TSUE TASHKENT STATE UNIVERSITY OF ECONOMICS

International journal of topics

INNOVATION SCIENCE AND TECHNOLOGY

Scopus || Electronic journal specializing in Scopus

ISSUE 4

Acceptance of papers **April, 2026**

Acceptance of papers

Published monthly

Topics

economics, technology, social sciences

ISSN 3060-5229

Electronic publication, Issue 4. 260 pages.
Approved for publication on April, 2026.

THE SCIENTIFIC-POPULAR ELECTRONIC JOURNAL **"INNOVATION SCIENCE AND TECHNOLOGY"** HAS BEEN REGISTERED UNDER THE NUMBER **C-5669633** BY THE AGENCY FOR INFORMATION AND MASS COMMUNICATIONS (AOKA) OF THE REPUBLIC OF UZBEKISTAN, EFFECTIVE FROM OCTOBER 9, 2024.

CONTACTS

Phone: **+998 50 737 87 88**

Website: https://ist-journal.uz

Email: innovationist2025@gmail.com

The scientific electronic journal “Innovation Science and Technology” has been included in the list of scientific publications recommended for the publication of main scientific results of dissertations for the award of PhD and DSc degrees in economics and technical sciences, in accordance with the Resolution No. 370 of the Presidium of the Higher Attestation Commission of the Republic of Uzbekistan, dated May 8, 2025.

Editorial board:

CONTENTS

CONTENTS

CONTENTS

EVOLUTION AND STANDARDIZATION OF SI MEASUREMENT UNITS IN THE INTERNATIONAL SYSTEM

Maxmudov Dostonbek Soyibjon o'g'li
Trainee Lecturer at Andijan Institute of Technology
xarakternemes@gmail.com

Abstract: This article explores the evolution and standardization of measurement units within the International System of Units (SI). It examines the historical development of measurement systems from traditional and inconsistent local units to a unified global standard that ensures accuracy, consistency, and comparability in scientific and industrial practices. The study highlights the key stages in the formation of the SI system, including the adoption of base units, international agreements, and the continuous refinement of definitions based on advanced scientific research. Special attention is given to the role of international organizations in maintaining and updating SI standards in response to technological progress. The article also discusses the importance of standardization in promoting global scientific communication and technological development.

Key words: international System of Units (SI), measurement units, standardization, metrology, evolution, base units, scientific measurement, calibration, international standards, precision.

INTRODUCTION

The evolution and standardization of measurement units within the International System of Units (SI) is one of the most important achievements of modern science, ensuring precision, consistency, and universality in scientific, technical, and industrial communication. Historically, different regions and countries used their own measurement systems, which often led to confusion, inconsistency, and difficulties in international trade and scientific research. The need for a unified system became increasingly urgent with the development of global science and technology.

In response to this need, the International System of Units (SI) was established and gradually refined through international agreements and scientific cooperation. Today, SI units are recognized as the universal standard for measurement in almost all fields of science and engineering. Their development reflects continuous scientific progress and the collective efforts of the international community to ensure accuracy and comparability of measurements across the world.

In Uzbekistan, the importance of adopting and strengthening the SI system has been emphasized within the framework of national reforms aimed at modernizing education, science, and industry. In particular, presidential decrees and governmental decisions on improving the quality of education, developing scientific research, and integrating into the global scientific space highlight the necessity of using international standards, including SI units, in academic and practical activities. These reforms support the development of metrological literacy among specialists and students, ensuring their competitiveness in the global environment.

From a scientific perspective, the SI system is based on clearly defined base units such as the meter, kilogram, second, ampere, kelvin, mole, and candela. Over time, these units have been redefined using advanced physical constants to increase precision and reliability. This evolution demonstrates the transition from physical artifacts to universal constants, marking a significant milestone in metrology. Therefore, studying the evolution and standardization of SI units is essential not only for understanding the history of measurement systems but also for analyzing their role in modern scientific development, international cooperation, and national progress.

LITERATURE REVIEW

The publication of the International Bureau of Weights and Measures (BIPM), known as the SI Brochure, is the most authoritative source on the International System of Units. This document provides a comprehensive overview of the structure, definitions, and updates of SI units. It explains the historical development of measurement units and highlights the transition from physical prototypes to fundamental physical constants [1].

The brochure also emphasizes the importance of global standardization in ensuring measurement consistency across scientific, industrial, and educational fields. In the context of this research, the BIPM document serves as a foundational reference for understanding the official structure and continuous evolution of the SI system.

Terry Quinn's work focuses on one of the most significant changes in the SI system—the redefinition of the kilogram. The study explains the historical reliance on physical artifacts, such as the International Prototype Kilogram, and the modern shift toward defining units based on physical constants [2].

The author highlights the scientific necessity of improving accuracy and stability in measurement standards. This source is particularly relevant for understanding the broader evolution of SI units, as it demonstrates how scientific advancements lead to the continuous refinement of international standards. It also illustrates the role of metrology in supporting technological progress and global scientific cooperation.

The reviewed literature shows that the evolution of SI units is driven by the need for higher precision, universality, and scientific reliability. Both sources emphasize the transition from traditional measurement systems to modern definitions based on fundamental constants, which is essential for global standardization.

RESEARCH METHODOLOGY

This study on the evolution and standardization of SI measurement units is based on a systematic and analytical research approach aimed at examining both the historical development and modern scientific transformations in metrology. The methodological framework combines theoretical analysis, comparative study, and documentary research to ensure a comprehensive understanding of the topic.

First, a historical analysis method is applied to trace the development of measurement systems from traditional local units to the establishment of the International System of Units (SI). This allows for identifying the key stages in the evolution of measurement standards and understanding the reasons behind the transition toward a unified global system.

Second, a comparative analysis method is used to examine differences between earlier measurement systems (based on physical artifacts and regional standards) and the modern SI system, which is based on fundamental physical constants. This method helps highlight the advantages of standardization in terms of accuracy, universality, and scientific reliability.

Third, a document analysis method is employed to study official materials, including publications from the International Bureau of Weights and Measures (BIPM), ISO standards, and scientific literature in metrology. These sources provide reliable data regarding definitions, updates, and international agreements related to SI units.

Additionally, a synthesis method is used to integrate findings from different sources and form a coherent understanding of the evolution and standardization process. This ensures that the study not only describes historical facts but also interprets their scientific significance.

Overall, the methodological approach of this research ensures a structured and objective analysis of the SI system, its development, and its role in modern science and global standardization.

ANALYSIS AND RESULTS

The International System of Units (SI) plays a fundamental role in modern science, industry, and everyday life. Its standardized nature ensures accuracy, consistency, and global compatibility of measurements across different disciplines.

One of the most important areas of application is engineering and manufacturing, where precise measurements are essential for designing safe, efficient, and high-quality products. In engineering processes, SI units are used to define dimensions, force, pressure, energy, and electrical parameters. For example, when designing mechanical structures or electronic devices, engineers rely on SI-based calculations to ensure that all components fit and function correctly. Even a small measurement error can lead to structural or technical difficulties, which highlights the importance of SI standardization in this field.

In laboratory and scientific research environments, SI units are crucial for ensuring measurement accuracy and reproducibility of experimental results. Laboratories around the world use SI-based instruments and calibration systems to maintain consistency in physical, chemical, and biological experiments. For instance, measurements of temperature in kelvin, mass in kilograms, and time in seconds allow scientists to compare results globally without discrepancies. This standardization also supports international collaboration in research, where data must be reliable and universally understandable.

In the field of medicine and pharmacy, SI units are especially important for ensuring patient safety and treatment effectiveness. Accurate dosage calculation of medicines depends on standardized units such as milligrams, milliliters, and micrograms. Even a minor deviation in measurement can affect treatment outcomes. For example, precise SI-based measurements are used in determining drug concentrations, infusion rates, and laboratory test results. This ensures that medical treatments are both safe and effective across different healthcare systems worldwide.

Overall, SI units are essential in medical dosage accuracy, engineering design, laboratory research, and industrial production. Their universal application ensures that scientific and technical activities are conducted with a high level of precision, reliability, and international compatibility.

The analysis of the evolution and standardization of the International System of Units (SI) shows that the development of measurement standards has significantly improved the accuracy, consistency, and universality of scientific measurements worldwide. Historical evidence indicates that earlier measurement systems were fragmented and varied across regions, which often led to errors in scientific communication, trade, and industrial production. The transition to the SI system resolved many of these issues by introducing a unified and internationally accepted framework.

One of the most important findings of this study is the gradual shift from artifact-based definitions of units to definitions based on fundamental physical constants. For example, the kilogram was once defined by a physical prototype, but in modern metrology it is defined using the Planck constant. This transition has increased measurement stability and reduced long-term inconsistencies caused by physical changes in reference objects [3].

Statistical data from international metrology reports show a continuous improvement in measurement precision after SI standardization reforms. The adoption of updated SI definitions in 2019 marked a major milestone, improving precision in fields such as physics, chemistry, engineering, and information technology.

Another important result is the increasing global adoption of SI units. Today, more than 95% of countries officially use the SI system in science, education, and industry, which demonstrates its universal acceptance and effectiveness [4] (Table 1).

Table 1. Evolution and Impact of SI Standardization[1]

Period	Key Development	Basis of Measurement	Impact on Accuracy
Before 1799	Local measurement systems	Human-based / regional standards	Low (inconsistent results)
1799–1875	Metric system introduction	Physical artifacts	Moderate improvement
1875–1960	International Metric Convention	Standard prototypes	High stability, but still limited
1960–2018	SI system establishment	Physical constants + artifacts	High accuracy and global use
2019–Present	Redefinition of SI units	Fundamental physical constants	Very high precision and stability

The results clearly indicate that the SI system has undergone significant transformation, evolving from inconsistent regional systems into a highly precise and globally standardized framework. The use of fundamental constants has greatly improved measurement reliability. Furthermore, international cooperation through organizations such as BIPM has ensured the continuous updating and refinement of the system. Overall, the findings confirm that SI standardization plays a crucial role in supporting scientific progress, technological innovation, and global communication in modern metrology.

CONCLUSION AND RECOMMENDATIONS

The study of the evolution and standardization of the International System of Units (SI) demonstrates that the development of a unified measurement system is one of the most significant achievements in modern science and metrology. The transition from diverse local measurement systems to a globally accepted SI framework has ensured higher accuracy, consistency, and comparability of scientific and industrial data.

The analysis shows that the replacement of physical artifacts with fundamental physical constants has greatly improved the stability and reliability of measurements. This shift has reduced many limitations of earlier systems and created a more precise foundation for scientific research and technological development.

Furthermore, the widespread adoption of the SI system has strengthened international scientific communication and cooperation. Today, SI units are universally used in education, engineering, industry, and research, which confirms their global importance and effectiveness.

1 author's development

In conclusion, the continuous evolution of SI units reflects the advancement of science and the increasing need for precision in measurement. The standardization process not only supports scientific progress but also plays a key role in global integration and technological innovation.

REFERENCES

1. BIPM. The International System of Units (SI Brochure, 9th edition). International Bureau of Weights and Measures, 2019.
2. Quinn, T. J. From Artefacts to Atoms: The Changing Definition of the Kilogram. Springer, 2012.
3. Taylor, B. N., & Thompson, A. The International System of Units (SI). NIST Special Publication, 2008.
4. Mills, I. M., et al. “Redefinition of the SI Base Units.” Metrologia, 2011.
5. Mohr, P. J., Newell, D. B., & Taylor, B. N. “CODATA Recommended Values of the Fundamental Physical Constants.” Reviews of Modern Physics, 2016.
6. Soyibjon o‘g‘li, M. D., & Shavkatbek, E. (2026). “Investitsiya loyihalarida xavflarni kamaytirishda iso 31000 dan foydalanish.” Yangi Renessansda Ilm-Fan Taraqqiyoti, 1(4), 174–180.
7. Soyibjon o‘g‘li, M. D. (2025, December). “Sanoat korxonalarida raqamli metrologiya joriy etilishining mahsulot sifati va eksport salohiyatiga ta’siri.” In Conference of Modern Science & Pedagogy (Vol. 1, No. 9, pp. 384–389).
8. Soyibjon o‘g‘li, M. D. (2025). “Challenges in implementing international standards in enterprises and strategies to overcome them.” Shokh Library, 1(13).

Proofreader: Zokir ALIBEKOV

Layout and Designer: Oloviddin Sobir ugli

2026. № 4

To publish articles in this journal, you may submit articles, advertisements, stories, and other creative materials through the following links. Materials and advertisements are published on a paid basis.

You may subscribe to the journal at any time using the following details. Once subscribed, please send a screenshot or photo of your payment confirmation to our Telegram page @iqtisodiyot_77. Based on this, we will send the latest issue of the journal to your address each month.

“The journal “INNOVATION SCIENCE AND TECHNOLOGY” has been registered by the Agency for Information and Mass Communications under the Administration of the President of the Republic of Uzbekistan from 09.10.2024 under the registration number №390637. License number: C-5669633. PNFL: 30407832680027

Our address: Tashkent city, Yunusobod district, 19th block, House 17.

TASHKENT STATE UNIVERSITY OF ECONOMICS

Google Scholar · OPEN ACCESS · ULRICHSWEB GLOBAL SERIALS DIRECTORY · Academic Resource Index ResearchBib · ISSN INTERNATIONAL STANDARD SERIAL NUMBER INTERNATIONAL CENTRE · CYBERLENINKA · OpenAIRE · ROAD · НАУЧНАЯ ЭЛЕКТРОННАЯ БИБЛИОТЕКА eLIBRARY.RU · BASE · INDEX COPERNICUS INTERNATIONAL · Crossref · doi Digital Object Identifier · CiteFactor Academic Scientific Journals · zenodo

Acceptance of articles

Published every monthly

Directions

Social, economic, political, technological, scientific

Scopus || Scientific electronic journal specializing in Scopus

CERTIFICATE NUMBER: №390637

ORDER NUMBER ACCORDING TO THE LICENSE REGISTER: C-5669633

CONTACT:

Contact us
+998 50 737 87 88

Telegram channel
t.me/scopus_IST2100

Journal official website
https://ist-journal.uz/index.php/IST