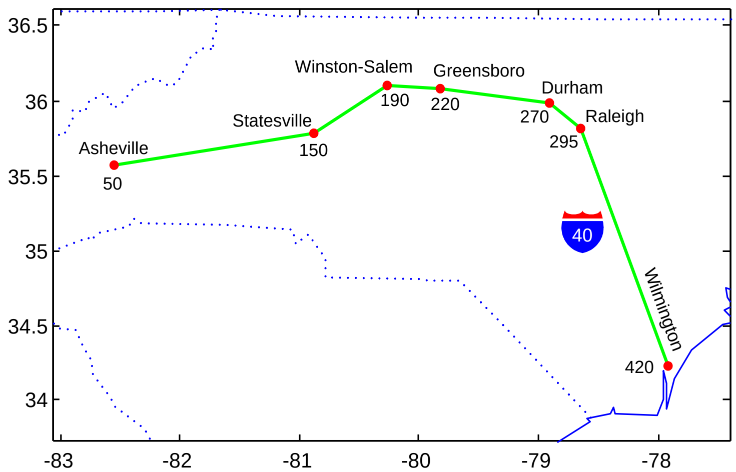
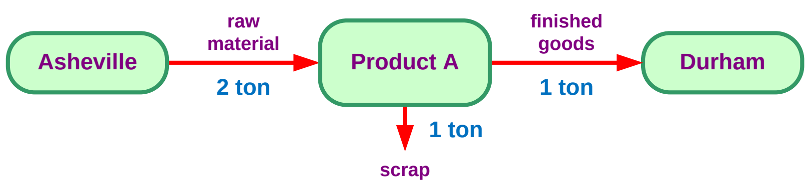
# ICA 2: Single-Facility Minisum Location

## ISE 453: Design of PLS Systems — Spring 2020

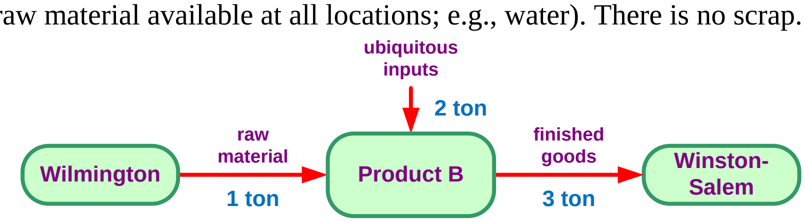



**Example:** Products A and B are to be produced in plants that will be located along I-40. The raw materials used to produce the products will be shipped from suppliers located at several cities along I-40 to the plants, and the finished goods will be shipped from the plants to customers located at several cities along I-40. The cost per ton-mile (i.e., the cost to ship one ton, one mile) for both raw materials and finished goods is \$0.10. In the figure above, the number of road miles from the beginning of I-40 at the western border of North Carolina to each city is shown below its name.

- Each ton of Product A to be shipped to a customer in Durham requires two tons of raw materials from a supplier located in Asheville. One ton of scrap will be produced along with each ton of finished product and will be disposed of near the plant producing the product.




- Every three tons of Product B to be shipped to a customer in Winston-Salem requires one ton of raw material from a supplier located in Wilmington and two tons of "ubiquitous inputs" (i.e., raw material available at all locations; e.g., water). There is no scrap.




(a) Where should the plant for each product be located so that procurement and distribution costs (i.e., transportation costs to and from the plant) are minimized? *Answer: Locate plant for A at Asheville and B at Winston-Salem*

(b) How would the location decision change if the customers paid for distribution costs (i.e., FOB Origin) instead of the producer (i.e., FOB Destination)? What would be the impact if there were competitors located along I-40 producing the same product? *Answer: No change for A since located at supplier. B would move from customer to supplier at Wilmington only if customer does not have an alternate supplier located closer. That B would stay at Winston-Salem implies that location decisions in a competitive environment should include both inbound and out bound transportation costs irrespective of who is actually paying for the transport (who pays, as specified via FOB terms, should only reflect who can transport at the lowest cost).*

(c) Which product is weight gaining and which is weight losing? For both products, why is their physical weight directly proportional to their monetary weight? *Answer: A is weight losing, B weight gaining. Physical weight is proportional to monetary weight only because inbound and outbound transport rates are the same.*

(d) If it were possible to produce both products in a single shared plant instead of at two dedicated plants, why is it now necessary to know each product's annual demand? *Answer: The monetary weight now depends on the relative demand of each product.*

1. A product is to be produced in a plant that will be located along I-40. Two tons of raw materials from a supplier in Ashville and a half ton of a raw material from a supplier in Durham are used to produce each ton of finished product that is shipped to customers in Statesville, Winston-Salem, and Wilmington. The annual demand of these customers is 10, 20, and 30 tons, respectively, and it costs $0.33 per ton-mile to ship raw materials to the plant and $1.00 per ton-mile to ship finished goods from the plant. Determine where the plant should be located so that procurement and distribution costs (i.e., transportation costs to/from the plant) are minimized (see slide for solution).

2. A product is to be produced in a plant that will be located along I-40. Three thousand pounds of raw materials from a supplier in Raleigh and a thousand pounds of a raw material from a supplier in Asheville are used to produce each ton of finished product that is shipped to customers Asheville, Statesville, Winston-Salem, Durham, Raleigh, and Wilmington. The annual demand of these customers is 41, 28, 40, 32, 22, and 18 tons, respectively, and it costs $0.20 per ton-mile to ship raw materials to the plant and $1.00 per ton-mile to ship finished goods from the plant. Where the plant should be located so that procurement and distribution are minimized?

3. A new tool crib is to be located on the floor of a facility. Workers from seven different workstations will make 13, 10, 21, 32, 26, 43, and 18 trips per shift to the tool crib. The 2-D locations of the workstations are shown. Assuming rectilinear distance is a reasonable approximation of the actual travel distance, determine the optimal location for the tool crib that will minimize the total distance that the workers travel.