

## **ВІДГУК РЕЦЕНЗЕНТА**

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на дисертаційну роботу **HAN YAFENG**

**«DEVELOPMENT OF INTEGRATED E-WASTE MANAGEMENT SYSTEM BASED ON RESOURCE-SAVING IN CHINA»**,

подану на здобуття ступеня доктора філософії  
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**Relevance of the topic of the dissertation.** In the wake of rapid advancements in science and technology, the pervasive integration of electronic products into daily life has become increasingly pronounced. However, the recycling practices for electronic waste in China remain non-standardized, leading to suboptimal disposal practices and significant adverse repercussions for both the environment and society. Given the imperative to foster a circular economy, it becomes paramount to establish effective recycling mechanisms that mitigate the detrimental impact of electronic waste. The pressing need for such initiatives has underscored the rationale behind selecting this research topic, defining its purpose, and delineating its objectives. This study is positioned to contribute by elucidating the theoretical and methodological underpinnings of an integrated e-waste management system, aligning with the fundamental principles of China's circular economy model while leveraging digital technologies.

**Connection of work with scientific programs, plans, topics.** This research was conducted under the auspices of the Erasmus+ Programme of the European Union, as part of the project "Towards Circular Economy Thinking & Ideation in Ukraine According to the EU Action Plan" (grant number 620966-EPP-1-2020). The focus of this dissertation aligns with the foundational principles articulated in significant policy frameworks, including "The 2030 Agenda for Sustainable Development" (Resolution

70/1 of the UN General Assembly), the "European Green Deal" (Announcement of the European Commission in 2019), the "Sustainable Development Strategy of Ukraine until 2030" (draft No. 9015 of 07.08.2018), and "China's National Plan on the Implementation of the 2030 Agenda for Sustainable Development" (Announcement of the Chinese government in 2019).

**The scientific novelty of the obtained results** consists in utilizing digital technologies in e-waste management system in China based on implementation circular economy strategies.

The dissertation contributes novel insights and advancements in the following key areas:

**Scientific and Methodological Approach for Urban E-Waste Management:**

- A pioneering scientific and methodological approach has been introduced to formulate a comprehensive system for urban e-waste management. This approach is designed to facilitate the adoption of Circular Economy (CE) principles through the integration of digital technologies and an intelligent recycling system. Emphasis is placed on formalizing the recycling processes of electronic waste, addressing a critical aspect of sustainable urban development.

**Conceptual Framework for Digitally Enabled Circular Economy:**

- The existing conceptual framework for a digitally enabled circular economy has been enhanced, focusing on the entire product life cycle. Unlike previous models, this framework incorporates various Industry 4.0 Digital Technologies (DTs) across all stages of the product life cycle. This augmentation accelerates the transition towards a Circular Economy by leveraging cutting-edge technologies throughout the entire life cycle of products.

**Evaluation Index System for City-Level Circular Economy Development:**

- A novel evaluation index system has been proposed to assess the level of Circular Economy development at the city level. Distinguished from previous models, this system comprises 17 indicators categorized into three dimensions: economy, resources, and environment. The evaluation metrics include economic strength, economic efficiency, resource reduction, pollution reduction, and reuse and recycling. This comprehensive system provides a nuanced and holistic perspective on Circular Economy progress.

#### **Intelligent Logistics and Recycling System for E-Waste Management:**

- An innovative intelligent logistics and recycling system has been developed for the management of electronic waste in the city of Xinxiang. This system, featuring a three-tier structure with community collection points, regional collection stations, and regional collection centers as its core, surpasses existing models. It establishes a new paradigm for intelligent and comprehensive recycling systems, characterized by strategic layout and extensive coverage.

#### **Advancements in Smart E-Waste Recycling Research:**

- Substantial progress has been achieved in academic research related to smart e-waste recycling in China. The dissertation systematically structures the state-of-the-art smart e-waste recycling solutions from commercial and emerging technology companies. Through an extensive literature review, key challenges have been identified, and countermeasures are proposed for the future development of smart e-waste management.

#### **Economically Incentivized Smart E-Waste Recycling System:**

- A systematic compilation of scientifically justified economic incentives has been presented for the smart e-waste recycling system. Aligned with

legal requirements in China's regulatory landscape, these incentives are designed to encourage consumer engagement with the smart e-waste recycling platform. This innovative approach seeks to drive sustainable practices in electronic waste disposal.

In summary, these contributions collectively elevate the understanding and operationalization of sustainable e-waste management, fostering advancements in both theoretical frameworks and practical applications within the context of Circular Economy principles and digital technologies.

**The dissertation holds significant scientific and practical implications,** particularly in the realm of enhancing e-waste management practices within urban settings. The practical relevance of this research extends beyond academia, making noteworthy contributions to the strategic decision-making processes of city policymakers, managers, and researchers alike. The following key aspects highlight the substantial practical significance of the dissertation:

1. Urban Transformation and Development of Urban Smartness:

- The research outcomes offer valuable insights for city policymakers and managers aiming to spearhead urban transformation initiatives. By integrating resource-saving principles and Digital Technologies (DTs), the dissertation provides actionable recommendations for the development of urban smartness. Policymakers can leverage this knowledge to enhance the sustainability and efficiency of urban systems.

2. Implementation of Circular Economy Principles:

- The dissertation serves as a practical guide for the implementation of Circular Economy (CE) principles in urban areas. City policymakers can draw upon the research findings to formulate and implement strategies that align with resource-saving practices. This includes the effective integration of digital technologies to optimize resource utilization and

minimize environmental impact.

### 3. Practical Reference for Researchers and Managers:

- The dissertation contributes a wealth of practical knowledge that serves as a reference for both researchers and managers involved in the field of e-waste management. The insights gained from this study offer a foundation for further research endeavors and provide managers with practical tools and strategies to navigate the complexities of e-waste management in a rapidly evolving technological landscape.

### 4. Optimizing the Potential of Digital Technologies:

- By highlighting the role of Digital Technologies in supporting Circular Economy transition, the dissertation offers practical guidance on harnessing the potential of DTs. City managers and decision-makers can leverage this information to implement digital solutions that streamline e-waste management processes, enhance efficiency, and contribute to the overall sustainability goals of the city.

### 5. Implementation in Henan Institute of Science and Technology:

- The tangible impact of the dissertation is exemplified by its successful implementation in the activities of Henan Institute of Science and Technology. The institution has incorporated the research findings into the development of an electronic waste management system, showcasing the direct translation of theoretical insights into real-world applications.

In conclusion, the practical significance of the dissertation is evident in its ability to inform and guide urban development, empower decision-makers with effective strategies, and facilitate the implementation of resource-saving practices and Digital Technologies in e-waste management. The incorporation of research outcomes into the activities of Henan Institute of Science and Technology underscores the direct and practical applicability of the study's findings.

**Publication of obtained results.** The main provisions of the dissertation are published in 9 scientific publications, including subsections in 1 book; 2 articles in scientific professional publications of Ukraine, which are included in international scient metric databases, 2 articles in a foreign publication indexed by the Scopus and Web of Science databases, the rest are conference proceedings.

Scientific works reflecting the main scientific results of the dissertation:

1. **Han, Y.**, Shevchenko, T., Yannou, B., Ranjbari, M., Shams Esfandabadi, Z., Saidani, M., Bouillass, G., Bliumska-Danko, K., & Li, G. (2023). Exploring How Digital Technologies Enable a Circular Economy of Products. *Sustainability*, 15(3), 2067. <https://doi.org/10.3390/su15032067> (Scopus, Web of Science).

2. **Han, Y.**, & Shevchenko, T. (2021). Exploring incentive mechanism in smart E-waste management system in China. *Bulletin of Sumy National Agrarian University*. 4(90), 50-59. <https://doi.org/10.32845/bsnau.2021.4.8>

3. **Han, Y.**, & Shevchenko, T. (2023). Exploring digital technologies and smart systems used in e-waste management in China: seminal research themes. *Bulletin of Sumy National Agrarian University*. 3(95), 3-9. <https://doi.org/10.32782/bsnau.2023.3.1>

4. **Han, Y.**, Shevchenko, T., Qu, D., & Li, G. (2022). Smart E-waste Management in China: A Review. *Proceedings of 2nd Congress on Intelligent Systems (CIS2021)*, Springer Book Series, Singapore, 2, 515-533. [https://doi.org/10.1007/978-981-16-9113-3\\_38](https://doi.org/10.1007/978-981-16-9113-3_38) (Scopus, Web of Science).

Scientific works certifying the approval of the dissertation materials:

5. **Han, Y.** (2021). Advancing e-waste management system based on intelligent technologies in China. *Proceedings of the VII International Scientific and Practical Conference “Modern Management: Trends, Problems and Prospects for Development”*, April 14, 2021. Alfred Nobel University, Dnipro (online) P.24-26.

[https://duan.edu.ua/en/index.php?option=com\\_content&view=article&id=467&catid=13](https://duan.edu.ua/en/index.php?option=com_content&view=article&id=467&catid=13)

6. **Han, Y.** (2021). Research on incentive mechanism of e-waste recycling in China. Proceedings of Conference “Answers on nowadays economic and environmental challenges in a vision of scientists”, June 29, 2021. Ukraine, P.72-75. <https://odeku.edu.ua/wp-content/uploads/materiali-konf-2021-epsdn.pdf>

7. **Han, Y.** (2023). Advancing rural waste management program in China: enlightenment from the case study. Proceedings of the scientific and practical conference “Economic development in the context of integration into the European research and innovation area”, June 23-24, 2023. Ukraine, P.27-30. <https://molodyivchenyi.ua/omp/index.php/conference/catalog/book/41>

8. **Han, Y.**, Shevchenko, T., & Zhao F. (2023). Research on the Development of Circular Economy in Modern Agriculture. Proceedings of IV International scientific and theoretical conference “Science of XXI century: development, main theories and achievements”, June 30, 2023. Finland, P.11-14. <https://previous.scientia.report/index.php/archive/issue/view/30.06.2023>

9. **Han, Y.**, Yi D. (2023). Application of smart technology in waste sorting management in rural China. Proceedings of X International scientific and practical conference “Science and technology: problems, prospects and innovations”, July 6-8, 2023. Japan, P.179-183. <https://sci-conf.com.ua/x-mizhnarodna-naukovo-praktichna-konferentsiya-science-and-technology-problems-prospects-and-innovations-6-8-07-2023-osaka-yaponiya-arhiv/>

**Remarks and wishes for the content.** Han Yafeng's dissertation stands out for its overall relevance, scientific merit, and practical significance. However, upon thorough examination, certain debatable issues, comments, and suggestions have arisen, contributing to a comprehensive evaluation of the work:

1. While exceeding the standard length of that kind of papers is not inherently

disadvantageous, it is suggested that specific sections could be condensed to adhere to the norm without compromising the integrity of the research;

2. The dissertation undeniably makes a substantial contribution to the theoretical and methodological aspects of the researched problem. However, the practical side of effective electronic waste management could benefit from more in-depth exploration in Chapter 2;
3. Chapter 2 exhibits an overload of textual material, hindering optimal comprehension. Introducing graphical objects for presenting analytical material would enhance the clarity and accessibility of the research;
4. The dissertation encompasses calculations spanning different periods, creating ambiguity. Clarity regarding the research period, whether 2004-2010 or 2014-2018, is essential for a comprehensive understanding of the study;
5. Some tables in Chapter 2, portraying dependencies obtained from experimental data, are deemed multi-informative and contribute to an unnecessary increase in volume. Recommending the relocation of these tables to appendices would streamline the main body of the dissertation;
6. The conclusions drawn in the dissertation, while generally comprehensive, are suggested to undergo further specification for a more nuanced and detailed representation;
7. Several areas of paper require attention due to editorial, stylistic errors, and inaccuracies in the design, these issues contribute to a diminished ease of information perception.

It is crucial to emphasize that these comments and suggestions, while warranting consideration, do not fundamentally detract from the overall positive assessment of the dissertation. They are meant to refine specific aspects, ensuring that the work aligns optimally with the standards of a doctoral dissertation. The dissertation, as a whole, merits a rather high overall evaluation.



Upon thorough examination of Han Yafeng's dissertation, titled "Development of Integrated E-Waste Management System Based on Resource-Saving in China," and related scientific works, it becomes evident that the dissertation represents a meticulously executed, independent scientific endeavor. This work not only holds intrinsic value but also contributes significantly to both theoretical and practical domains. The dissertation solves a specific scientific task regarding the development of theoretical and methodological principles and the formulation of scientific and practical recommendations for the formation of management system of university's educational and scientific assets in the context of transition to the model of circular economy in China.

The dissertation meets the requirements of the Order of the Ministry of Education and Culture of Ukraine No. 40 dated January 12, 2017 "On approval of requirements for the preparation of a dissertation", the requirements of the educational and scientific program successfully completed by the applicant, the requirements of the Procedure for awarding the degree of Doctor of Philosophy and the cancellation of the decision of the one-time specialized academic council of the institution of higher education, scientific institution on awarding the degree of Doctor of Philosophy (approved by Resolution of the Cabinet of Ministers of Ukraine dated January 12, 2022 No. 44), and its author – Han Yafeng - can be recommended for awarding the degree of Doctor of Philosophy in specialty 073 "Management" by a one-time specialized academic council.

**Рецензент**

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