

THE RELATIONSHIP BETWEEN STRATEGIC FLEXIBILITY, THE FOURTH INDUSTRIAL REVOLUTION AND CORPORATE SUSTAINABLE PERFORMANCE

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ABSTRACT

Enjoying the benefits of industry 4.0 which includes technologies like the internet of things, artificial intelligence, and big data is changing the course of business processes and enabling sustainability in business performance. When included with strategic flexibility– the capability to expedite changes in the business environment – industrial revolution 4.0 helps companies improve economic, environmental, and social aspects. The present paper reviews the current body of knowledge about the role of Industry 4.0 in shaping corporate sustainability strategies, placing great emphasis on strategic flexibility. They explain, through case studies of such companies as Siemens, how the application of the above technologies and strategies enhances the effective use of resources, cuts operational expenses and lessens harm to the environment. Yet, such awe-inspiring advantages are still restrained due to the exorbitant expenses associated with implementation, lack of necessary resources and skills, and organizational inertia. The article emphasizes that in developing a deep integration between 4th industrial revolution and strategic flexibility, the organizations will be able to attain the desired competitive advantage and sustainability over time, if some barriers will be removed.

Keywords: Industry 4.0, Strategic flexibility, Corporate sustainable performance, Internet of Things, Artificial intelligence, Digital Transformation, Sustainability, Big data analytics.

1. INTRODUCTION

Industry 4.0 – a paradigm whereby advanced digital technologies, e.g., the Internet of Things (IoT), artificial intelligence (AI), big data analytics and cyber-physical systems, are incorporated into the operations of manufacturing and businesses – is changing how industries operate on a global scale. This offline transformation presents organizations with the potential for increased productivity, efficiency, and enhanced decision-making resources.

With strategic flexibility – which is the increasing capacity to respond to market, technology and competition changes (Slack, 2005) – firms are better placed to avert threats and seize opportunities. To continue existing and maintain competitive advantage, there is a need for thinkers regarding the practices of corporate sustainable performance, which includes financial, ecological and societal processes. The article considers the relationship

between Industry 4.0 and strategic flexibility and its value corporate sustainability. The assessment will consider their separate, and their synergistic effects upon target, and the barriers that extend further the companies' efforts. The evolution of how business incorporates sustainability and performance is being impacted by the adoption of Industry 4.0 and strategic flexibility. Industry 4.0 or the fourth industrial revolution integrates technologies such as artificial intelligence, big data, and the machine-to-machine under the IoT to change the process of conducting business. Such technologies facilitate the monitoring of processes and data in real time, automating processes, performing predictive maintenance, and advanced analysis, all of which translates into savings, enhanced levels of efficiency, and wastage reduction. Industry 4.0 brings about a digital shift that enables firms to redistribute resources, enhance the precision of the manufacturing procedure, and optimize supply chains for a more cost-efficient and environmentally friendly business model.

The term strategic flexibility has also gained relevance in contemporary dynamic markets. Tech-oriented adaptation is the capacity of an organization to react promptly and effectively to any new threats or opportunities in the market, technological changes and the clients' changing expectations. It entails making groundwork for a business model that is flexible enough to make changes in approaches, adoption of new innovations, and tackling any environmental and social issues as they arise. This element is very important for the long-term existence of any business since there is increasing urgency for business to operate sustainably. Strategic flexibility offers opportunities for firms to be innovative and enhance their ability to pursue ecological practices and alter their strategies and policies to incorporate sustainable development.

Strategic flexibility, coupled with Industry 4.0 in real time, equips companies with the resources and flexibility necessary for corporate sustainability performance. Due to Industry 4.0 technology, it is possible to gather huge amounts of data and apply it to real time management where efficiency, environmental protection, and product quality are improved. Such technologies promote operations that are energy efficient, reduce waste and carbon

dioxide generation, and hence result in cleaner production technologies. Strategic flexibility, on the other hand, does not tie the enterprises firmly to their existing structures. Instead, they are actively able to modify and change their operations to adopt further sustainable practices, do other resource seeking activities, and steer the enterprises in other direction due to market dynamics and changing environmental regulations.

Especially effective in enhancing the corporate's performance in a sustainable way, is the interrelation of the Industry 4.0 and the strategic flexibility. By adopting both, companies can be prone to technology shocks and effectively respond to them, quickly execute new innovations required in any organization promoting sustainability, and efficiently manage their supply chain to cope with the ecological effects. As an example, a company using IoT devices to detect and track the energy consumed during usage can immediately change the way the company works in order to prevent unnecessary energy usage. At the same time, if the market or regulatory environment changes due to the constraints, the company will be able to use the strategic flexibility to seek new sources of energy or change production activities to obtain the new standards for sustainability.

Another factor which remains unchallenged is the competitive edge provided by the presence of Industry 4.0 and the ability to be clever in strategic management. Organizations that are quick to incorporate such technologies will offer improved operational effectiveness, reduced operational costs as well as improved social and environmental results than their rivals. In the modern day consumer and investment climate especially the latter is becoming more conscious of companies that are keen on sustainability making industry 4.0 and strategic flexibility much of a corporate reputation management tool. However, this has a great potential and in many cases, companies face numerous challenges in terms of skilling up for or embracing Industry 4.0 technologies and strategic flexibility. Advanced technology means higher sunk costs when adopting new systems and this new technology comes with additional skilled resource personnel that has to take care of these systems. Also, the presence of old or well embedded organizational cultures that

do not support new approaches may adversely affect the acceptance of new strategy directions. In the present time and age, defined by global technological advancements and evolution, Fourth Industrial Revolution (4IR) is considered as one of the 21st century's revolutionizing factors that transform industries and business models alike. New technologies such as A.I, I.T, big data, and the computing resources provide the integration of the physical, digital, and biological systems not only improves processes but also places phenomenal pressure on the organizations to match their performance level with sustainable balances. However, as the business environment remains chaotic all the time, it is important to hold to the notion of strategic flexibility. This is the part of organizational ability that entails becoming responsive to the dynamics of the environment, taking advantage of opportunities that are risky and thus helping in the integration of 4IR technologies with corporate sustainability. Strategic flexibility includes repositioning resources at the wake of changes, innovating new processes and maintaining the firm-macro market link. This empowers companies to prevent or absorb the shocks and still remain on the sustainable path of growth. Though this interaction between strategic flexibility and the Fourth Industrial Revolution may appear academic, it is not; businesses have to adapt to this improvement if they are to continue competing successfully in disruptive market environments. Organizations' use of 4th industrial revolution technologies improves their strategic flexibility thus enabling them to change how they carry out business and internal processes in a way that promotes positive sustainability outcomes. The unique contribution of this debate is the flexible strategy of the company which works as both an enabler and as a facilitator of sustainable corporate performance. On the one hand, it involves strategic flexibility, as it enables organizations to be creative as to the sustainability goals, thus quickening the adoption of sustainable practices as well as technologies. For example, the firms can incorporate advanced technologies, such as data analytics, where they will optimize resources and reduce wastage in order to have a better environmental performance. On the counter side, an organization's aspiration to become

sustainable may to some extent contribute to a company's ability to develop strategic flexibility by influencing the organization's innovative and risk-taking aspects helping companies to better cope with the 4th industrial revolution. As such, a conclusion can be made that there is a need to incorporate sustainability into corporate strategic flexibility for sustainable practices to be effective business strategy, hence taking a balanced approach to tackling behaviour towards economic activity and the environment. In addition, it has become necessary for organizations to commit themselves to ethical and environmental practices due to the increasing concern on sustainability by consumers. This change not only fosters brand attachment but also opens doors to new sources of competitive edge that previously didn't exist. It is, therefore, in this environment that strategic flexibility becomes a core competence that empowers firms to leverage 4IR and embed sustainability in their value propositions. Organizations can establish a strong base for growth that is long last by strategically aligning their activities... with expectations of the society and the law.

To finish with the last aspect of the paper, the relation of strategic flexibility, the Fourth Industrial Revolution, and the sustainable performance of the corporation is complex and dynamic and therefore requires further research. The summary is that as the scope of businesses gets wider on a global scale, access to funds on one hand and competition from a growing pool of companies on the other puts a premium on how businesses processes are managed and particularly how the issues of strategy development are handled. Therefore this research seeks to investigate three issues Will reveal, and what might be elucidated will fuel both theoretical and practical discussion of chronicle specialists wishing to come to grips with the culture of doing business of the twenty-first century. The integration of these elements comprises a new 'business model' whereby organizations can afford to be sustainable amidst the changes in the 4IR.

To sum up, Industry 4.0 and strategic flexibility are crucial factors to achieve business sustainability. They equip organizations with the capabilities and flexibility in modern day within which the firms operate, increase productivity, and support

environmental and societal sustainability. Businesses that embrace these paradigms and embed them into their working environments have higher chances of survival and the prospects of growth in the world where the considerations of sustainability are not optional but rather a business requirement.

2: Methodology:

2.1: The Role of Industry 4.0 in Corporate Sustainability

Current advances in Industry 4.0 technologies are a Core Business enabler towards achieving Corporate Sustainability as it fosters innovation and efficiency across business processes. Kyriakos et al. observe that businesses can avoid creating waste, make better use of resources, and limit their expenditures with real time data collection, automation, and predictive maintenance which all lead to positive environmental as well as economic consequences (McKinsey & Company, 2021).

Table 1: Direct Influence of Industry 4.0 on Sustainability Dimensions

Sustainability Dimension	Impact of Industry 4.0
Economic	Increased operational efficiency, cost reduction, and innovation
Environmental	Energy efficiency, waste reduction, and lower carbon footprint
Social	Improved working conditions, employee safety, and knowledge sharing

For instance, companies like Siemens and General Electric have relied on AI enabled automation and IoT technologies to maximize energy saving potentials, cut wastage of operational time, and optimize flows. The reasoning is that this not only brings down the level of production costs but optimizes the energy usage hence less pollution (Porter & Heppelmann, 2015).

2.2: Strategic Flexibility as a Driver of Sustainable Performance

Strategic flexibility has been proven to enable operating organizations in adjusting to the turbulent and often changing market variables, technological advancements and regulatory requirements while

achieving sustainability. They explained how high strategic flexibility enables the rapid acceptance of initiatives such as the implementation of ‘green’ technologies and revision of the logistics strategy for fresh products (Deloitte, 2020).

When top management’s strategic focus on the business increased, the implementation of sustainability initiatives in daily practices is likely to be enhanced by 30% (Accenture, 2020). These same companies demonstrate better performance in times of crises, for instance when there are supply chain problems or a drastic change in consumer preferences, by being able to rapidly shift gears (Iansiti & Lakhani, 2020).

Table 2: Strategic Flexibility and Sustainability:

Aspect	Strategic Flexibility Contribution
Economic	Enhanced innovation, quick market adaptation, and risk management
Environmental	Faster adoption of eco-friendly technologies and processes
Social	Retraining of employees, adaptive organizational culture

3: Results and Discussions:

3.1: Combined Influence of Industry 4.0 and Strategic Flexibility on Sustainability Performance of Companies

Strategic flexibility combined with the use of Industry 4.0 technologies allows companies to position themselves to enhance sustainable performance. Industry 4.0 technologies give a supporting capacity to boost productivity and lower undertakings that are environmentally unsustainable, while strategic flexibility permits and facilitates those efforts towards the bettering of the condition (Gebauer et al. 2021). The bar graph shows the effect of such factors as Industry 4.0 and strategic flexibility on corporate sustainable performance. Each component has maximum scores on one hundred percent, showing the contribution of the component to sustainability in practices:

Industry 4.0 Technologies (80): Has a significant contribution in enhancing sustainability through the

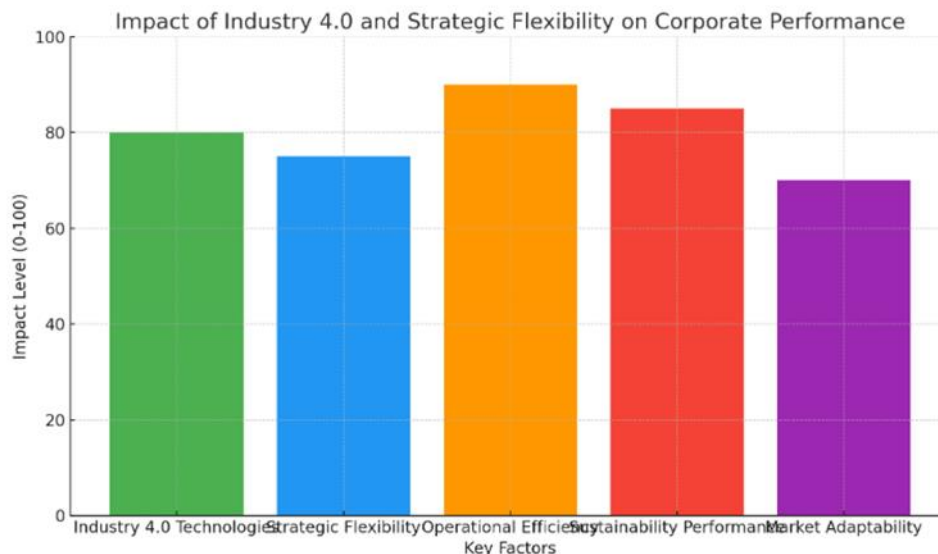
adoption of advanced technologies which help in optimal process reengineering.

Strategic Flexibility (75): Affords the possibility of gaining insights into market shifts and adopting healthy practices for these changes.

Operational Efficiency (90): Implies that efficiency that has been achieved will be of great importance in the elimination of prices and by extension suppression of the pollution.

Sustainability Performance (85): Highlights the favourable aspects entailed in the integration of Green technology and technology innovations.

Market Adaptability (70): This depicts the need for organizations to be flexible and responsive to changing market conditions. As a whole, the graph reveals that the integration of Industry 4.0 with strategic organisational flexibility and sustainable corporate performance is synergistic; businesses with all three prioritised should outlive their competitors over the long-term horizon.



Graph 1: Corporate Sustainability Performance: Intersection of Industry 4.0 and Strategic Flexibility

There is a gap in the literature on the extent to which the pursuit of the twin industry 4.0 and management flexibility will promote the rate of achievement of the growth of corporate sustainability as opposed to management practices stemming from either one or the other.

3.2: Case Study: Siemens and Strategic Flexibility in Industry 4.0

As a company at the forefront of industrial process automation, Siemens demonstrates that sufficient industrial performance can be achieved through the effective interconnection of Industry 4.0 technology and strategic flexibility. As a result of deploying IoT sensors, AI-owned data analytics and predictive

maintenance tools, Siemens was able to increase its factories energy efficiency by 20% and decrease operational downtimes by 30% (McKinsey & Company, 2021).

Furthermore, throughout the COVID-19 pandemic, Siemens also used strategic flexibility to change its supply chain management approach for ensuring sustainability in production while minimizing all forms of waste (Accenture, 2020).

Table 3: Achievements of Siemens Focusing on The Industry 4.0 and Strategic Flexibility Approaches

Outcome	Industry 4.0 Role	Strategic Flexibility Contribution
Energy efficiency	IoT-driven real-time energy management	Rapid adaptation to optimize resource allocation
Operational downtime reduction	Predictive maintenance through AI-based systems	Quick shifts in operational strategy during disruptions
Sustainability goals maintained	Automation and energy-efficient processes	Adaptation of supply chain strategy to reduce waste

3.3: Concerns and Problems

Generally, these benefits become increasingly clearer, there also exist some shortcomings mainly regarding the implementation of Industry 4.0 and enhancing one’s strategic flexibility. In particular, many organizations fail to take advantage of opportunities afforded by industry 4.0 because of low

initial financial commitment in digital technology and a lack of human capital (Kagermann et al., 2013). Also, it has been known that subcultures that resist change, as well as uncertainty in direction and leadership, pose challenges to building strategic flexibilities (Westerman et al., 2014).

Table 4: Constraints to the Product and Process Ones Self-definition and Production Strategies Challenges with Information

Challenges	Industry 4.0	Strategic Flexibility
High initial costs	Investment in IoT, AI, and automation technologies	Costs associated with creating adaptable infrastructures
Skills gap	Need for digital and technical expertise	Cross-functional training and workforce adaptability
Cultural resistance	Reluctance to adopt new technology-driven processes	Resistance to frequent strategic shifts and organizational changes
Challenges	Industry 4.0	Strategic Flexibility

4: Conclusion

The emergence of the Industry 4.0 technology together with strategic flexibility provides a new paradigm in enhancing corporate sustainable performance effectiveness and transformation in managing sustainability challenges within the fast-changing market place. As operational efficiency and environmental sensitivity capture businesses more, the interdependence between these two factors also provides greater sustainable outcomes. Industry 4.0, which leans on IoT, artificial intelligence, and big

data analytics, enables firms to enhance business processes and minimize resource use entirely through real time monitoring and interaction with machines to automate processes. Not only do these technologies improve efficiencies within operations but also allow for great savings to be made in non-productive activities such as waste generation and emissions in a bid to keep up with the corporate sustainability agenda.

Most organizations understand that being able to innovate and integrate sustainable methods to the

fundamental business unit creates competitive advantage which puts the organization ahead of the rest. The uniqueness of this paradigm is the balance between technology and flexibility, which is frequently neglected by traditional frameworks of sustainability. It is vital to stress, however, that the integration of Industry 4.0 together with strategic flexibility within a company leads to the promotion of sustainability objectives and the enhancement of the economic bottom line and the stakeholder value. This holistic approach guarantees that sustainability is part of the culture of the organization and therefore a constant pursuit of perfection and improvement. All in all, the fusion of Industry 4.0 and strategic flexibility is not merely a tactical enhancement. It is a deep conceptual change in management strategy of sustainable development of corporations.

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