AN INTEGRATED QUALITY/QUANTITY MODEL OF A TRANSFER LINE

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Quality and quantity are equally important attributes of a manufacturing system, and there is a large body of literature dealing with each. However, there is very little analytic work that treats the interaction of quality, quantity, and cost.

Factory designers and managers know that it is desirable that inspection take place immediately after the operation that is inspected. When this is not done, a large number of bad parts may be produced before the faulty operation is detected, and this is costly. However, it is also costly to inspect after each operation. As a result, factories are often designed so that multiple inspections are performed at a small number of stations, and the likelihood of producing many bad parts is great. A quantitative examination of the trade-offs in inspection location is therefore needed.

In addition, new phenomena arise: for example, the yield of a line becomes a function of the sizes of buffers. This is because when buffers are larger, more material accumulates between an operation and the inspection of that operation. All such material will be defective. It is important to quantify that relationship.

The goal of this research is to extend existing production line models to include inspection, especially inspection that is performed at one or more stages downstream from where the inspected operation takes place.

We extend models of production lines with unreliable machines and finite buffers. In this model, there are two kinds of material in a buffer: good and defective. Operators cannot distinguish among them except by using a downstream inspection station. (Eventually, our models will include many kinds of defective parts, classified according to the defect or defects a part has.) A machine has three states: up and producing good parts; up and producing bad parts; and down for repair. We assume that operators do not know which up state a machine is in until they deduce that is it is producing defective parts by detecting the bad parts in the downstream inspection step. Once the machine has entered the defective state, it stays there until a bad part has been observed, and then the machine goes into the down-for-repair state. (It can also get into that state due to an observable failure, such as a broken tool.) The inspection is not perfect: it sometimes does not detect bad parts.

We begin by analyzing a two-station model where the second station includes both an operation and an inspection. We then extend this to a long line model and analyze it by means of a new decomposition technique.

Future work includes the extension of this model to more general topologies and to the design of a system. Design means the simultaneous choice of machines, locations and sizes of buffers, and locations of inspection