Chapter 6
Leveraging Microservices Architecture With .NET Core for Scalable Enterprise Applications in Sustainable Industrial Processes

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ABSTRACT

The transition toward sustainable industrial processes has become an imperative in the face of growing environmental concerns, regulatory pressures, and the pursuit of operational efficiency. This chapter explores the integration of Microservices Architecture with .NET Core to develop scalable, resilient, and adaptable enterprise applications that directly support sustainability goals. By decoupling complex systems into independently deployable services, organizations can optimize resource utilization, reduce energy consumption, and streamline operational workflows. The discussion covers key architectural principles, deployment strategies, and performance optimization techniques, with a focus on enabling continuous innovation while minimizing environmental impact. Real-world applications are examined in sectors such as manufacturing, energy, and supply chain, highlighting the potential of microservices to drive digital transformation aligned with sustainable development objectives. The chapter also addresses challenges such as inter-service communica-

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tion, data consistency, and governance, offering best practices to overcome them. Ultimately, this work provides a comprehensive framework for leveraging .NET Core microservices to foster both business scalability and environmental responsibility.

1. INTRODUCTION

Sustainability in industry used to be more of a "nice-to-have," something to showcase in annual reports and glossy marketing brochures. Now, it's a strategic imperative. Whether driven by tightening environmental regulations, shifting consumer expectations, or the simple reality of dwindling resources, organizations across manufacturing, logistics, and energy production are being forced to rethink how they operate. But here's the tricky part: these industries are also expected to become *more* efficient, *more* innovative, and *more* digitally integrated—all while cutting their environmental footprint. That's a tall order, and it's where technology, particularly modern software architecture, can make all the difference.

For decades, industrial software systems tended to be monolithic—single, massive applications that handled everything from inventory tracking to quality control to compliance reporting. They were reliable in the sense that they "just worked," but they were also painfully rigid. Changing one part of the system often meant touching everything, like trying to fix a leaking pipe that's buried inside a concrete wall. Updates were risky, integrations with new tools or platforms were slow, and scaling—whether to accommodate more data, more users, or entirely new business functions—was often a nightmare.

That rigidity has been especially problematic in the era of sustainability. Industrial processes are evolving at a pace that old monoliths simply can't match. Think about the rise of real-time emissions monitoring, predictive maintenance using IoT sensors, or adaptive production scheduling that responds to fluctuations in renewable energy availability. These are not "bolt-on" features; they're dynamic capabilities that need to be integrated deeply and quickly into the business infrastructure. A company locked into a monolithic software approach may find itself unable to keep up—or worse, unable to comply with new sustainability regulations in time.

Enter microservices. The concept isn't new—Amazon famously embraced it in the early 2000s—but its application in sustainable industrial contexts is still relatively fresh. At its core, microservices architecture breaks down a complex system into smaller, independently deployable services. Each service does one thing well—whether it's managing inventory, analyzing sensor data, or generating compliance reports—and communicates with other services through lightweight APIs. This decoupling offers a kind of flexibility that's almost tailor-made for the shifting demands of sustainable operations. Need to roll out a new energy-optimization

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