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CONNECTING INDUSTRIAL ENGINEERING WITH SUSTAINABLE DEVELOPMENT GOALS

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Abstract

In the year 2015, the United Nations members agreed to develop a futuristic agenda till 2030 on sustainable development of the world. This path-breaking initiative by the United Nations addresses the concern towards prosperity in the economy, protection of the environment, and societal wellness. The Sustainable Development Goals (SDGs) offer a comprehensive and multifaceted perspective on development. It is attempted to link SDGs with the role of Industrial Engineerers. They can play an important role in achieving SDGs goals as SDGs goals are backed by the traditional concept of triple bottom line of sustainability. A few research directions are also proposed in this paper.

Keywords: Sustainability, Industrial Engineering, Sustainable Development Goals, Triple Bottom Line

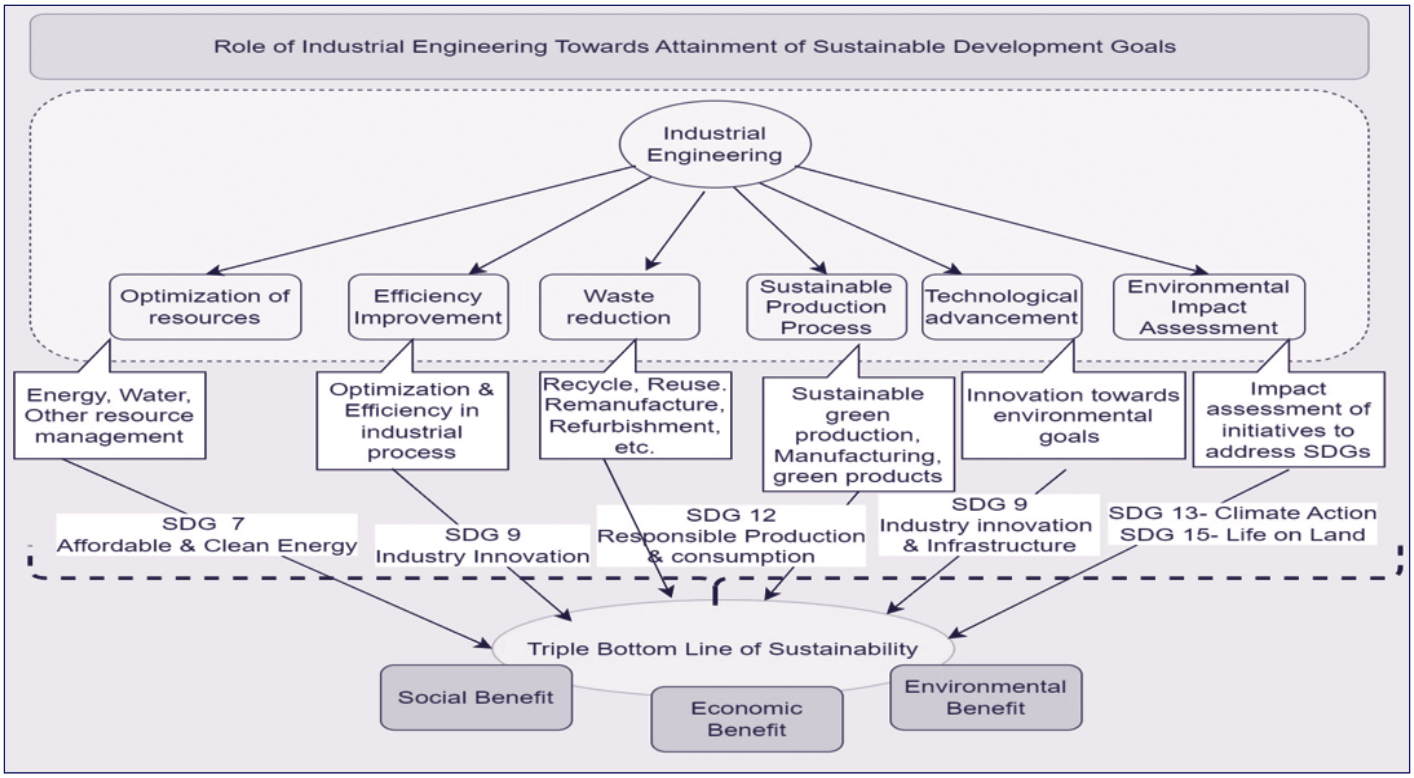
INTRODUCTION:

In September 2015, the United Nations held a meeting in New York, where they made a commitment to the sustainability of the planet by proposing 17 Sustainable Development Goals (SDGs). Targets were also outlined for the year 2030 (https://sdgs.un.org/). The SDGs have evolved as an instrument to guide the mankind for the most challenging problem of recent times. The world has to undergo through developments without compromising the ability of future generations to meet their own needs (WCED, 1987). These SDGs embrace a broad range of objectives, including the elimination of poverty and hunger, the promotion of equitable economic development, and preservation of threats towards environmental sustainability. Inclusivity, equality and collaboration are the main characteristics of the SDGs. Within the context of these challenging tasks ahead of us, the role of Industrial Engineering (IE) is undoubtedly very important. IE can become an effective driving force behind the accomplishment of ambitious SDGs. IE has an important role to play in the achievement of the SDGs through efficient management of resources. A wide range of sustainability initiatives, strategies and standards offer direction and information at the organisational level on activities that may be executed (Borgert et al., 2018).

There are three key principles of sustainable development goals: social aspect, economic aspect, and environmental aspect (Figure 1). Specific SDGs, which are dominantly associated with Industrial Engineering are SDG 2 (Zero hunger). SDG 2 aims to promote sustainable agriculture, improved agricultural productivity and elimination of food waste. Shankar et al. (2018) have discussed risk management in achieving food security in India. SDG 7 (Affordable and clean energy) aims to focuses on solar, wind and other energy sources to improve energy productivity. Another important domain where IE can contribute is renewable energy integration with conventional power generation (Sinha et al., 2019). SDG 8 (Human-centric design for decent workplace) aims to design safer end ergonomically effective work place and supports prioritizing of employers well-being. SDG 9 is an area of great importance as it deals with industry innovation and infrastructure. It aims to promote sustainable industry and and its resilient infrastructure to support economic development. SDG 11 (sustainable cities and communities) aims to promote green transport and investment in public transport, SDG 12 (Responsible consumption and production) aims to promote efficient use of natural resources, elimination of wastage from post-harvesting stage to consumers in a supply chain, The concept of circular economy is much more important now. Figure 1 exhibits the three pillars of sustainability and presents their mapping to various SDGs.

Industrial Engineering can support in designing processes that facilitate reuse, recycling, and repurposing of materials. These can contribute towards a circular economy and also promote the adoption of innovative technologies, such as automation and smart manufacturing, to improve efficiency and reduce resource consumption. Industry 4.0 (Kumar et al, 2022) aims towards a cyber-physical manufacturing environment, yet the need for elimination of waste is a prime concern. IE can contribute in many other ways to achieve sustainable development goals (SDGs) (Gandhi et al., 2024). Clean and green energy production, green transportation, climate resiliency, continuous improvement programs, flexibility and adaptability, waste reduction strategies, lean manufacturing practices, supply chain optimization, circular economy implementation are the areas which industrial engineers can address in a much better manner (Shankar and Gupta, 2024)

Figure 1:` Connecting Industrial Engineering with Triple Bottom Line Concept of Sustainability and SDGs



2. INDUSTRIAL ENGINEERING CONNECT WITH SDGS

Industrial Engineering has a great role to play in achieving sustainable development goals (SDGs).

2.1 Role of Industrial Engineering (IE)

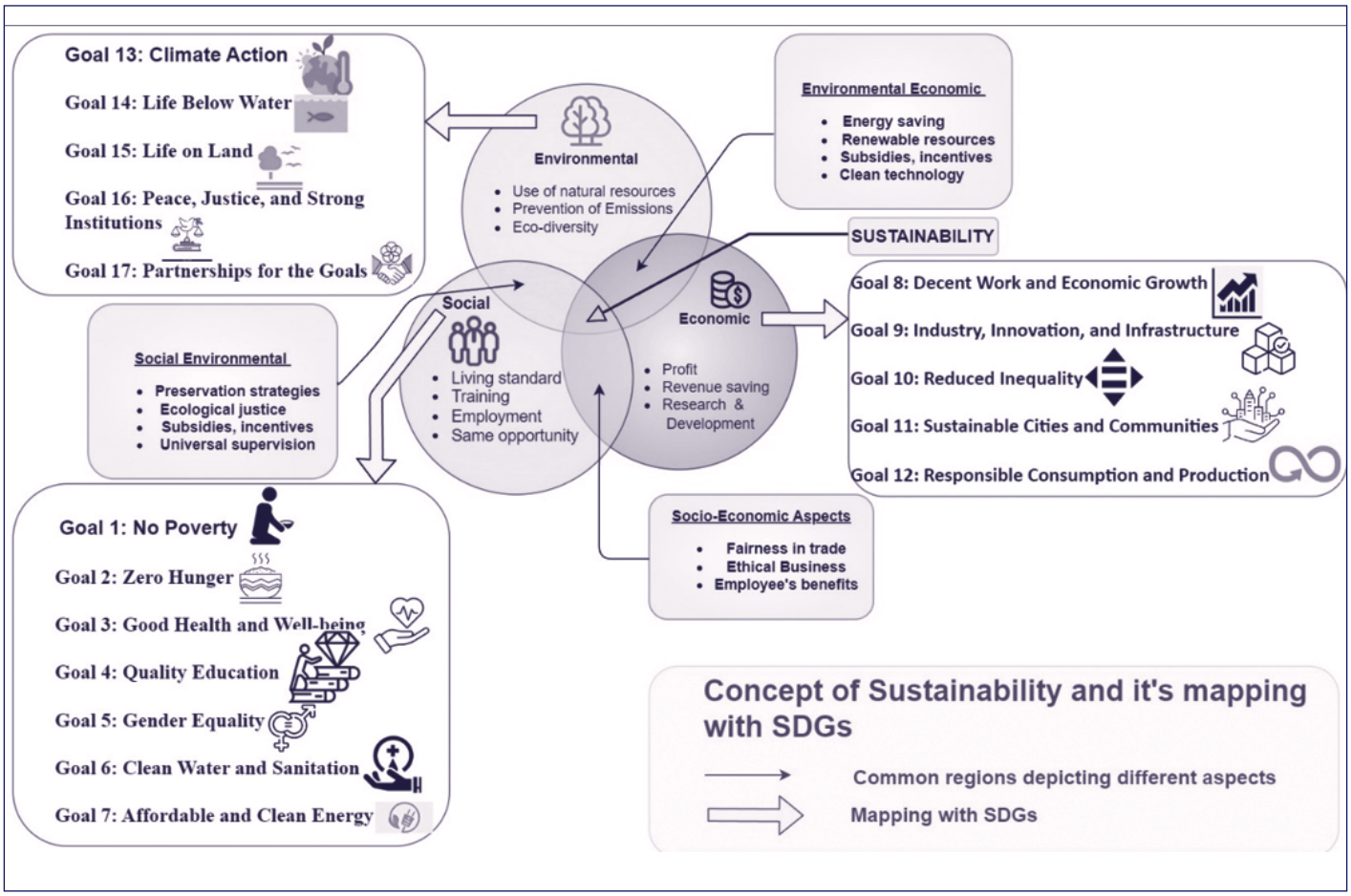
Industrial Engineering encompasses development, design, supply and sales services, and goes beyond traditional manufacturing systems to encompass more generic production systems against the backdrop of information, integration, and intelligence (Shankar, 2012). To accomplish sustainable development of the entire system, considerations such as design, manufacturing cycle, market reaction, resource consumption, and environment protection should be made in addition to management of quality and cost (Liao et al., 2022). In the modern world, an industrial cluster is a unique type of economic organization that is crucial for fostering regional economic growth (Ren et al., 2023; Xue et al., 2022). It is therefore far more important to understand and deal with effective resource utilization.

Numerous initiatives in India are on the anvil. which are directly or indirectly focusing on SDGs. For example, the Sagarmala initiative aims towards linking the sea coastline of India with its hinterland. This would facilitate economic growth of the region. In the recent interim budget of Government of India, presented in Parliament on February 1, 2024, it has been proposed that the beneficiaries of rooftop solar system through Pradhan Mantri Suryoday Yojna will get free electricity up to 300 units per month (Ref.: Mint: Feb 02, 2024). Industrial Engineers may look at the issues such as how the ten million households would sell the surplus solar energy through the grid. This issue was earlier pointed out by researchers (Sinha et al., 2019). As per Interim Budget 2024 of India (Ref.: Mint Feb 02, 2024) proper facility location and energy distribution model can help in an approximate annual saving up to Rs. 15000 per household. Yet, Industrial Engineers must look into a futuristic problem of solar waste disposal from the point of view of facility location and environment protection (Gautam et al., 2022). The purpose of highlighting these examples is to bring the attention of Industrial Engineers on the three pillars of sustainability – economic prosperity, environment protection and social well-being.

It is often contended that industrial development promotes economic growth, yet it puts some strain on the environment. This strain on the environment has to reduce by industrial engineers' effort towards designing and managing circular supply chains and promoting the net zero economy (Lahane et al., 2023). There is a need to address effectiveness of resource utilization (Yuan et al., 2020; Guo et al., 2020). Industrial urbanization, however, also widens the production scale, which raises the consumption of raw materials and thus leads to increased pollution (Guo et al., 2020). Chen & Wang (2022) suggested that an industrial cluster can be a "double-edged sword". It will both accelerate economic growth and worsen environmental pollution in the cluster area. Thus, a key issue facing modern social development is how to strike a balance between industrial growth and environment degradation in order to promote inclusive and sustainable economic growth. Herein lies the role of IE in achieving SDG 12 - Responsible Consumption and Production, which aims to minimize waste and ensure more sustainable production processes by optimizing resource utilization through methods like lean manufacturing etc. Production facilities that implement lean principles will see

a reduction in energy and material waste. SDG 8 (Decent Work and Economic Growth) can be achieved through the application of IE principles such as implementation of ergonomic practices in manufacturing plants, IE principles can improve worker safety and reduce the risk of occupational injuries. Similarly, SDG 11 (Sustainable Cities and Communities) can be achieved through IE principles, which can improve transportation efficiency and reduce carbon emissions and congestion in urban areas (Fulzele & Shankar, 2022).

Figure 2: Conceptual Framework of Sustainability with Its Three Pillars and Mapping these with SDGs



Industrial engineers' expertise in addressing supply chain optimization can improve the supply chains such as food supply chain (Gupta & Shankar, 2023) and minimization of food wastes (Gupta et al., 2023). thus contributing towards SDG-2 (Zero Hunger). Similar approaches can also help in the timely delivery of medical supplies during emergencies, thereby contributing to SDG-33 (good health and wellbeing). Advanced methods for demand forecasting, including machine learning and predictive analytics, are included in supply chain optimization. Other strategies can help to optimize inventory levels and lower the chances of stockouts or overstocking. Logistics optimization improves transportation routes and gives supply chain visibility by integrating real-time tracking and technology integration (IoT, RFID, blockchain etc.). For perishables, cross-docking approach has potential to reduces warehouse storage time. Collaborative Planning, Forecasting, and Replenishment (CPFR) and risk management techniques further guarantee supply networks that are responsive to unanticipated events (Jacobs et al., 2023). For Industrial engineers, these issues bring out challenging academic pursuit towards achieving SDGs.

3. CONCLUSION

The three pillars of sustainability are closely linked to sustainable development goals. The paper has attempted to map these so that Industrial engineers can find their role that fits best with their expertise. Industrial Engineers can help in designing and implementing the sustainable systems, which help in economic prosperity, social well-being and environmental protection of the planet earth.

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