

¹Mihai APOSTOL, ²Constantin Stelian STAN, ³Mihai CHIȘAMERA,
⁴Georgian CABEL, ⁵Codrut CARIGA

A TECHNICAL ANALYSIS OF THE EVOLUTION OF COIN AND MEDAL MINTING METHODS

¹⁻⁵University Politehnica of Bucharest, Faculty of Materials Science and Engineering, 313 Splaiul Independenței, 6 District, Bucharest, ROMANIA

Abstract: The history of coin and medal minting methods spans millennia, reflecting the advancement of technology and the changing needs of societies. This technical analysis explores the evolution of coin and medal minting techniques, from ancient civilizations to modern industrial processes. By examining the key innovations and methodologies employed throughout history, this study sheds light on the fascinating journey of numismatic craftsmanship. The study begins by delving into the earliest forms of coin and medal production, highlighting the techniques used by ancient civilizations such as the Greeks, Romans, and Chinese. It explores the manual methods of hand-striking coins and casting medals, shedding light on the intricacies of engraving and die-making. As we progress through history, this analysis identifies pivotal developments. The transition from manual labor to mechanized minting processes revolutionized the precision and efficiency of coin production. Furthermore, this analysis investigates the emergence of modern coin and medal minting techniques, including the use of computer-aided design (CAD), digital engraving, and advanced metallurgical processes. These innovations have allowed for greater intricacy in design, increased durability, and enhanced security features, meeting the demands of contemporary economies and collectors. Additionally, the study addresses the environmental and ethical concerns associated with coin and medal production, including the use of sustainable materials and responsible sourcing. The evolution of minting methods also includes the development of eco-friendly practices to minimize the environmental impact of coin and medal production. Ultimately, this technical analysis provides a comprehensive overview of the evolution of coin and medal minting methods, demonstrating the intricate balance between tradition and innovation. By understanding this evolution, we gain insights into the cultural, technological, and economic shifts that have shaped the world of numismatics, offering valuable perspectives for collectors, historians, and scholars alike.

Keywords: coins, medals, die, manufacturing

INTRODUCTION

The history of coinage and medal production is a testament to human ingenuity and technological advancement. Coins and medals have not only served as mediums of exchange and symbols of honor but also as windows into the evolution of metallurgy, engineering, and artistic craftsmanship. This technical analysis embarks on a journey through time to explore the fascinating evolution of coin and medal minting methods, from ancient civilizations to the cutting-edge technologies of the modern world.

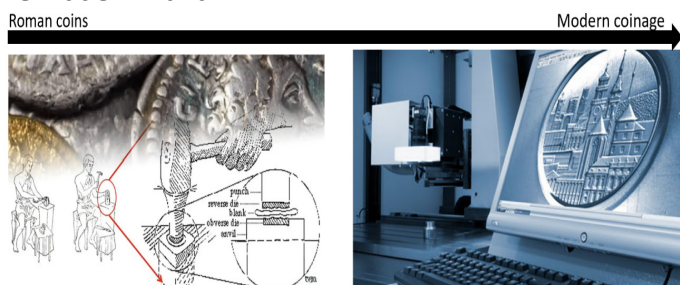


Figure 1. Evolution of the coins manufacture

The ancient Romans crafted their coins from flat, round metal discs or 'mints' using a method we now refer to as minting – a term still associated with wealth today! Unlike today's automated factory processes, Roman minted coins were entirely handcrafted within a workshop space

resembling a blacksmith's forge. In the early 200s BCE, these coins were primarily composed of bronze, but over time, the Roman coin-making process evolved to incorporate silver, gold, and copper. The most iconic and widely circulated coin throughout the Roman Empire was the denarius, produced through the pressing of silver. Remarkably, the denarius remained in circulation for an astounding five centuries. In the creation of their coins, the Romans employed two distinct techniques on metals – cold striking and hot striking.

Coins and medals have played pivotal roles in economies and societies across the globe. They have been used to facilitate trade, commemorate important events and individuals, and serve as artifacts that reveal the cultural, political, and economic landscapes of their respective eras. As these roles evolved, so did the techniques and technologies used in their creation. This study aims to dissect the progression of minting methods, offering insights into the technical intricacies that underlie the creation of these tangible pieces of history. By examining the evolution of coin and medal minting, we gain a deeper appreciation for the artistry, craftsmanship, and innovation that have shaped this field over centuries. Our exploration begins by examining the origins of coin and medal production, where rudimentary techniques

involving hand-crafted dies and manual striking processes dominated the landscape. As we journey through time, we encounter the monumental shifts brought about by the Renaissance and the Industrial Revolution, which heralded the era of mechanized minting and mass production. In the modern era, the integration of computer-aided design (CAD), digital engraving, and advanced metallurgical processes has transformed the art of coin and medal minting. These technological advancements have not only enhanced the precision and quality of these numismatic objects but have also introduced novel security features to combat counterfeiting. Moreover, this analysis does not stop at the technical aspects of minting methods; it also delves into the ethical and environmental considerations surrounding coin and medal production. Responsible sourcing of materials and sustainable practices have become integral aspects of the minting industry, reflecting society's growing awareness of the environmental impact of industrial processes. As we navigate this historical and technical terrain, we will uncover the rich tapestry of innovations, challenges, and societal shifts that have shaped coin and medal minting methods. By understanding the evolution of these techniques, we gain a deeper appreciation for the integral role that numismatics plays in documenting our shared history. In this paper we want to focus on the technical processes and artistic achievements that have defined the world of coin and medal minting, linking past and future through the lens of craftsmanship and innovation.

ANALYSIS OF CURRENT COIN MINTING PROCEDURES USED TO CREATE MEDALS

A metal shaping process known as coining plays a pivotal role in the production of coins and medallions. The conventional method of manufacturing medallions necessitates a pressing demand for expediting production, cost reduction, and the minimization of material wastage. In order to streamline the manufacturing process and curtail production expenses, contemplation of an alternative coining technique becomes imperative. Coining, essentially, signifies a form of metal forming wherein the material undergoes a minute displacement relative to the part's overall volume. Within minting facilities, the conceptualization of medallion and coin designs conventionally commences with the creation of hand-rendered sketches on paper. Subsequently, these designs traverse through a series of intermediary processes before being transcribed onto the dies.

This study encompasses a comprehensive scrutiny of the coining process, the introduction of an alternative approach that integrates Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) applications

into the design and production phases, as well as the proposal of modular die designs tailored for both blanking and coinage dies.



Figure 2. Plaster and silicone model



Figure 3. Silicone and acrylic model

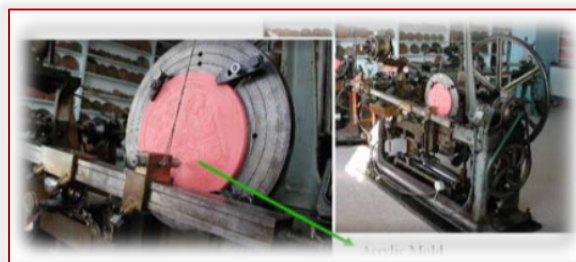


Figure 4. Classic reduction machine

To initiate this creative endeavor, the Art Workshop embarks on a preliminary investigation, wherein the sculptor and a dedicated design team delve into historical contexts and pertinent aspects of the specific event or gather essential information pertaining to the individual for whom the coin or medallion is intended. Once preparatory groundwork reaches its culmination, the sculptor proceeds to delineate the design on paper, amplifying its scale to a certain magnitude. The design team, in turn, undertakes the task of discerning the optimal design configuration, considering an array of alternatives for the impending coin or medallion project. Subsequently, sculptors commence the meticulous refinement of the positive plaster model, ensuring that every intricacy is meticulously attended to. Following the completion of the positive plaster model, a corresponding negative silicone model is meticulously crafted. This is done with the explicit purpose of facilitating the transfer of intricate details onto an acrylic model, which constitutes a robust thermoplastic sign material characterized by its relative toughness. The subsequent phase entails the replication of the negative silicone

model onto the acrylic substrate, effectively generating a positive mold. Secondly, within the Die/Mold workshop, the relief design undergoes a laser reading process via an engraving machine. It is worth noting that the traditional engraving machines are mechanical in nature, functioning by proportionally reducing the dimensions, height, and intricacies of the relief through the coordinated movement of a mechanical probe and tool. Depending on the specific dimensions and level of detail required for the mold, this process can extend over a duration of at least 36 hours. One notable challenge arises from the necessity for the dies utilized in the production of the master die to maintain precise alignment with the original part throughout the manufacturing process. As a result, achieving the desired level of tolerance within the relief design becomes a formidable task.

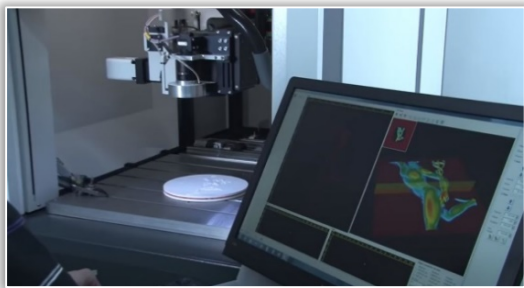


Figure 5. A view of 3D laser scanning

The engraving of the die can also be executed through the application of state-of-the-art technology. The process involves a series of steps commencing with the initial phase of 3D scanning of the plaster model. Subsequently, the processed file is seamlessly transitioned into CNC programming. This, in turn, facilitates the utilization of either mechanical engraving or laser engraving machines to realize the desired die.

■ Mechanical engraving using a CNC machine for coining die

Mechanical engraving, employing a CNC machine, represents a precise and versatile method for the creation of coining dies. This advanced technique harnesses the power of automated control systems to intricately carve out the required relief patterns and designs on the die surface. CNC machines, guided by precise coordinates, offer exceptional accuracy and repeatability, ensuring that the resulting coining dies meet the exacting standards necessary for the production of coins and medallions. This method not only streamlines the manufacturing process

but also allows for the realization of intricate and finely detailed coin designs with a high degree of precision and consistency.



Figure 6. A view of mechanical engraving using a CNC machine

■ Laser engraving using a CNC machine for coining die

This innovative method leverages the precision of laser technology to etch intricate relief patterns and designs onto the die's surface. Guided by digital instructions and precise coordinates, CNC-controlled laser engraving machines offer unparalleled accuracy, repeatability, and flexibility in producing coining dies of exceptional quality. The benefits of laser engraving in coining die production are multifaceted. Firstly, it allows for the creation of highly detailed and fine relief designs with remarkable intricacy, which is particularly advantageous for crafting coins and medallions that demand intricate artwork. Additionally, laser engraving is a non-contact process, reducing wear and tear on the machinery and extending its operational lifespan.



Figure 7. A view of laser engraving using CNC machine

■ Manual polishing of coin dies

Manual polishing of coin dies is a fundamental and meticulous process within the coin minting industry. Coin dies are essential components responsible for imprinting intricate designs and details onto coins. The quality of these dies directly affects the final appearance and precision of the coins produced. In the world of coin minting, manual polishing of coin dies is a labor-intensive yet indispensable process. It ensures that coin dies maintain their quality and longevity, ultimately leading to the production of coins with sharp and well-defined designs. While automation has made strides in this field, the artistry and skill of manual polishing remain integral to achieving exceptional coin quality.



Figure 8. Manual polishing of coin dies

■ The heat treatment of coin dies

The heat treatment of coin dies represents a critical metallurgical process integral to the enhancement of their durability and performance within the coin minting process. This procedure involves a series of carefully controlled heating and cooling cycles, each meticulously calibrated to achieve specific metallurgical transformations and desired mechanical properties.

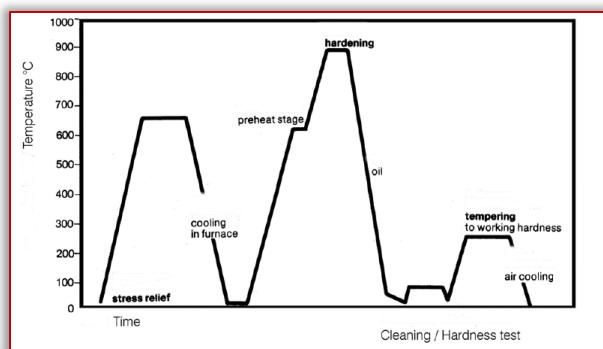


Figure 9. K 455 steel heating and tempering diagram

■ Hard chromium plating of coin dies

An electroplating procedure is systematically employed to administer a deposition of hard chromium onto the die's surface. This strategic intervention serves a twofold purpose: the mitigation of wear during the coining process and the consequential extension of the operational lifespan of the dies.



Figure 10. A view of the chrome plating process of the dies

■ Blanking process

To begin with, within the minting facility, an alloy material is cast and subsequently processed through rolling operations to achieve the desired thickness. Subsequently, blanks are meticulously cut from the rolled metal alloy. These alloys typically comprise a blend of base

metals, and their composition undergoes rigorous and precise control measures.

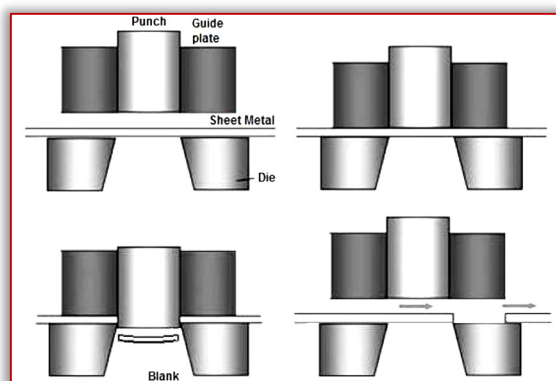


Figure 11. Punching of blanks used to obtain coins

The amount of cutting clearance between the punch and the die is of great importance in all sheet metal work. It is usually given as a percentage of the thickness of cut material, as shown in the next Table.

Table 1. The tolerance of the cutting space between the punch and the cutting die depending on the thickness of the cut material

Material	Hardness HV	Clearance as a % of thickness
Mild Steel	94-144	5-10
70/30 Brass	77-110	0-10
Copper	64-93	0-10
Zinc	61	0-5
Aluminum	21-28	0-5

During the rolling, work hardening is naturally applied to the blank metal. Before the coinage, the blanks need to be softened slightly in a furnace by bring blanks up to a certain temperature and then cooling them again. This provides metal to relieve thermal stresses. After annealing, the blanks are burnished to make their surface brighter, remove any discoloration and in some cases apply a minute amount of lubricant to assist in coining. In the burnishing machine, surfaces of blanks are etched and polished by tumbling inside a mixture of small steel balls and ceramic media combined with special chemicals. After burnishing, the blanks are dried with hot air.

The volume of the metal and the volume of the enclosure between the dies when they are confined should remain the same. Excessive loads that developed inside the dies do not damage the press and dies themselves unless the metal volume exceeds the space between upper and lower dies when closed. In order to ensure that volume of the blank remain constant, the weight, which is easily measured and converted to volume should be carefully controlled.

Coining is a metal forming process that cannot be considered as a simple process because the process can be characterized by entirely 3-D material deformation and continuously changing boundary conditions.

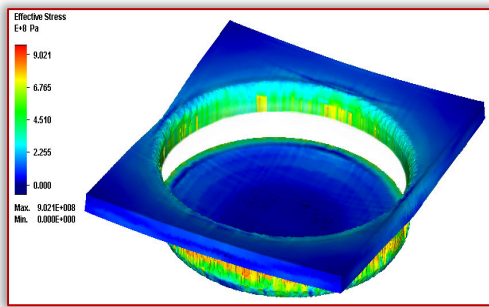


Figure 12. Effective Stress Distribution for Blanks

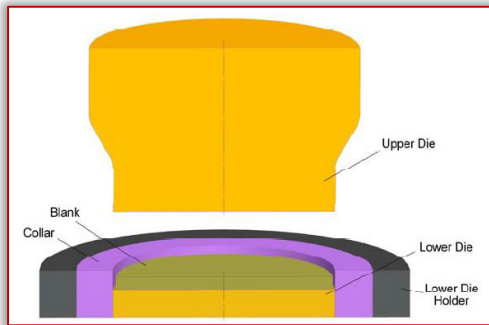


Figure 13. A simulation of the process of pressing a coin

Therefore, production of a full solution requires experienced and challenging people who perform the simulation in relatively short calculation times. In order to predict the flow of metal, stress, strain and temperature distributions, accurate and robust algorithms are required.



Figure 14. Effective Stress Distribution in the coin with a Diameter of 89mm

After both of the upper and lower dies are mounted, alignment of them is checked with few test shots when the press is in unloaded position.



Figure 15. A view of Assembled Upper Die Set

After it is ensured that the alignment of the upper and lower dies is done appropriately, the upper die set is brought to the upper dead centre so that shut height can be adjusted for the coining process.



Figure 16. A view of Die Sets before the Coinage

Taking into consideration that the diameter and weight of a coin are predetermined prior to the commencement of the design phase, the thickness of the semi-finished coin blanks is meticulously calculated using specialized 3D software. This calculation is aimed at ensuring that an adequate quantity of material is utilized, thereby facilitating the faithful replication of all intricate details incorporated into the coin's design.

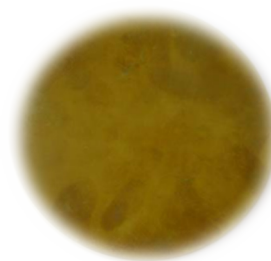


Figure 17. Circular Blanks before minted

The blank is carefully placed within the lower supporting die, a pivotal step in the coin minting process that initiates the transformation of the blank into a finished coin. This precise positioning is fundamental, as it ensures that the blank aligns perfectly within the die, setting the stage for subsequent operations that will impart the coin's unique design and features.



Figure 18. A view of the Blank on the Lower Supporting Die

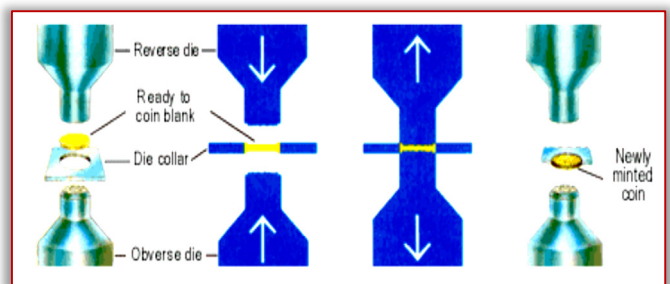


Figure 19. The process of punching blanks and pressing coins



Figure 20. Minted coin

Following the coining process, a meticulous assessment of both the design and technical specifications is undertaken. This post-production evaluation is crucial to ensure that the minted coins meet the intended standards and that all aspects, from the visual elements to the precise technical details, adhere to the desired criteria.

■ The importance of technical analysis of the evolution of coin and medal minting

The importance of conducting a technical analysis of the evolution of coin and medal minting methods lies in its multifaceted significance across various domains, including history, technology, artistry, economics, and environmental sustainability. Here are several key reasons highlighting the importance of such an analysis:

- Preservation of Cultural Heritage: Coinage and medals serve as important artifacts reflecting the cultural, historical, and political contexts of their times. Analyzing the evolution of minting methods helps preserve and understand the cultural heritage of civilizations through the ages.
- Advancement of Technology: The evolution of minting methods parallels technological progress. Studying these developments provides insights into how societies have advanced in metallurgy, machinery, and automation, which can have broader applications beyond numismatics.
- Artistic Expression: Coins and medals are often miniature works of art, featuring intricate designs and engravings. A technical analysis helps in appreciating the artistic aspects of these pieces, shedding light on the skill and creativity of craftsmen throughout history.
- Economic Significance: Coins are integral to economies. Changes in minting methods impact currency production efficiency, costs, and the quality of coins in circulation. Understanding these changes can provide valuable economic insights.
- Numismatic Research: Numismatists and collectors rely on technical details to authenticate, classify, and value coins and medals. An in-depth analysis aids collectors in accurately assessing the historical and numismatic value of their holdings.
- Security and Counterfeiting: Advances in minting techniques, such as incorporating security features, play a vital role in combating counterfeiting.

Understanding these security measures is crucial for maintaining the integrity of currencies and collectibles.

- Environmental Considerations: In the modern era, sustainability is a growing concern. Examining the environmental impact of coin and medal production, as well as exploring sustainable practices, is essential for responsible numismatic manufacturing.
- Education and Outreach: Research on the evolution of minting methods can serve as a valuable educational resource. It helps engage students, historians, and the general public in understanding the complexities of coin and medal production.
- Collector and Investor Knowledge: Collectors and investors in numismatics rely on information about minting methods to make informed decisions. Understanding the technical aspects can guide investment strategies and ensure the acquisition of high-quality coins.
- Interdisciplinary Insights: The analysis of minting methods bridges multiple disciplines, including history, engineering, art, and economics. Such interdisciplinary exploration fosters a holistic understanding of the subject matter.

In summary, a technical analysis of the evolution of coin and medal minting methods is essential for preserving cultural heritage, advancing technology, appreciating artistry, understanding economic implications, supporting numismatic research, enhancing security measures, promoting sustainability, facilitating education, aiding collectors and investors, and fostering interdisciplinary insights. It enriches our understanding of history, technology, and art while addressing contemporary concerns like sustainability and security.

■ Advanced research on technical analysis of coin and medal

Certainly, in this studies are some key contributions and developments related to the technical analysis of the evolution of coin and medal minting:

- Advanced Metallurgical Techniques: Recent advancements in metallurgy have allowed for the use of new and innovative coin and medal materials. These materials offer improved durability, resistance to wear, and unique aesthetic qualities. For example, the use of bi-metallic or polymer-based coins has become more common in many countries.
- 3D Printing and Additive Manufacturing: The adoption of 3D printing and additive manufacturing technologies has opened up new possibilities for coin and medal design and production. These technologies enable the creation of highly intricate and customizable designs with great precision.

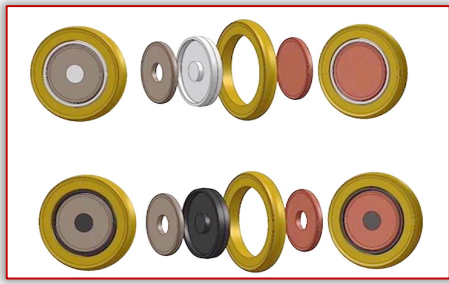


Figure 21. Various combinations through different geometries and material selections of the separators as well as the inserts

— Digital Engraving and Design Software: The use of digital engraving tools and design software has become prevalent in the minting industry. This allows for the creation of detailed and intricate designs that were once difficult or impossible to achieve using traditional methods.

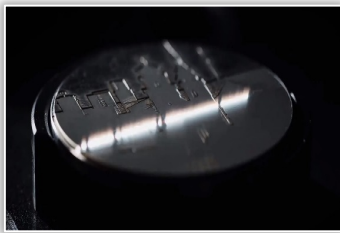
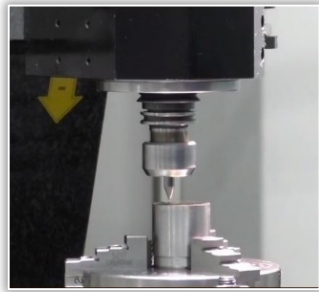


Figure 22. Application of electronic files for the production of moulds using CNC machines

— Anti-Counterfeiting Measures: With the rise of sophisticated counterfeiting techniques, there has been a significant focus on integrating advanced security features into coins and medals. These include microprinting, holograms, color-changing inks, and other covert security features that are challenging for counterfeiters to replicate.



Figure 23. security features using laser micro-engraving

— Minting Automation: Automation has continued to advance, allowing for faster and more efficient coin and medal production. High-speed coin presses, robotics,

and automated quality control systems have become integral to modern mints.

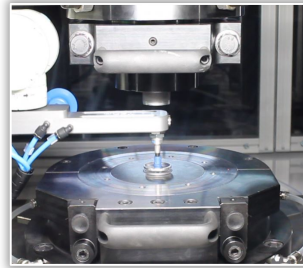


Figure 24. Automation of coin pressing using robot arm

— Digital Minting Technologies: Some mints have embraced fully digital minting processes, where coins and medals are designed, produced, and stored digitally. This allows for greater flexibility, reduced lead times, and the ability to create on-demand or limited-edition pieces.

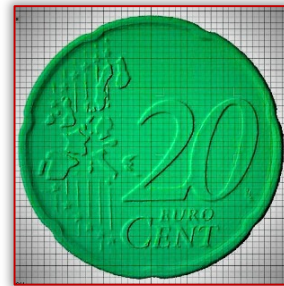


Figure 25. 3D inspection of coins using 3D optical scanning

— Sustainability and Responsible Sourcing: Increasing awareness of environmental concerns has prompted mints to adopt more sustainable practices. This includes responsible sourcing of materials, recycling, and reducing energy consumption in the minting process.

— Virtual Mint Tours: Mints and numismatic organizations have leveraged technology to offer virtual mint tours and interactive online platforms. These initiatives provide enthusiasts and collectors with insights into the minting process from the comfort of their homes.

— Research and Documentation: Ongoing research and documentation efforts aim to catalog and preserve the history of coin and medal production techniques. This includes the creation of archives, databases, and reference materials for researchers and collectors.

— Education and Outreach: Mints and numismatic organizations are actively engaged in educational outreach, including workshops, seminars, and online resources. This helps disseminate knowledge about coin and medal minting techniques to a wider audience.

These contributions reflect the dynamic nature of the coin and medal minting industry, where technology, craftsmanship, and innovation continue to shape the way coins and medals are produced and appreciated. As technology advances and new challenges arise, the field of numismatics adapts and evolves, ensuring the

continued relevance and fascination of coin and medal collecting.

CONCLUSIONS

The evolution of coin production, from manual coin pressing to the utilization of CNC machines and CAD software, represents a significant transformation in the numismatic industry. Several noteworthy conclusions can be drawn from this evolution:

- Precision and Consistency: The transition from manual coin pressing to CNC machines and CAD software has ushered in an era of unparalleled precision and consistency in coin production. CNC machines can execute intricate designs with pinpoint accuracy, resulting in coins that adhere to exacting specifications.
- Complexity of Designs: CAD software has revolutionized coin design by allowing for the creation of highly intricate and detailed coin motifs that were previously challenging to achieve through manual methods. This has expanded the creative possibilities for coin designers.
- Efficiency and Speed: CNC machines have drastically reduced production times, enabling the rapid minting of coins in comparison to manual techniques. This increased efficiency can be particularly advantageous in meeting high demand.
- Customization and Personalization: The integration of CAD software and CNC machines has made it easier to customize and personalize coins. This is valuable for creating commemorative coins, special editions, or coins for specific events or individuals.
- Quality Control: The use of CNC machines allows for precise quality control throughout the coin production process. Imperfections and defects can be identified and rectified more efficiently, resulting in a higher standard of finished coins.
- Reduced Wear and Tear: CNC machines are less physically taxing on the dies, as they do not require the forceful manual pressing used in traditional methods. This reduction in wear and tear can extend the lifespan of coin dies.
- Technological Advancements: The adoption of CNC machines and CAD software reflects the broader trend of incorporating advanced technology into traditional industries. It showcases how technology can enhance age-old practices while preserving the artistry and craftsmanship associated with coin production.
- Historical Continuity: Despite these technological advancements, coin production retains its historical significance and cultural importance. Modern methods pay homage to the time-honored traditions of coin minting while embracing contemporary tools and techniques.

It can be said, the shift from manual coin pressing to the integration of CNC machines and CAD software marks a pivotal moment in the evolution of coin production. It has brought forth improved precision, efficiency, and creative possibilities, ensuring that coins continue to play a vital role in our society while adapting to the demands of the modern world.

In summary, the technical analysis of the evolution of coin and medal minting methods offers a fascinating journey through time, uncovering the intricate and multifaceted aspects of this age-old craft. From the rudimentary techniques of ancient civilizations to the cutting-edge technologies of the modern era, the study of coin and medal minting methods reveals a rich tapestry of innovation, artistry, and historical significance. Throughout history, coins and medals have served as tangible symbols of culture, power, and economic exchange. Their production methods have mirrored the advancements in technology, metallurgy, and design capabilities of each era. This analysis has illuminated several key findings:

- Historical Significance: Coins and medals are invaluable artifacts that provide invaluable insights into the history and culture of the societies that produced them. The evolution of minting methods parallels the rise and fall of civilizations, making it an indispensable field of study for historians and archaeologists.
- Technological Advancements: From hand-struck coins of antiquity to the precision of modern digital engraving and computer-aided design, the technical sophistication of coin and medal production has continuously evolved. Innovations such as coin presses, automation, and security features have transformed the industry.
- Artistic Expression: The artistry in coin and medal design has flourished over the centuries. Engravings, motifs, and intricate details reflect the artistic sensibilities and cultural influences of their time. Technical advancements have enabled greater artistic freedom and complexity in design.
- Economic Implications: Coinage has played a pivotal role in economies worldwide. Understanding the evolution of minting methods provides insights into the economic stability and challenges faced by societies. It also underscores the importance of efficient, reliable, and secure coin production.
- Environmental Responsibility: The contemporary minting industry recognizes the need for sustainable and responsible practices. This includes ethical sourcing of materials, eco-friendly production methods, and minimizing the environmental footprint of coin and medal minting.

— Numismatic Insights: For numismatists and collectors, technical analysis is essential for authenticating, grading, and valuing coins and medals. It aids in distinguishing genuine pieces from counterfeits and contributes to a deeper appreciation of their collections.

— Interdisciplinary Nature: The study of coin and medal minting methods spans multiple disciplines, from history and metallurgy to engineering and art. It showcases the interconnectedness of these fields in preserving and understanding our past.

In an ever-evolving world, the technical analysis of coin and medal minting methods serves as a bridge between tradition and innovation. It not only preserves our cultural heritage but also propels us forward into the future, where new materials, technologies, and environmental considerations continue to shape the fascinating world of numismatics. As we continue to uncover the secrets of the past through the lens of minting techniques, we are reminded that the story of coins and medals is a testament to human creativity, adaptability, and the enduring value of history.

Acknowledgement

This work has been funded by the European Social Fund from the Sectoral Operational Programme human Capital 2014–202, through the Financial Agreement with the title “Training of PhD students and postdoctoral researchers in order to acquire applied research skills–SMART”, Contract no. 13530/16.06.2022–SMIS code:153734.

References:

- [1] Library.oopen.org, (2019). Money and Coinage in the Middle Ages [online] Available at: <https://library.oopen.org/bitstream/handle/20.500.12657/24386/1005729.pdf?sequence=1&isAllowed=y> [Accessed 2.11.2022]
- [2] Colcestreasurehunting.co.uk. Identifying British coinage. [online] Available at: <http://www.colchestertreasurehunting.co.uk/c/coinhistory.htm> [Accessed 3.11.2022]
- [3] Muzeydeneg.ru. Coin minting technique [online] Available at: <http://muzeydeneg.ru/research/tehnika–chekanki–monet–ch–3–stanochnaya–chekanka–testonov–i–talerov/> [Accessed 3.11.2022]
- [4] Vsemedali.ru. A Brief Essay on the History of Medal Art [online] Available at: <http://vsemedali.ru/books/item/f00/s00/z0000000/st003.shtml> [Accessed 1.11.2022]
- [5] Romancoins.info. Roman Numismatic Gallery [online] <http://www.romancoins.info/Lydia600BCELTrite.jpg> [Accessed 1.11.2022]



ISSN: 2067-3809

copyright © University POLITEHNICA Timisoara,
Faculty of Engineering Hunedoara,
5, Revolutiei, 331128, Hunedoara, ROMANIA
<http://acta.fih.upt.ro>