The Road Ahead for Municipal Solid Waste Management in the 21st Century: A Novel-standardized Simulated Paradigm

M S S Danish1,2, H Zaheb2, N R Sabory2, H Karimy2, A B Faiq3, H Fedayi3 and T Senjyu1

1 Electrical and Electronics Department, University of the Ryukyus, 1 Senbaru 9030213, Japan
2 Energy Engineering Department, Kabul University, Jamal Mina, 1006, Afghanistan
3 Electrical and Electronics Department, Kabul University, Jamal Mina, 1006, Afghanistan

Email:mirsayedshah@yahoo.com

Abstract. The recent global trend in lifestyle change, alter in economic and human civilization growth has a dramatic increase in municipal solid waste (MSW) generation that led to a renewed interest in researches and innovations in this context. A primary objective of the study is to identify influencing factors in term of MSW from different standpoints hiring tangible and non-tangible cause and effect theory to foster sustainability through an exhaustive decision-making model and strategy. Explicitly, this research effort breakdown a business model into manageable chunks to address how to systematically manage MSW; and which tools and techniques should be efficaciously applied to adapt each step of the process. Decidedly, an inclusive strategy and model can be demonstrated with a real-world application with some significant implications for future practice as a multilateral planning and design reference for students, researchers, scholars, and practitioners in the context of MSW management. Therefore, in a general term, the outlook of this study is based on the evolution of the state of the art of a novel model for MSW management based on multi-oriented approach, comprises technical, social, environmental, institutional, business, management, policy, and cultural factors.

1. Introduction
A rapid change in economic growth and human civilization have led to a dramatic increase in MSW generation in the urban and rural levels, especially in the least developed countries. That faces these nations with the challenge to maintain a clean air and an effective framework for MSW disposal and treatment. According to [1], the top ten pollutant cities in the world with poor air quality due to many factors; the increasing population growth and MSW generation are parts of this problem, shown in Table 1.

| Rank | City                  | Pollution Index | Exp Pollution Index |
|------|-----------------------|-----------------|---------------------|
| 1    | Accra, Ghana          | 97.88           | 177.34              |
| 2    | Tetovo, Macedonia     | 96.85           | 177.01              |
Numerous studies have attempted to explain the term of sustainability, in general consensus [2-5] the concept of sustainably can be referred that how to use the energy resources in a way to be sufficient for now, and do not compromise the ability of future generations to meet their needs. The most important criteria for sustainable energy production are accessibility, affordability, disparity, safety, use efficiency, supply and production efficiency, cost effectiveness, and environmental impacts on air, water, and soil quality [6, 7]. Mismanagement of MSW can lead to unexpected environmental and social disasters. According to the [8, 9], 97% of cities in low and middle-income countries with more than 100,000 inhabitants do not meet the World Health Organization (WHO) air quality guidelines that can cause the risk of stroke, heart disease, lung cancer, and chronic and acute respiratory diseases, including asthma.

2. Methodology
The methodology of this paper is concerned with an amalgamated approach, which targeted various domains and stakeholders (residence, scholars, researcher, technology developers, enterprise, the government body, policy-makers, and so on). A systematic process of the model development is given in Fig 1, which composes qualitative and quantitative elements within logical consequence attitudes and analysis. Each step is demonstrated with applicable tools and techniques, which are parameters-sensitive that can be described based on the adequate inputs (objectives, factors, identifiers, constrains, hypothesis, characteristics, etc) in order to model a proper solution for MSW.

3. Standardized paradigm
Increasing globalization enforces standardizations to align interchangeability and converge diversities within defined global paradigms for qualitative and quantitative values optimization and economic integration. The first-ever efforts of standardization were proposed in the early twentieth century [10], now it applies globally beyond its initial objective as a body of certification and certainty. The ISO 14001 standard is promulgated in 1996, in compliance with British BS 7750 standard, which aims to strengthen toward a green paradigm for production and consumption in term of Environmental Management System (EMS) [10]. The adoption of ISO 14001 in the main global economic zone countries is shown in Figure 1.

The IC-GDP ratio is calculated by ICI that shows the share between the number of worldwide issued certificates and percentage share of total world GDP in 2015 (in USD at current exchange rate of the time) Figure 2 [10, 11].

4. The proposed framework-scheme
Since, this research is a multi-dimensional study that involves various potential partners with different roles and expected contributions, the major objective of this research is to provide equal opportunities to all stockholders involved in MSW management and governance process. Reference to our finding, there is need for an interconnected scheme of collaboration among the stockholders to address a close coordination.
The proposed scheme is projected to simulate scenario-based methodology. In which, scenarios’ optimum outcomes are separately obtained in term of suitability criteria to align the optimum solutions in form of an integrated moderate model of implementation. The cause and effect technique can be hired to explore the root cause and propose a reasonable solution. There are various approaches for weighing and scoring according to different codes and methodologies. The weighing approach can be applied to score and reach a decision. The purpose of a dynamic-flexible scenario is to adapt to the real situation with optionality of wizard methodology to select different feasible option. These scenarios can be door-to-door, pay-for-use and many more options.

While, delineating indicators for each influential factor is a prerequisite for weighting approach. A detailed discussion on weighing approach and indicators is not the scope of this study, the authors will deal with these topics extensively future. The driven scheme in Figure 3 is flexible roadmap to adjust desired parameters and milestones for Triple-R control. These parameters and objectives can vary from city to city due to local resiliency and demand. For instance, to reduce solid waste disposal production and foster collection can set incentives and penalties, engage private and public sectors, promote awareness programs, suggest alternatives, and so on. An overall optimization of current MSW management system through upgrading and adding new futures (technically and technologically) to simply MSW collection and disposal flow can enhance this trend.

A complete instruction of this scheme will be provided in the future studies along with some case studies to evaluate the viability of the proposed mechanism, and to validate the effectiveness of the model within the given hypothesizes and parameters/characteristics.

Figure 1. The global economic zone countries ISO 14001 statistics [9]).

Figure 2. The global economic zone countries ISO 14001 adaption percentage.
Figure 3. The proposed framework-scheme for MSW management.
5. Conclusion
The overall objective of this study is to shape a sustainable-cost-effective model that enhances Triple-R (Reduce, Reuse, and Recycle) efficiency and effectiveness considering technical and technological efficiencies in term of MSW management. That the proposed scheme relies on the most crucial factors to meet desired objectives. Unlike recently, this research deals with first-ever effort to conceptualize a viable roadmap/Scheme for a proper management of municipal solid waste along with it implementation systematic phases. The special measures are hired in this study to draw an exhaustive framework in compliance of resiliency and sustainability criteria throughout its life-cycle. This study can have some significant implications for future practice as a multilateral planning and design reference for students, researchers, scholars, and practitioners related to a municipal solid waste management and operation. The authors are willing to put forward a series of procedures paradigm in details within management, engineering, and business domains based on the world-wide accepted approach in a synergistic manner in the future.

6. References
[1] Pollution Index Rate 2018. https://www.numbeo.com/pollution/rankings_current.jsp, Numbeo (accessed on: 12 November 2018)
[2] Danish M S S, Sabory N R, Ershad A M, Danish S M S, Ohta R, Sediqi M, Ahmadi M and Senjyu T 2017. The least developed countries need for changing the passive trend of renewable energy exploitation to a proactive trend, International Journal of Energy and Power Engineering. 5 215-21.
[3] O'Neill-Carrillo E, Irizarry-Rivera A A, Colucci-Rios J A, Perez-Lugo M and Ortiz-Garcia C 2008. Sustainable energy: Balancing the economic, environmental and social dimensions of Energy. In Energy 2030 Conference, 2008. Nov 17 Atlanta 1-7
[4] Brundtland G, Khalid M, Agnelli S, Al-Athel S, Chidzero B, Fadika L, Hauff V, Lang I, Shijun M, de Botero M M and Singh M 1987. Our common future (Brundtland report). Medicine and War 4 17-25
[5] Danish M S S, Senjyu T, Sabory N R, Danish S M S, Ludin G A, Noorzad A S and Yona A 2017. Afghanistan's aspirations for energy independence: Water resources and hydropower energy. Renewable Energy 113 1276-87
[6] Danish M S S, Senjyu T, Ibrahim J M, Ahmadi M and Howlader A M 2019. A managed framework for energy-efficient building, Journal of Building Engineering 21 120-8
[7] Danish M S S, Sabory N R, Ershad A M, Danish S M S, Yona A and Senjyu T 2017. Sustainable architecture and urban planning trough exploitation of renewable energy, International Journal of Sustainable and Green Energy 6 1-7
[8] Scafà M, Carbonari S, Papetti A, Rossi M and Germani M 2018. A new method for product service system: the case of urban waste management, Procedia CIRP, Linköping 73 67-72
[9] WHO Global Ambient Air Quality Database 2018. http://www.who.int/airpollution/data/cities/en (accessed on: 20 November 2018)
[10] Heras-Saizarbitoria I, Boiral O and Allur E 2018. Three decades of dissemination of ISO 9001 and two of ISO 14001: Looking back and ahead, In ISO 9001, ISO 14001, and New Management Standards, Cham, Springer 1-15
[11] Heras-Saizarbitoria I 2018 ISO 9001, ISO 14001, and new management standards (Ferrara: University of Ferrara) p 218

7. Acknowledgment
This study is a part of International Exchange Agreement research efforts between Engineering Faculties of University of the Ryukyus and Kabul University signed on 19th April 2017, followed by a sub-agreement (Exchange Collaboration Agreement, 7th May 2018), by the support of Center for Strategic Research Project, University of the Ryukyus (Senbaru 1, Nishihara, Okinawa, 903 -0213, Japan) under the research budget of JFY 2018 (98394640).