

Enhancing Industrial Productivity Through Smart and Sustainable Solutions

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Introduction

Contemporary manufacturing companies now have a very challenging double mission in front of them. These include increasing their efficiency in order to be able to compete successfully in the growingly tough environment of

international competition and at the same time decreasing the negative impact of their activities on the environment due to the increased pressure from regulators, stakeholders, and other resource limitations. Contrary to this, however, many successful cases show that both these aspects can actually go hand-in-hand.

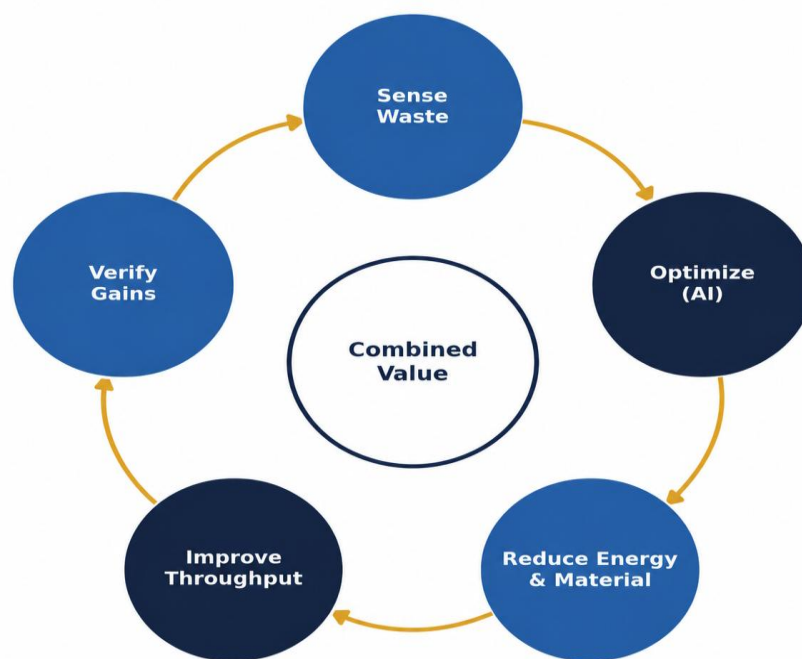


Figure 1: Process overview

The article discusses how the integration of intelligence and sustainability in processes is taking place to improve the productivity of industries, the technologies that are being utilized to integrate both the aspects, and the strategy that can be adopted by companies to benefit from both sides at the same time. Figure 1 shows a loop of productivity which includes waste detection, intelligence-based optimization, reduction of energy and materials, increased throughput, and gain confirmation.

The Convergence of Productivity and Sustainability

Traditionally, productivity and sustainability have been seen as distinctly different organizational issues, and sometimes even conflicting ones. Productivity programs would concentrate on efficiency, speed, and savings while sustainability programs concentrated on complying with regulations and responsible use of resources, and in many organizations, they were completely segregated. However, this distinction is becoming more and more obsolete due to a very simple yet very effective idea: waste – from excessive energy use, to scrap materials, from downtime to inefficient utilization of resources – is a burden both to the environment and to the budget. Thus, eliminating waste is a step toward accomplishing both productivity and sustainability goals.

Smart Technologies Driving Combined Gains

Predictive Maintenance

Predictive maintenance, which is made possible by Internet of Things (IoT) sensors coupled with artificial intelligence (AI) analysis, minimizes unexpected downtime and increases equipment longevity, hence improving efficiency, while at the same time minimizing wastage of energy and materials resulting from equipment malfunction.

AI-Driven Process Optimization

The use of artificial intelligence in production process optimization will increase both throughput and yield and decrease energy and material waste by making changes to processes that have not been able to be made in the past due to manual analysis of the process.

Energy Management Systems

By using advanced energy management systems, which give information on how energy is consumed in the manufacturing process at real time, manufacturers can pinpoint and stop energy waste, lowering their cost of operation and reducing the effects on the environment, but also revealing inefficiencies within the process.

Digital Twins

Digital Twin Technology helps the manufacturers in optimizing their production process by simulation, thus finding ways where they can enhance not only the efficiency of their process but also the efficiency of resource utilization in the process before making any physical changes.

Advanced Robotics and Automation

Modern automated systems, especially those that work in conjunction with intelligent process control systems, not only enhance production rates and consistency but also save material by eliminating waste due to increased precision, and they save energy by operating efficiently.

Circular Manufacturing Technologies

Technologies that aid in the efficient retrieval, processing, and recycling of materials, including high-tech sorting and recycling technologies, could potentially cut costs for raw materials directly, as well as the environmental costs related to the extraction of virgin materials and waste disposal.

Operational Practices Supporting Combined Gains

Lean and Green Manufacturing Integration

The concept of lean manufacturing that is always based on getting rid of any type of waste is consistent with the ideas of sustainability. Companies that manage to combine both lean

manufacturing and sustainability are likely to discover more possibilities for improvement than if they address each one of these issues separately.

Total Productive Maintenance

The total productive maintenance methodology is one in which the equipment operators themselves are actively involved in maintenance activities and continuously improving activities, contributing to not only productivity but also sustainability through higher efficiency in equipment operations and longevity of assets.

Continuous Improvement Culture

Continuous improvement culture which involves participation of all levels of employees in making small incremental improvements to the process often reveals issues which will help to boost productivity and sustainability goals since many inefficiencies in the process are related to wasting both time/output and resources.

Cross-Functional Metrics and Incentives

Companies that use an integrated approach to performance management by measuring their productivity and sustainability, rather than measuring them separately, manage to get more value from their integration due to the fact that the improvement efforts will be evaluated against these two aspects together.

Strategic Approach to Capturing Combined Value

Identifying High-Impact Convergence Opportunities

The first step for manufacturers would be to identify areas of operation where the chances of achieving both productivity and sustainability are highest – such as those that involve intensive use of energy, excessive material wastage, or even unexpected downtime.

Building Integrated Business Cases

Instead of assessing proposed initiatives in isolation according to productivity and sustainability dimensions, companies need to create business cases where the whole added value of both dimensions is captured; this may offer a better argument for an initiative than when any one of the two dimensions is used independently, especially when initiatives require substantial investments.

Establishing Integrated Governance

By dismantling the silo effect that exists within organizations between the functions of operations and sustainability, with regard to integrated governance systems, shared metrics, and collaboration planning processes, one can guarantee that any smart technology investment is assessed and put into practice with both objectives in mind.

Scaling Successful Pilots Thoughtfully

As is the case for all digital and technology efforts, manufacturers should pursue smart and sustainable solutions using a rigorous process that entails piloting, assessing cumulative impact, and rolling out successful initiatives throughout the enterprise, instead of embarking on large-scale transformation without prior evidence of cumulative value.

Measuring Combined Impact

For effectively measuring and expressing the dual benefit that intelligent and sustainable solutions have, metrics need to be defined that measure both aspects of benefits. Combined metrics that can be used are energy used/emissions per unit of production, which measures efficiency and environmental benefit; OEE (Overall Equipment Effectiveness), which measures the benefit of availability, performance, and quality; material yield/waste rates, which measures efficiency and environmental benefit; and total cost of ownership metrics, which take into account direct operating costs as well as growing environmental costs.

Challenges and Considerations

Although there is plenty of rationale behind bringing together productivity and sustainability goals, manufacturers should keep in mind that not all projects will contribute to both equally well, and some compromises may have to be made. Furthermore, in

order to unlock the full potential of intelligent and sustainable solutions, it is often important to make certain investments up front – in terms of technologies, data, and capabilities – which may be difficult to justify at once but can be spread out

according to available funding. Last but not least, sustaining productivity and sustainability improvements over the long run calls for more than one-shot technology implementation.

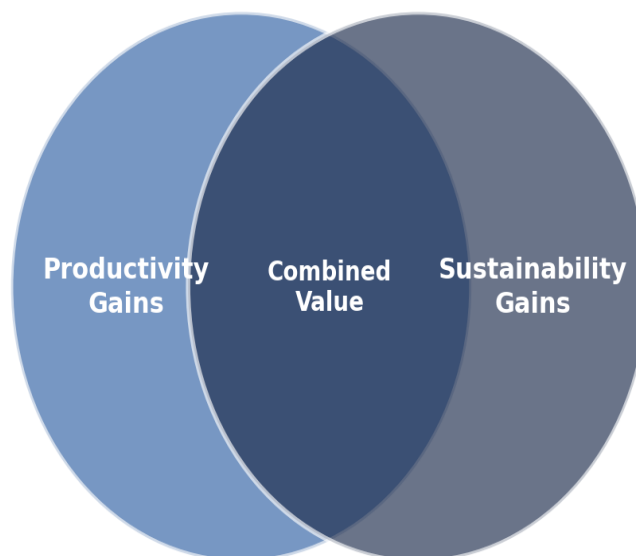


Figure 2: Key framework at a glance

Figure 2 shows the link between productivity and sustainability and how the integration of the two brings about the value created through efficiency gains as well as sustainable results.

Conclusion

The long-held belief that productivity and sustainability are opposing concepts is no longer relevant. Through smart technologies, which include predictive maintenance, artificial intelligence-driven process optimization, energy management

systems, digital twins, and automation, manufacturing organizations are now able to address both productivity and sustainability, sometimes through the exact same initiative. By taking a holistic strategy approach where there is the identification of high-impact convergence points, the development of a business case and governance for them, and the establishment of metrics for them, manufacturing organizations will be able to unlock all the value at their convergence points.