Box 2-9. The Origins and Pathways of Cola Can

A striking case study of the complexity of industrial metabolism is provided by James Womack and Daniel Jones in their book *Lean Thinking* [1996], where they trace the origins and pathways of a can of cola in England. The can itself is more costly and complicated to manufacture than the beverage. Bauxite is mined in Australia and trucked to a chemical reduction mill, where a half-hour process purifies each ton of bauxite into a half-ton of aluminum oxide. When enough of that is stockpiled, it is loaded on a giant ore carrier and sent to Sweden or Norway, where hydroelectric dams provide cheap electricity. After a month-long journey across two oceans, it usually sits at the smelter for as long as two months.

The smelter takes two hours to turn each half-ton of aluminum oxide into a quarter-ton of aluminum metal, in ingots 10 meters long. These are cured for two weeks before being shipped to roller mills in Sweden or Germany. There each ingot is heated to nearly 900 degrees Fahrenheit and rolled down to a thickness of an eighth of an inch. The resulting sheets are wrapped in 10-ton coils and transported to a warehouse, and then to a cold rolling mill in the same or another country, where they are rolled tenfold thinner, ready for fabrication. The aluminum is then sent to England, where sheets are punched and formed into cans, which are then washed, dried, painted with a base coat, and then painted again with specific product information. The cans are next lacquered, flanged (they are still topless), sprayed inside with a protective coating to prevent the cola from corroding the can, and inspected. The cans are palletized, fork lifted, and warehoused until needed. They are then shipped to the bottler, where they are washed and cleaned once more, then filled with flavored syrup, phosphorus, caffeine, and CO_2. The sugar is harvested from beet fields in France and undergoes trucking, milling, refining, and shipping. The phosphorus comes from Idaho, where it is excavated from deep open-pit mines—a process that also unearths cadmium and radioactive thorium. Round-the-clock, the mining company uses the same amount of electricity as a city of 100,000 people in order to reduce the phosphate to food-grade quality. The caffeine is shipped from a chemical manufacturer in England.

The filled cans are sealed with an aluminum "pop-top" lid at the rate of 1,500 cans per minute, then inserted into cardboard cartons printed with matching color and promotional schemes. The cartons are made of forest pulp that may have originated anywhere from Sweden or Siberia to the old-growth, virgin forests of British Columbia that are the home of grizzlies, wolverines, otters, and eagles. Palletized again, the cans are shipped to a regional distribution warehouse, and shortly thereafter to a supermarket, where a typical can is purchased within three days. The consumer buys 12 ounces of the phosphate-tinged, caffeine-impregnated, caramel-flavored sugar water. Drinking the cola takes a few minutes; throwing the can away takes a second. In England, consumers discard 84 percent of all cans, which means that the overall rate of aluminum waste, after counting production losses, is 88 percent. The US still gets three-fifths of its aluminum from virgin ore, at 20 times the energy intensity of recycled aluminum, and throws away enough aluminum to replace its entire commercial aircraft fleet every three months.

Source: Hawken et al. 1999: 49-50, as cited in D.V. Smith and K.F. Jalal (2000), p. 45