Editorial

Modelling and Analysis of Sustainability Related Issues in New Era

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1. Introduction

Smart Manufacturing of Industry 4.0 was first proposed in Hanover Fair, Germany in 2011, which received great attentions from various nations [1]. Industry 4.0 utilizes new technologies such as 3D printing, robot, and autonomous vehicle, and links all the components in the manufacturing systems by using Cyber-Physical Systems (CPS) [2] and Internet of Things (IoT) [3,4]. Then, the system will real-timely collect and monitor the activity data of all the components and give intelligent responses to various problems that may arise in the factory by the real-time analysis results of Cloud computing [5] and Big Data [6]. Finally, the manufacturing process can be fine-tuned, adjusted, or set up differently with the customer needs in order to achieve the goal of mass customization and customer satisfaction. Under Industry 4.0, Manufacturing Execution System (MES) [7,8] is an online information system and a feedback and control system for production. Under Industry 4.0, there are great changes on production processes, production planning and control, quality assurance, internal control, cost determination, and other management issues. However, it is expected that it can create positive sustainability impacts along the whole value chain.

The 2005 World Summit on Social Development identified sustainable development goals, such as economic development, social development, and environmental protection [9], which are called the three pillars of sustainability. Sustainable development goals are expected to provide the following potential benefits: (1) Environmental benefits: "*Environmental sustainability* is the ability of the environment to support a defined level of environmental quality and natural resource extraction rates indefinitely [10]." It can enhance and protect ecosystems, improve air and water quality, decrease waste streams to air and land, and preserve and restore natural and renewable resources; (2) Economic benefits: "*Economic sustainability* is the ability of an economy to support a defined level of economic production indefinitely." [10]. It can decrease operating costs; create, expand, and shape markets for green products and services; improve occupant productivity and optimize life-cycle economic performance; (3) Social benefits: "*Social sustainability* is the ability of a social system, such as a country, family, or organization, to function at a defined level of social well-being and harmony indefinitely. Problems like war, endemic poverty, widespread injustice, and low education rates are symptoms that a system is socially unsustainable." [10] It can enhance occupant comfort and health; heighten aesthetic qualities; minimize strain on local infrastructure; and improve overall quality of life [11].

The purpose of this special issue is to explore the topics related to sustainability issues in the new era, especially in Industry 4.0 or other new manufacturing environments.

2. Summary of 15 Papers in this Special Issue

Table 1 shows the summary information of 15 papers in this special issue, including Research Topic, Paper/Author, Method/Model, Research Object, and Industry/Field. From this table, we can find that these papers are related to carbon emissions, carbon tax, Industry 4.0, economic sustainability, and Corporate Social Responsibility (CSR). These 15 papers also can be classified as the papers of environmental, economic, and social sustainability.

Table 1. Summary information of 15 papers in this special issue.

		Topic	Paper/Author	Method/Model	Research Object	Industry/Field
Carbon Emissions/Carbon Tax **(Environmental Sustainability)**	1.	Carbon Emissions Forecasting	Sutthichaimethee and Kubaha (Contribution 1)	LS-ARIMAXi-ECM Model *	Thailand	Construction Industry
	2.	Optimal Carbon Reduction and Return Strategies under Carbon Tax Policy	Wang and Huang (Contribution 2)	Utility Function; Mathematical Formulation	China	Not Specific
	3.	Design for Fuel Consumption Reduction of Cars	Azizi (Contribution 3)	Fuel Consumption Model	Oman	Automobile Industry
Carbon Emissions/Carbon Tax/Industry 4.0 **(Environmental & Economic Sustainability)**	4.	Green Production Decision Model under Industry 4.0	Tsai and Lai (Contribution 4)	Mathematical Programming; Activity-Based Costing	A Case Company in Taiwan	Paper Industry
	5.	Green Production Decision Model under Industry 4.0	Tai and Lu (Contribution 5)	Mathematical Programming; Activity-Based Costing	A Case Company in Taiwan	Tire Industry
	6.	Green Production Decision Model under Industry 4.0	Tsai, Chu, and Lee (Contribution 6)	Mathematical Programming; Activity-Based Costing	A Case Company in Taiwan	Aluminum-Alloy Wheel Industry
	7.	Green Production Decision Model under Industry 4.0	Tsai, Lan, and Huang (Contribution 7)	Mathematical Programming; Activity-Based Costing	A Case Company in Taiwan	Steel Industry
	8.	Carbon Emissions Cost Analysis	Tsai and Jhong (Contribution 8)	Mathematical Programming; Activity-Based Costing	A Case Company in Taiwan	Knitted Footwear Industry
Industry 4.0 **(Economic Sustainability)**	9.	Relationship between Overall Equipment Efficiency (OEE) and Manufacturing Sustainability in Industry 4.0	Yazdi, Azizi, and Hashemipour (Contribution 9)	Time Study Approach; Agent-based Algorithm	Northern Cyprus	Small and Medium Sized Enterprises (SMEs)
	10.	Antecedents to Digital Platform Usage in Industry 4.0	Müller (Contribution 10)	In-depth expert Interviews	102 German and Austrian Industrial Enterprises	Various Industries
Economic Sustainability	11.	Sustainable Solutions to Consumers for Electrical Appliances	de Oliveira Matias, Santos, and Abreu (Contribution 11)	Multi-Attribute Value Theory (MAVT); Multi-objective Optimization; Evolutionary Algorithm (EA)	Portugal	Electrical Appliances Industry
	12.	Material Flow Cost Accounting for Waste Reduction	Huang, Chiu, Chao, and Wang (Contribution 12)	ISO14051-based Material Flow Cost Accounting	A Case Company in Taiwan	A Flat-panel Parts Supplier
Corporate Social Responsibility (CSR) **(Social Sustainability)**	13.	Corporate Social Responsibility for Social Sustainability	Liu(Contribution 13)	Multi-Attribute Decision Model (MADM); DEMATEL **; VIKOR ***	Taiwan	Not Specific
	14.	Sustainable Successions in Family Business	Liu (Contribution 14)	Multi-attribute Decision Model (MADM)	A Case Company in Taiwan	Not Specific
	15.	Influences of CSR on Firm Value	Hu, Lin, Liu, Chen, and Chen (Contribution 15)	Artificial Intelligence (AI)-based Fusion Model	Top 100 Companies in China	Not Specific

Note: * LS-ARIMAXi-ECM: Long and Short-term Auto-Regressive Integrated Moving Average with Exogenous Variables and the Error Correction Mechanism. ** DEMATEL: Decision Making Trial and Evaluation Laboratory. *** VIKOR: VlseKriterijumska Optimizacija I Kompromisno Resenje.

3. Review of the Special Issue

3.1. Carbon Emissions/Carbon Tax

Sutthichaimethee and Kubaha (Contribution 1) use LS-ARIMAXi-ECM Model to forecast energy-related carbon emissions for the construction sector in Thailand. The results indicate that determining future national sustainable development policies requires an appropriate forecasting model, which is built upon causal and contextual factors according to relevant sectors, to serve as an important tool for future sustainable planning.

Wang and Huang (Contribution 2) present a proposal to determine an optimal carbon reduction level and online return strategies under carbon tax policy when a firm produces and sells its green products via an e-commerce platform. They find that if the residual value of the returned product is relatively small, the firm should not offer an online return service; and the platform should reduce its referral fee as the unit carbon tax increases.

Azizi (Contribution 3) applies a fuel consumption model to design an effective Proportional Integral Derivative (PID) controller for controlling the active suspension system of a car in order to eliminate the imposed vibration to the car from pavement and to reduce the fuel consumption and contributes to environment sustainability.

3.2. Carbon Emissions/Carbon Tax/Industry 4.0

Contributions 4-8 are a series of papers presenting the green production decision models in Paper (Contribution 4), Tire (Contribution 5), Aluminum-Alloy Wheel (Contribution 6), Steel (Contribution 7), and Knitted Footwear Industry (Contribution 8) by using the methods of Activity-Based Costing (ABC) and Mathematical Programming. In these papers, ABC is used to more accurately measure the costs of activities in the manufacturing processes. Mathematical Programming is used to find the optimal product-mix maximizing the company's profit under the various resource, sale, and production related constraints with the carbon tax costs. Among them, Contributions 4–7 explore the production decision models under Industry 4.0. Industry 4.0 can utilize, collect, and monitor the activity data of all the components in real-time by using various sensor systems, Cyber-Physical Systems (CPS), and Internet of Things (IoT), to give intelligent responses to various problems that may arise in the factory by the real-time analysis results of cloud computing and big data and to attain the various benefits of Industry 4.0 implementation. The parameters of the mathematical programming model will be updated periodically from the new big data set. For example, ABC cost parameters can be updated from more real data (see Contributions 5).

Besides this, Contribution 8 incorporates the concept of cap-and-trade in the production decision model and considers the carbon emission cost, including carbon tax and carbon right costs. This paper assumes that the company has the upper limit of carbon emission allocated from the government and that the company can buy the carbon emission right from the market if the company have the opportunity of the additional sales.

3.3. Industry 4.0

There are two papers related to Industry 4.0 with economic sustainability (Contributions 9 and 10). Yazdi et al. (Contribution 9) explore the relationship between Overall Equipment Efficiency (OEE) and manufacturing sustainability for small and medium sized enterprises (SMEs) under Industry 4.0 by using time study approach and agent-based algorithm. Müller (Contribution 10) investigates the potentials and challenges of digital platforms for the purpose of generating an understanding of the antecedents to the use of digital platforms under Industry 4.0 by established manufacturers. This research uses a qualitative empirical research approach of the in-depth expert interviews with managers of 102 German and Austrian industrial enterprises from several industrial sectors. Its results indicate that the main potentials of digital platforms are reducing transaction costs, combining strengths of enterprises, and realizing economies of scale as well as economies of scope.

3.4. Economic Sustainability

De Oliveira Matias et al. (Contribution 11) propose a decision support approach to provide a set of sustainable solutions from the market to the consumer for electrical appliances by adopting a Multi-Attribute Value Theory (MAVT), combined with an optimization technique based on Evolutionary Algorithms (EA).

Huang et al. (Contribution 12) utilize ISO14051-based material flow cost accounting as an analytical evaluation tool to conduct a case study on a flat-panel parts supplier to determine whether the efficient use of recycled glass could reduce company costs. The primary finding is that the film layer on recycled washed glass tends to be stripped during the production process, causing increased reprocessing costs and thus rendering the cost of renewable cleaning higher than that of reworking.

3.5. Corporate Social Responsibility (CSR)

There are three papers investigate the issues of Corporate Social Responsibility (CSR), which is belong to the issues of social sustainability. Liu (Contribution 13) uses Multi-attribute Decision Model (MADM), DEMATEL, and VIKOR to assess the impact of Corporate Social Responsibility for the implementation of internal control that includes Corporate Social Responsibility. The empirical results indicate that a social responsibility-oriented internal control system may be a better strategy than maintaining the original internal control objectives.

Liu (Contribution 14) utilizes Multi-Attribute Decision Model (MADM) to construct an analytical framework containing the key decision-making factors for family business succession. The results indicate that corporate characteristics, family capital, and niche inheritance are the most important without consideration of whether the continuation of the business after succession will be doomed to failure.

Hu et al. (Contribution 15) construct an artificial intelligence (AI)-based fusion model to examine the relationship between CSR's multidimensional characteristics and firm value by using the top 100 companies in China as a research sample. This research breaks down CSR into numerous dimensions used to examine each dimension's impact on firm value. The results indicate that "Environmental responsibility" is the most essential element on firm value determination since the Chinese government has placed much more emphasis on environmental protection in recent years.

4. Concluding Remarks

The purpose of this special issue is to investigate the topics related to sustainability issues in the new era, especially in Industry 4.0 or other new manufacturing environments. There are three pillars of sustainability, including environmental sustainability, economic sustainability, and social sustainability. This special issue collects 15 sustainability-related papers in various industries by using various methods or models. Although this special issue does not fully satisfy our needs, it still provides abundant related material for environmental, economic, and social sustainability. However, there still are many research topics waiting our efforts to study to solve the problems of sustainability.

List of Contributions:

1. Sutthichaimethee, J.; Kubaha, K. Forecasting Energy-Related Carbon Dioxide Emissions in Thailand's Construction Sector by Enriching the LS-ARIMAXi-ECM Model.
2. Wang, J.; Huang, X. The Optimal Carbon Reduction and Return Strategies under Carbon Tax Policy.
3. Azizi, A. Computer-Based Analysis of the Stochastic Stability of Mechanical Structures Driven by White and Colored Noise.
4. Tsai, W.-H.; Lai, S.-Y. Green Production Planning and Control Model with ABC under Industry 4.0 for the Paper Industry.
5. Tsai, W.-H.; Lu, Y.-H. A Framework of Production Planning and Control with Carbon Tax under Industry 4.0.
6. Tsai, W.-H.; Chu, P.-Y.; Lee, H.-L. Green Activity-Based Costing Production Planning and Scenario Analysis for the Aluminum-Alloy Wheel Industry under Industry 4.0.

7. Tsai, W.-H.; Lan, S.-H.; Huang, C.-T. Activity-Based Standard Costing Product-Mix Decision in the Future Digital Era: Green Recycling Steel-Scrap Material for Steel Industry.
8. Tsai, W.-H.; Jhong, S.Y. Carbon Emissions Cost Analysis with Activity-Based Costing.
9. Yazdi, P.G.; Azizi, A.; Hashemipour, M. An Empirical Investigation of the Relationship between Overall Equipment Efficiency (OEE) and Manufacturing Sustainability in Industry 4.0 with Time Study Approach.
10. Müller, J.M. Antecedents to Digital Platform Usage in Industry 4.0 by Established Manufacturers.
11. de Oliveira Matias, J.C.; Santos, R.; Abreu, A. A Decision Support Approach to Provide Sustainable Solutions to the Consumer, by Using Electrical Appliances.
12. Huang, S.Y.; Chiu, A.A.; Chao, P.C.; Wang, N. The Application of Material Flow Cost Accounting in Waste Reduction.
13. Liu, J.Y. An Internal Control System that Includes Corporate Social Responsibility for Social Sustainability in the New Era.
14. Liu, J.Y. An Integrative Conceptual Framework for Sustainable Successions in Family Businesses: The Case of Taiwan.
15. Hu, K.-H.; Lin, S.-J.; Liu, J.-Y.; Chen, F.-H.; Chen, S.-H. The Influences of CSR's Multi-Dimensional Characteristics on Firm Value Determination by a Fusion Approach.

Conflicts of Interest: The authors declare no conflict of interest.

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