Gadget Manufacturing Simulator

Gordan’s Gadgets (GG) manufactures gadgets from widgets and thing-a-bobs, which are created from raw materials (steel, plastics, electricity, etc.) As GG produces gadgets, it stores them in warehouses for sale and distribution. Assuming that raw materials are available as needed, their manufacturing process consists of the following entities that build or manager resources:

* A Thing-a-bob Builder (TB) that constructs thing-a-bobs on demand (or in anticipation of near-term future demand). It takes approximately 10 minutes to create a thing-a-bob and a TB can only produce one at a time.
* A Widget Builder (WB) that constructs widgets on demand (or in anticipation of future demand). It takes approximately 12 minutes to create a widget and a WB can only produce one at a time.
* A Gadget Assembler (GA) that obtains thing-a-bobs and widgets from TB’s and WB’s to construct gadgets, and places finished gadgets in warehouses (WH). A GA requires 3 thing-a-bobs and 2 widgets to produce a gadget, and once it has all these 5 items, it takes approximately 15 minutes to produce one gadget. A GA can only produce one gadget at a time.
* Gadget Warehouses (GW) that store completed gadgets until they are shipped to customers. A WH can hold 1000 gadgets. Shipping is only done once a week, so a WH may have hold gadgets for up to over 10,000 minutes.

Before spending a lot of money to re-tool their manufacturing plant, GG would like to create a software simulator of their process so they can model various what-if scenarios. Specifically, they want to explore how TB’s, WB’s, GA’, and GW’s they need to produce a given number of gadgets per hour (i.e., achieve a given throughput).

Design a distributed system, with the necessary communication protocols, that simulates GG manufacturing process and allows the user to

* Start up any number of TB’s, WB’s, GA’s, and GW’s
* Specify the maximum number of thing-a-bobs that a TB can stock pile
* Specify the maximum number of widgets that a WB can stock pile
* Specify the failure rate and average down time for TB’s, WB’s, and GA’s
* Specify the potential variance from average construction times for thing-a-bobs, widgets, and gadgets
* Monitor and log throughput
* A scale factor for speed-up time, e.g., 1 min = 100 ms