

# INDUSTRY 5.0: REDEFINING STRATEGIC COST MANAGEMENT FOR SUSTAINABLE VALUE CREATION

## Abstract

This research explores how circular manufacturing and strategic management accounting can work hand in hand to support Industry 5.0 and India's vision of Viksit Bharat 2047. It explains how accounting tools such as Material Flow Cost Accounting (MFCA), Life Cycle Assessment (LCA), and Environmental, Social and Governance (ESG) performance measures can help organizations reduce waste, use resources more efficiently, and create long-term value. The study also explores at the current progress of Indian industries, the opportunities and the challenges of adopting circular production practices. Finally, it shows that management accountants have an important role in helping businesses become more sustainable, resilient, and future-ready.



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### The Changing Industrial Landscape

The circular approach is slowly replacing traditional “take-make-dispose” model of

production. Today, businesses are expected to use resources wisely, reduce waste, and lower their impact on the environment. Also, digital technologies are helping companies improve sustainability and make better use of available resources. To support this, management accounting provides useful tools such as Life Cycle Costing (LCC) and Material Flow Cost Accounting (MFCA). These tools help organizations understand costs, identify material wastes and losses, and make better decisions.

*Table 1. Comparison between Linear economy and Circular economy*

| Aspect       | Linear Economy                         | Circular Economy                                    |
|--------------|----------------------------------------|-----------------------------------------------------|
| Resource Use | Extract, use and dispose of resources. | Reduce, reuse, repair and recycle (4R's) resources. |
| Cost Focus   | Focus on production cost.              | Focus on life-cycle value and long-term savings.    |
| Waste        | Waste is discarded after use.          | Waste is reused as a resource for new production.   |
| Product Life | Short product life.                    | Longer product life through repair and reuse.       |

|                              |                                          |                                                                      |
|------------------------------|------------------------------------------|----------------------------------------------------------------------|
| <b>Environmental Impact</b>  | Higher pollution and resource depletion. | Lower pollution and better resource conservation.                    |
| <b>Business Goal</b>         | Maximize production and sales.           | Create sustainable value with efficient resource use.                |
| <b>Supply Chain</b>          | Depends on new raw materials.            | Uses recycled and recovered materials wherever possible.             |
| <b>Management Accounting</b> | Emphasis on cost control.                | Emphasis on resource efficiency, sustainability, and value creation. |

### Current Research and Perspectives

Recent studies show that the circular economy is not only an environmental initiative but also a smart business strategy. It helps organizations deal with resource shortages, rising costs, and climate-related challenges. Researchers have identified tools such as Material Flow Cost Accounting (MFCA) and ESG reporting as important methods for measuring and improving circular performance. At the same time, Industry 5.0 promotes the use of technology in a way that supports people, protects the environment, and encourages sustainable manufacturing.

### 1. Industry 5.0 and Circular Economy – Combined benefits

Industry 5.0 is different from earlier industrial models because it focuses on collaboration between people and smart technologies. As a result, businesses can not only achieve efficiency but also can work towards more sustainable and circular production systems. As we all know that, in synergy 1+1 is not equal to 2 but “11”.

Industry 5.0 places people at the heart of manufacturing. Instead of relying only on automation, it encourages human creativity and innovation to solve environmental and operational challenges. This approach helps industries reduce their environmental impact while creating safer, more sustainable, and socially responsible workplaces (Lei et al., 2024).

### 2. The Role of Technology in Circular Production

Artificial Intelligence (AI) is helping industries make better use of resources and improve sustainability. It can identify material waste, optimize production processes, and support better decision-making. Studies show that AI-based Industry 5.0 systems can improve resource efficiency by up to 30%, helping companies reduce waste and lower carbon emissions (Waqas & Naseem, 2025). This makes AI an important technology for supporting circular production.

Another important technology is the **Digital Twin**, which creates a virtual model of a real production system. It allows companies to monitor operations in real time, predict problems, and manage resources more effectively. Models such as the ‘**Sustainable Digital Twin Maturity Path**’ help organizations adopt digital technologies while supporting circular economy principles. By using technologies such as the Internet of Things (IoT) and edge computing, businesses can improve productivity and make production more sustainable (Sajadieh & Noh, 2025).

Blockchain technology helps companies track the movement of materials throughout the supply chain. This improves transparency, builds trust among suppliers and customers, and supports circular production practices. At the same time, as industries utilise digital technologies, strong cybersecurity measures are necessary to protect important business and production data.

### 3. Circular Economy Principles in Industry 5.0

Industry 5.0 combines economic growth with environmental protection and social well-being. It encourages businesses to use resources responsibly while building production systems that are flexible, sustainable, and able to adapt to changing conditions.

An important feature of Industry 5.0 is the integration of circular economy principles into every stage of a product’s life cycle. Companies are encouraged to design products that last longer, can be repaired, reused, and recycled. Practices such as eco-design and material recovery help reduce waste, conserve natural resources, and support sustainable production (Shafique et al., 2024).

#### 4. Sectoral and Urban Applications

The ideas of Industry 5.0 and the circular economy are not limited to manufacturing. They are also being used in urban planning and the development of smart cities. Startups and innovation centres are helping cities become more sustainable, resilient, and better prepared for future challenges (Berniak-Woźny et al., 2025).

These concepts are also changing the way buildings and cities are designed. Sustainable urban planning promotes energy-efficient buildings, better use of resources, and lower carbon emissions. By combining circular economy principles with smart technologies, cities can improve environmental performance while providing a better quality of life for their residents (Xie & Sun, 2025).

#### Strategic Management Accounting for the Circular Economy

To move from a linear economy to a circular economy, companies need to measure both money and environmental impact. Strategic Management Accounting (SMA) helps managers make better decisions by reducing waste, saving resources, and improving business performance.

#### 1. The Strategic Circular Value Accounting (SCVA) Model

Figure 1 shows the core components of the SCVA process.

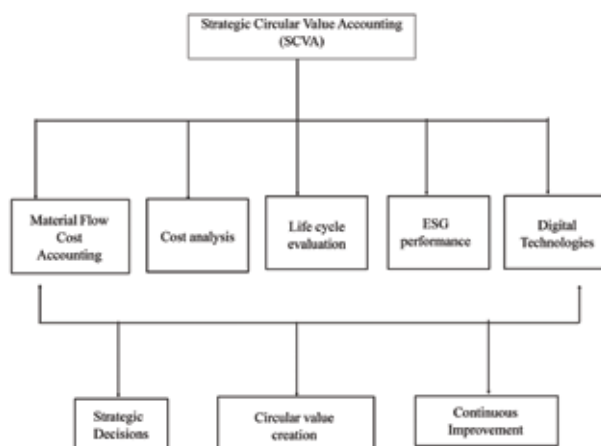


Figure 1. Strategic Circular Value Accounting (SCVA) Framework

The SCVA framework brings together key accounting and sustainability practices to

support circular production. It connects resource management, cost measurement, life-cycle evaluation, and ESG performance into a continuous improvement process. This helps organizations create long-term value while using resources more efficiently.

Table 2. Strategic Management Accounting Tools for Circular Production

| Tool                                        | What it does                                                                         | Why is it used                                        |
|---------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------|
| <b>Life Cycle Costing (LCC)</b>             | Calculates the total cost of a product from start to end of the life of the product. | Helps companies reduce costs over the product's life. |
| <b>Material Flow Cost Accounting (MFCA)</b> | Finds where materials are wasted during production.                                  | Helps reduce waste and use resources better.          |
| <b>Carbon Accounting</b>                    | Measures the carbon emissions of a company.                                          | Helps reduce pollution and meet environmental goals.  |
| <b>ESG Reporting</b>                        | Reports a company's environmental, social, and governance performance.               | Helps companies be more transparent and responsible.  |

#### Challenges in Implementation

Although Industry 5.0 offers many benefits, adopting it can be challenging. Many organizations are slow to implement circular practices because they are unsure about the financial benefits or return on investment (ROI). In addition, global issues such as geopolitical conflicts can make it difficult for businesses to focus on sustainability goals. The increasing use of Artificial Intelligence (AI) also raises concerns about data privacy, security, and fairness, making ethical guidelines essential.

The successful adoption of Industry 5.0 requires cooperation among different departments and stakeholders. Strong leadership, teamwork, and active participation from employees, suppliers, and customers are important for implementing circular production practices effectively.

There are many companies in India which have

adopted this circular production models and have turned out to be successful. This proves that the model is practical and viable.

### Assessing Impact in the Indian Industrial Sector

India's major industries have a great opportunity to reduce carbon emissions by adopting circular production practices. Sectors such as steel, cement, aluminium can save resources, lower emissions, and reduce operating costs.

*Table 3. Key Performance Indicators (KPIs) for India's Industrial Decarbonisation*

Source: Niti Aayog

| Sector    | Target Year | Target                                                                        |
|-----------|-------------|-------------------------------------------------------------------------------|
| Steel     | 2047        | 500 million tonnes crude steel production capacity                            |
| Cement    | 2070        | Net Zero Roadmap adopted (sectoral decarbonisation pathway)                   |
| Aluminium | 2070        | Sectoral decarbonisation roadmap released                                     |
| Overall   | 2070        | Net Zero emissions                                                            |
| Overall   | 2030        | 45% reduction in emissions intensity from 2005 level                          |
| Overall   | 2030        | 50% cumulative installed electric power capacity from non-fossil fuel sources |

### 1. Case Studies from Indian Industry

India's cement sector is already showing what's possible. Companies like UltraTech have successfully replaced over 20% of their raw materials with industrial by-products, with a goal to reach 50% by 2030 (Viswaprasad et al., 2025).

In the steel industry, Tata Steel has managed to cut water consumption by nearly a quarter through circular supply chain innovations. This sector could prevent 130 million tonnes of CO<sub>2</sub> emissions by 2030 (Viswaprasad et al., 2025; Herrmann, 2025).

Similarly, Tata Motors has reduced vehicle production energy intensity by over 16% by following industrial symbiosis and circular frameworks (Viswaprasad et al., 2025; Lahane et al., 2023).

### 2. Strategic Pathways Forward

To strengthen circular production, organizations should use tools such as Material Flow Cost Accounting (MFCA), Life Cycle Costing (LCC), and ESG reporting in their daily operations. Also, investing in digital technologies and encouraging cooperation across departments can improve resource efficiency and support long-term sustainability.

### Conclusion

Industry 5.0 and the circular economy can help industries to achieve the target as stated in the table 3 (KPI) successfully. By using smart technologies together with strategic management accounting, organizations can reduce waste, improve resource use, and create long-term value. These practices will support India's vision of **Viksit Bharat 2047**. JAI HIND! **MA**

### References

- Berniak-Woźny, J., Sliż, P., & Siciński, J. (2025). Empowering smart cities through start-ups: A sustainability framework for incubator-city collaboration. *Systems*, 13(4), 0219.
- Herrmann, P. (2025). Decarbonising India's Hard-to-Abate Sectors: The Role of Circular Economy Solutions. *Repository*.
- Lahane, S., Kant, R., Shankar, R. and Patil, S.K. (2023). 'Circular supply chain implementation performance measurement framework'. *Production Planning & Control*.
- NITI Aayog. (2026) Roadmap for Cement Sector Decarbonisation. New Delhi: Government of India.
- Sajadieh, S. M. M., & Noh, S. D. (2025). A review of digital twin integration in circular manufacturing for sustainable industry transition. *Sustainability*, 17(16), 7316.
- Shafique, M. N., Adeel, U., & Rashid, A. (2024). The synergy between Industry 5.0 and circular economy for sustainable performance in the Chinese manufacturing industry. *Sustainability*, 16(22), 9952.
- Viswaprasad, R., Sunitha, K. and Parvataneni, N.S. (2025). 'Corporate Pathways to Sustainability through Resource Management in Indian Enterprises'. *Indian Journal of Business*, 2(4).