for real-time performance limited their usage to a small circle of specialists. This situation clearly revealed that electronic music should not remain solely a studio-based, tape-focused production activity, but should also be developed as a practice grounded in immediate performance, performative interaction, and direct musician–instrument relationships.

From an organological perspective, these systems transformed the instrument's body into a room-sized machine assembly, while the performance interface shifted to punched tape programming panels and control consoles. Yet, relegating bodily gestures and real-time responsiveness to the background emphasized — in contrast — the need for a "return to performance," a need that would later find expression in voltage-controlled synthesizers. In this sense, intermediary solutions such as the Electronic Sackbut proposed a novel response by shrinking the instrument's body and making its interface responsive.

Electronic Sackbut: Pioneer of Voltage Control and Performance-Oriented Interface

Contrary to the large-scale, extremely laborious studio systems, the Electronic Sackbut — developed beginning in 1945 by the Canadian inventor Hugh Le Caine — represents an astoundingly forward-looking approach to future synthesizer design. Considered one of the earliest prototype examples of voltage-controlled synthesizers in music history, this instrument occupies a special position because it early on materialized the idea of performance-based instantaneous control in electronic music.

The Electronic Sackbut featured a mechanism sensitive to the pressure applied to the keys. This allowed the performer to modulate the timbre and other sound parameters in real-time by varying the pressure on the keys, providing highly sensitive and simultaneous control. The control was achieved by routing the voltage signal generated by the keyboard to the sound-producing oscillators and sound-shaping circuits. This structure can thus be considered both an early form of the voltage-control principle and a performance-oriented interface enabling the real-time control of multiple parameters. Indeed, the conceptual foundations of the modular synthesizers developed in the 1960s by Robert Moog and Don Buchla bear clear traces of this approach pioneered by the Electronic Sackbut.

From an organological standpoint, this example reduced the instrument's body to a compact, physically accessible console placed before an individual performer and redefined the performance interface via pressure sensitivity and continuous parameter modulation. In doing so, it created a critical bridge between the programmable but "static" machine aesthetics of the studio era and the performance-centered modular systems of the 1960s. As such, it offered a technological and aesthetic precedent for the future identity of the electronic instrument under the voltage-controlled paradigm.

The studio era redefined the concept of the instrument not as a discrete object, but as an expanded studio instrument comprising tape recording systems, mixing consoles, large-scale programmable synthesizers, and embedded electronic infrastructure within spatial environments. RCA Mark II and the Siemens system, through their structures that excluded the performer and positioned the composer as the "programmer" of the system, created a radical rupture in the performer–instrument relationship. In contrast, examples like the Electronic Sackbut opened an alternative path: through voltage control and performance-oriented interfaces, they reunited electronic sound with embodied performance practices. These opposing orientations reveal that the development of electronic instruments was not determined solely by technical possibilities, but also by aesthetic choices regarding the distribution of composer–performer roles.

Magnetic tape technologies and early studio-synthesis systems provided unprecedented levels of control and abstraction over sound, expanding the aesthetic horizons of electronic music through the schools of Musique Concrète and Elektronische Musik. However, the high cost, complex programming processes, and lack of real-time performance capability of large-scale prototypes such as RCA Mark II and Siemens system posed a limitation: they confined electronic music to a narrow expert circle. This limitation spurred a search for smaller-scale, flexible voltage-controlled systems in which both composer and performer could directly and intuitively control parameters during performance — a search that laid the groundwork for the emergence of modular synthesizers in the 1960s.

The Rise of Voltage-Controlled Synthesis: From Modular Systems to the Commercial Synthesizer Identity (1960s)

The 1960s represent a critical period marking the transition of electronic music from its "invention age" to its "instrument age." During this era, as voltage-controlled systems became standardized, modular architectures emerged, in which electronic sound-producing modules could be connected independently yet flexibly. Thus, the synthesizer came to be positioned not merely as a technology producing new sounds, but as a musical instrument that directly expands the creative expressive capacity of composers and performers. This technical transformation shifted the production of electronic music away from the institutional studio monopoly towards individual musicians; it laid the foundation for the rapid proliferation of electronic sounds across a broad spectrum—from academically centered experimental work to popular music and commercial production practices (Pinch & Trocco, 2002; Menoche, 2005; Horn et al., 2022).

Moog and Buchla: Two Aesthetic Lines from Keyboard-Centered Design to Experimental Interfaces

In the mid-1960s, the synthesizers developed in two different regions of the United States by Robert Moog (East Coast) and Donald Buchla (West Coast) represented not only a technical but also an aesthetic and organological divergence in the design of voltage-controlled electronic musical instruments. This divergence manifested across many levels—from control interfaces and timbral possibilities to target user profiles and musical contexts. Robert Moog adopted the piano keyboard as the primary control interface in his synthesizer designs, aiming for rapid adoption by traditional musicians educated in Western musical canon. This choice facilitated the alignment of Moog synthesizers with tonal music language and laid the groundwork for their quick popularity in genres such as rock, jazz, and pop. In contrast, Donald Buchla deliberately rejected the traditional keyboard interface's tonal and formal constraints, positioning electronic music as a fundamentally experimental domain. Control units such as touch plates, random voltage generators, and sequencers stood out in Buchla's systems, guiding the performer toward a more open-ended sound organization, independent from conventional pitch structures (Holmes, 2008, p. 221; Pinch & Trocco, 2002; White, 2022).

This bifurcation of approaches is directly reflected in the sonic output produced by the synthesizers. Moog systems typically relied on subtractive synthesis, shaping harmonically rich waveforms through filtering—especially using Moog's characteristic ladder low-pass filter—to yield the warm, full-bodied, and rounded timbres that became their hallmark. Conversely, Buchla synthesizers prioritized techniques such as wave-shaping and frequency modulation, aiming to produce more metallic, sharp, and complex sonic textures. Buchla's design philosophy was less about imitating traditional instrument timbres than about creating previously unheard soundscapes; thus, the electronic instrument was positioned not as a carrier of existing musical language, but as a tool for generating a new sonic language altogether (Horn et al., 2022; White, 2022).

From an organological perspective, the Moog–Buchla divergence illustrates how decisively the instrument's interface design and aesthetic positioning can shape its identity. With their keyboard-based interfaces, Moog synthesizers integrated the electronic instrument into existing instrumental families; by contrast, Buchla systems defined the instrument as a new body–machine interaction space. Consequently, the 1960s became a dual-directional organological expansion period, in which electronic instruments could simultaneously integrate into the conventional instrument family or radically diverge from it (Pinch & Trocco, 2002; Menoche, 2005; White, 2022; Horn et al., 2022).

***Switched-On Bach*: The Legitimation of the Moog Synthesizer and Its Positioning in Popular Music**

The real turning point in bringing the Moog synthesizer out of academic and institutional studio circles and before a broad listening audience came with the release of Switched-On Bach by Wendy Carlos in 1968. In the album, works by Johann Sebastian Bach were re-performed solely using the Moog modular synthesizer, employing multichannel recording and meticulous editing processes; this resulted in an interpretative approach that challenged the instrument's boundaries in terms of articulation, dynamics, and timbral variety. Achieving unexpected commercial success, *Switched-On Bach* rose high on the classical music charts and repositioned the synthesizer as a "serious" musical instrument capable of carrying a historical repertoire — rather than merely an experimental or effect-oriented device (Jenkins, 2007, p. 50; Holmes, 2008, p. 218; Pinch & Trocco, 2002).

Following this rupture, Moog synthesizers quickly gained prevalence in the realm of popular music. As leading figures of the time such as The Beatles and Mick Jagger began using the Moog in studio recordings and stage productions, electronic timbres became a permanent component of rock and pop's sonic world. In this way, the synthesizer shed its identity as a device confined to closed studio environments and acquired an established instrument status both on stage and in the studio; this contributed to the blurring — and in some aesthetic contexts, the dissolution — of boundaries between electronic music and popular music (Pinch & Trocco, 2002; Menoche, 2005).

From an organological perspective, this process can be read as a phase during which the legitimacy domain of the electronic instrument expanded. With the same body and timbre architecture, the Moog gained a hybrid identity as an instrument capable of carrying both Bach interpretations and popular music repertoire — thus transforming the electronic instrument into a flexible "family member" that can traverse different layers of musical culture.

The significance of *Switched-On Bach* is not limited to legitimizing the Moog as a "serious" music instrument. The fact that Wendy Carlos (then known as Walter Carlos) later became publicly visible as a trans woman intersects with gender and visibility debates frequently highlighted in electronic music history. The synthesis technologies — on one hand frequently identified with male-dominated, high-tech studio environments and on the other hand associated with identity and expressive freedom through figures such as Carlos — transform electronic instruments into tools that carry cultural and social meanings beyond their technical function. This context calls for an organological analysis that extends beyond body and interface design to include the relationship between the instrument and the social position of its performer (Pinch & Trocco, 2002).

Moreover, the historical importance of *Switched-On Bach* should not be regarded as limited to timbral and performative innovations. The fact that Wendy Carlos publicly came out as a trans artist in the following years suggests that the synthesizer could function not only as a tool offering new sound possibilities, but also as an expressive domain enabling a rethinking of gender identity, body, and technology. The relatively "bodiless" and abstract interfaces of electronic instruments create a space with potential to challenge traditional gender roles shaped around conventional instrument performance; this calls for the socio-cultural dimension of organological analysis to be taken into account. From this perspective, *Switched-On Bach* can be viewed not only as the legitimation of the Moog synthesizer but also as one of the early heralds of new possibilities opened by electronic technologies in the realms of identity and representation.

An Alternative from Europe: EMS VCS3 and the Birth of a Portable Synthesizer Aesthetic

Around the same period, Europe witnessed noteworthy developments that directly shaped the design of electronic instruments. In 1969, the British firm Electronic Music Studios (EMS) released the VCS3 — conceived as a more compact, portable, and affordable alternative compared to the large modular systems of Robert Moog or Don Buchla. Instead of the patch cables commonly used in Moog systems, the VCS3 employed a "pin matrix" — a patch panel resembling a chessboard — where users could insert small pins to connect oscillators, filters, amplifiers, and modulators. Although it had a fixed physical housing, this design preserved much of the routing flexibility and sound-design capabilities characteristic of modular synthesizers. Because of its relatively small size and portable body, the VCS3 offered clear advantages for stage use. Its distinctive timbre, featuring the slightly "rough" texture produced by analog waveforms filtered through its circuitry, along with its innovative control interface, led to widespread adoption — particularly in Europe's progressive rock and electronic music scenes. Bands such as Pink Floyd and Tangerine Dream used the VCS3 both in live performances and studio recordings, helping the instrument become one of the defining icons of Europe-centric electronic sound aesthetics. These developments signified a shift: the instrument's body was liberated from the studio walls and settled into portable enclosures; the musical space itself moved from the fixed studio to the stage, tour, and mobile environments. By the end of the 1960s, the timbral diversity, control flexibility, and creative possibilities offered by voltage-controlled modular synthesizers were clearly demonstrated. Yet the large physical size, complex patching, and high cost of modular systems still limited their user base. Consequently, there emerged a clear demand for solutions that offered portability, standardization, and ease of use — and in response, the 1970s witnessed the rise of integrated synthesizers that combined oscillators, filters, and envelope generators within a single housing.

Moog, Buchla, and EMS — with instruments such as VCS3 — collectively demonstrated the timbral potential and control flexibility of voltage-controlled synthesis, helping the synthesizer become an indispensable tool for both experimental music and popular music alike. However, the large modular systems' physical bulk, complicated patch structures, and lack of portability created a need — especially for live performance contexts — for more compact, standardized, and quickly deployable instruments. This need drove the development and widespread adoption of integrated synthesizers throughout the 1970s.

Integrated Synthesizers: The Massification of Synthesized Sound (1970s)

The 1970s mark a period in which the synthesizer was redefined—as both a technical architecture and a musical entity—as a "fully-fledged instrument." During this phase, technology shifted away from large-scale studio systems toward portable, relatively low-maintenance, all-in-one solutions; modular configurations gave way to compact synthesizers integrating oscillators, filters, envelopes, and keyboard control within a single housing. This transformation made electronic sound production accessible to a broader community of musicians—no longer confined to a narrow circle of specialists—with the rise of polyphony. Consequently, the synthesizer evolved into a core instrument that influenced not only experimental sound aesthetics but also the harmonic textures and arrangement practices of popular music.

The Icon of Portable Analog Synthesis: Minimoog

The most critical threshold marking the beginning of this era was the release of the Minimoog by Moog Music in 1970. The Minimoog combined the fundamental components of modular systems—three oscillators, a low-pass filter, and two envelope generators—into a single wooden-bodied keyboard instrument, with pre-wired architecture. This design gave rise to an intuitive, patch-cable–free synthesizer type, highly suited for both stage and studio use. Organologically, the Minimoog represents a turning point by transforming the "system" logic of modular synthesis into a discrete, portable "instrument" identity.

The characteristic "Moog bass" and "lead" sounds quickly became predominant in the timbral palette of genres such as progressive rock, funk, and jazz-fusion. Musicians like Rick Wakeman of the band Yes helped elevate the instrument's symbolic status by using multiple Minimoogs on stage. This success reinforced the industry-wide tendency to regard synthesizers not simply as studio-based experimental devices but as portable, integrated, performance-oriented musical instruments.

Integrated Synthesizers: The Diversification of Designs and Growing Competition

The commercial and aesthetic success achieved by Minimoog opened the door for many manufacturers to enter the synthesizer market during the 1970s — leading to greater technological variety, new design approaches, and production of synthesizers at more accessible price points. In this process, the company ARP Instruments emerged as one of Moog's strongest competitors: models like ARP 2600 and ARP Odyssey stood out with more stable oscillator designs and distinctive timbral characters.

From the mid-1970s onward, Japanese firms such as Korg and Roland also joined the global synthesizer producers. Roland, with products like System 700 and System 100, targeted professional studio users, while Korg's MS-series synthesizers aimed at a broader and semi-professional musician base.

These developments led not only to diversification in circuit design and technical capacity but also to significant variation in instrument aesthetics, user-interfaces, and performance practices. As a result, the synthesizer became part of a broad instrument family embodying different design philosophies and use-contexts.

The competition between Moog and ARP in the 1970s shows that expectations for an "ideal instrument" were shaped not only by technical and timbral parameters, but also by considerations such as stability, stage reliability, user interface, and pricing. While Moog's characteristic filter-driven timbres attracted certain preferences, ARP's stable tuning and modulation possibilities associated that brand with different performance and production practices. Thus, from an organological perspective, defining a "successful instrument" in that era must take into account not only musical aesthetics, but also industrial, economic, and usage-contextual criteria.

The Emergence of Polyphony and Programmable Memory

In the second half of the 1970s, the most significant breaking point in synthesizer technology was the adoption of polyphony. Until that time, synthesizers had largely been designed as monophonic instruments, allowing only a single note to be played at a time. With the development of polyphonic synthesizers, it became possible to play multiple notes simultaneously, thereby enabling chord production, the creation of harmonic textures, and the construction of multi-layered harmonic structures directly on the synthesizer. This transformation elevated the synthesizer from being merely a "lead" instrument carrying melodic lines to a harmonically functional and central instrument.

In this context, one of the most important instruments was the Prophet-5, released by Sequential Circuits in 1978. In addition to offering five-voice polyphony, the Prophet-5 attracted attention with its programmable memory feature, which was highly innovative for its time. Musicians could store sounds they designed in the instrument's memory and, especially during stage performances, quickly recall them with a single keypress. This feature eliminated the need to reconfigure the panel before each track, making performance more practical and rendering the synthesizer a highly reliable instrument for professional stage use.

From an organological perspective, the 1970s are characterized by a standardization of instrument bodies into compact, portable, industrial housings; and by a stabilization of interfaces around keyboards and panel-based knobs/switches. Features such as polyphony and memory positioned these instruments, in both their harmonic functionality and live-practice usability, alongside orchestral instruments — thus granting the electronic instrument a "core instrument" status, indispensable in both studio and stage contexts.

However, at this point, the instability of analog circuits, production costs, and the limited number of timbral algorithms fostered interest in microprocessor-based digital solutions with parameter structures that could be precisely defined and reliably reproduced. This interest accelerated the transition to the digital era in the 1980s, centered around frequency modulation synthesis, sampling techniques, and the MIDI standard — making possible an evolution of the instrument from physical circuits to digital algorithms and communication protocols.

Integrated synthesizers such as the Minimoog, instruments by ARP, and the Prophet-5 democratized analog synthesis for both studio and stage use; with polyphony and programmable memory, they transformed the synthesizer into one of the central instruments of popular music. Nonetheless, challenges such as tuning instability, limitations in sound storage capacity, and difficulties in reliably reproducing complex timbres led to increasing interest in digital, microprocessor-based synthesizer systems — a shift that paved the way, through FM synthesis, sampling, and MIDI, for the synthesis of instruments no longer limited to analog hardware but based on digital algorithms and protocols.

Digital Sound, New Synthesis Paradigms, and Inter-Instrument Communication (1975–1985)

By the late 1970s, the prevailing model of analog synthesis reached its peak, only to enter a fundamental transformation with the integration of microprocessors into musical instruments. In this new era, sound began to be shaped not via voltage-controlled analog circuits, but through digital signals generated by mathematical algorithms and numerical data. In doing so, electronic sound production was moved into a wholly new technological paradigm — one that replaced continuous electrical oscillations at the circuit level with processes based on digital sampling and computation

Techniques such as frequency modulation (FM synthesis) and sampling did not merely introduce new timbral possibilities — often impossible or difficult to realize with analog synthesis — but also rendered sound design more predictable, reproducible, and software-based. FM synthesis enabled the generation of highly complex, bright and dynamic timbres from relatively simple waveforms, while sampling technology made it possible to record acoustic instruments and environmental sounds digitally and replay them via a keyboard. Consequently, real and artificial sound worlds came together under the same digital umbrella

Another critical milestone of this period was the development of the MIDI (Musical Instrument Digital Interface). With MIDI, synthesizers, drum machines, and computer-based systems from different manufacturers could connect and communicate over a universal protocol, enabling the synchronized transmission of note information, control data, and timing across devices. This structure laid the groundwork for a modular, layered, and flexible music-production ecosystem — both in the studio and on stage.

Taken together, the developments centered around digital synthesis, sampling, and the MIDI standard mark a turning point — a period that established the technical and aesthetic foundations of modern music production.

Synclavier and Fairlight CMI: The Shaping of Digital Sound

The earliest examples of digital synthesis were conceived as large-scale, high-cost, multifunctional closed systems. Introduced in 1975 by New England Digital, the **Synclavier** stands out as one of the most striking examples of this approach. Developed as part of a research project at Dartmouth College, this instrument was built on a fully microprocessor-based architecture. Despite its complex software infrastructure, its button-based control panel offered a relatively user-friendly programming environment for its time. By combining additive synthesis with early forms of FM synthesis, the Synclavier provided the possibility of producing a wide palette of timbres; however, due to its very high cost, it remained accessible only to large-scale studios and a limited number of renowned musicians (Holmes, 2008, p. 265; Battier, 2020).

Released in 1979, the Fairlight CMI holds a separate and pioneering significance for popularizing sampling technology in music production practice. On the Fairlight CMI, any sound recorded via microphone could be transferred into the digital domain and replayed at different pitches via a keyboard. This granted composers and producers a virtually unlimited sound source, ranging from everyday environmental noises to orchestral instruments. The ability to edit waveforms on-screen with a light pen turned the system not only into a performance instrument but also into an interactive sound-design platform. Through the productions of artists such as Peter Gabriel and Kate Bush, this innovative structure played a decisive role in shaping the pop and art-rock aesthetic of the 1980s (Holmes, 2008, p. 325; Russ, 1997; Self, 2002).

From an organological perspective, Synclavier and Fairlight CMI can be regarded as two foundational reference points of the early period in which digital synthesis and sampling, through hybrid structures integrating hardware, software, and user interface, redefined the concept of the instrument.

The Bright Signature of FM Synthesis: Yamaha DX7 and the Digital Timbral Aesthetic of the 1980s

One of the most important thresholds enabling digital technologies to reach mass audiences was the implementation of FM synthesis in musical instruments. The method, developed by John Chowning at Stanford University, is based on the principle that the frequency of one oscillator is modulated by another, enabling the production of highly complex, dynamic, and bright timbres. Capitalizing on the potential of FM synthesis at an industrial scale, the company Yamaha released the Yamaha DX7 in 1983; the DX7 quickly achieved remarkable global commercial success and became one of the most widely used synthesizers of the 1980s. Its bright, metallic, sharply attacked sound character — including bell-like electric piano tones, tight and clear basses, and percussive timbres — was extensively employed in pop, rock, and R&B productions of the era. In contrast to the warm and organic timbres of analog synthesizers, the DX7's clean, sharp and "modern" sound profile aligned closely with the aesthetic tendencies of the 1980s (Jenkins, 2007, p. 74; Horner & Beauchamp, 2008; Lavengood, n.d.).

In this context, the DX7 concretizes several critical transformations on an organological level. First, while the instrument's body took the form of a durable, standardized keyboard housing shaped by industrial design principles, its timbral world was handed over to complex digital algorithms — meaning that within a supposedly "traditional" keyboard body, an entirely new sonic universe began to reside. Second, the large number of parameters and relative complexity of programming led many users to rely on factory presets rather than designing their own sounds; this resulted in certain sound sets evolving into widely recognized cultural signatures instead of realizing the instrument's full sonic potential. Thus, the DX7 became an example that reveals the dual nature of the digital instrument: on one hand democratizing sound synthesis, on the other hand reproducing certain aesthetic templates at mass scale (Lavengood, n.d.; Russ, 1997; De Poli, 2023).

Conclusion

This article has treated the trajectory from the late-19th-century electromechanical experiments to the mid-1980s digital transformation as an organological re-reading of early electronic musical instruments. The evolutionary line under discussion is shaped around key technological rupture points that profoundly transformed the ways music is produced and performed. Rather than wholly rejecting the technology-centred historical framework outlined by Holmes and Jenkins, the study proposes an organological lens placed atop that framework — demonstrating that each periodical rupture signified not only a new sound-production technique, but also a redefinition of the instrument's body, interface, spatial disposition, and its relationship with the performer.

Pioneering and massive projects such as Telharmonium concretely demonstrated the viability of electronic sound production despite their practical limitations; the spread of vacuum-tube technology made possible instruments with unusual performance interfaces like Theremin and commercially successful models such as Hammond Organ. Magnetic-tape technology afforded composers unprecedented control over sound; voltage-controlled systems laid the groundwork for the first synthesizers suitable for individual use (such as systems by Moog and Buchla). With the rise of microprocessor-based digital systems, the prevalence of FM synthesis, sampling, and the establishment of the MIDI protocol mark a period that laid the technical and conceptual foundations of contemporary music production.

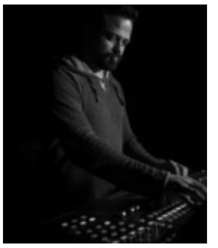
The instruments discussed in this study are evaluated not only as technical devices, but as cultural actors that transformed musical aesthetics, compositional practices, performance modes, and the sonic universe of popular culture. Aesthetic trends such as Musique Concrète and Elektronische Musik made the creative potential of electronic sound visible from different theoretical frameworks; the release of Switched-On Bach by Wendy Carlos helped legitimize the synthesizer as a "serious" musical instrument in the eyes of a wide listening public. The Yamaha DX7 became one of the primary sound sources defining a period's popular music aesthetic; through such instruments, composers and performers did not merely produce new timbres, but significantly expanded expressive possibilities by enabling detailed and instantaneous control over sound. In this sense, electronic musical instruments stand not only as new tools, but as carriers of creative possibilities that changed the direction of music history.

From an organological perspective, this historical process requires a fundamental rethinking of the concept of the instrument. The lineage extending from electromechanical behemoths to compact organs; from the touchless performance principle of the Theremin to the hybrid-interface Ondes Martenot; from studio-based systems to voltage-controlled modular architectures and digital synthesizers — all these developments make it necessary to reconsider core organological categories such as the instrument's body, sound-production mechanism, performance interface, spatial disposition, and socio-cultural usage in an electronic context. In this framework, the instrument should be seen not merely as a physical resonator, but as a holistic construct integrating electrical circuits, control voltages, digital protocols, and studio infrastructure. The building-scale body of the Telharmonium; the body–space interaction of the Theremin; the "extended instrument" function of large-scale studio recording and editing equipment; and the data-protocol–driven architecture of MIDI-based digital instruments all clearly demonstrate that the discipline of organology needs new categories beyond traditional instrument classifications.

The legacy of early electronic instruments continues to exist today — both technically and aesthetically. The synthesis methods developed through these instruments (additive, subtractive, FM) and the modular structure concept are being digitally re-implemented and extended in software-based virtual instruments. Computer-based music production is rooted directly in the production logic of early studio practices and the MIDI standard. On the other hand, the analog-revival movement that gained momentum from the 1990s onward renewed interest in these instruments and encouraged the design and production of a new generation of analog synthesizers (Jenkins, 2007, p. 13). Consequently, early electronic instruments are no longer mere historical curiosities — they have become aesthetic and technological models that are still referenced in contemporary music production.

In conclusion, this study positions early electronic musical instruments not as obsolete technical curiosities lost in history, but as the foundational links of the aesthetic, technological, and organological dynamics that continue to shape today's music production environment. The Telharmonium's extreme centralization and the portability of the Hammond Organ; the closed, programme-based systems of the studio era and the performer-centred design of voltage-controlled synthesizers; the tension between the "imperfect but warm" sound world of analog synthesis and the stable, predictable timbres afforded by digital technology — all these continue to form the core axes of debate in the relationship between music and technology. Approaching electronic instruments within the expanded scope of organology enriches discussions of instrument classification and enables a reconsideration of music-technology history at the intersection of body, space, and control. In this respect, the study provides a theoretical basis and conceptual framework for future organological research focused on electronic and digital instruments.

Biodata of Author



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