INTERNATIONAL JOURNAL OF INNOVATIVE TRENDS IN ENGINEERING (IJITE)
VOLUME 23, NUMBER 01, 2016
ISSN: 2395-2946

Analysis of Flow Lines

Sriram Bharath[1]

[1] *PhD Scholar Department of Mechanical Engineering, GITAM University, Hyderabad, India.*

Abstract - During the last decades considerable progress has been made in the performance analysis of tightly-coupled Flow lines. However, to the best of our knowledge, industrial planners rarely use analytical methods for the performance evaluation of flow lines in the design phase of an FPS. Instead, simulation is often the only planning tool applied. Although computer power is increasing dramatically, a large amount of computing time is still required to achieve statistically significant simulation results. Two flow lines were considered one balanced and other unbalanced line, the capacity of both the lines were maintained same, the study is done on the performance of these lines with different processing times, breakdown and with defective pats. The comparison of flow lines is done with parameters i.e. with same processing time and different processing time and with and without break down and with and without imperfect production.

Keywords – Flow line; Simulation; Flexsim; Balancing; Buffer.

1. INTRODUCTION

Considering the huge number of possible design alternatives, this often results in the selection and installation of a suboptimal system configuration. In this paper we present a new approximation procedure for the analysis of FPSs. The procedure can be applied to systems with manual and/or automated stations, and it accounts for station breakdowns as well as for imperfect production with scrapping. FPSs of this kind are found in the automobile, electronic and nutrition industries. The comparison of flow lines is done with parameters i.e. with same processing time and different processing time and with and without break down and with and without imperfect production.

Flexsim is a powerful analysis tool that helps engineers and planners make intelligent decisions in the design and operation of a system. With Flexsim, you can build a 3-dimensional computer model of a real-life system, and then study that system in either a shorter time frame or for less cost than with the actual system. In technical terms, Flexsim is classified as a discrete-event simulation software program. This means that it is used to model systems which change state at discrete points in time as a result of specific events. Common states might be classifications such as idle, busy, blocked or down, and some examples of events would be the arrival of customer orders, product movement, and machine breakdowns.

2. SYSTEM MODEL

We consider a linear FPS including M single-server stations separated by M -1 finite buffers. Discrete parts enter the system at station 1 and, as long as production quality is good, consecutively proceed from station 1 to station M in a fixed predetermined sequence. Storage space in front of the first station is unlimited and never empty (i.e., station 1 is never starved), and the last station has always space enough to put a completed part (i.e., station M is never blocked). The system has the following characteristics.

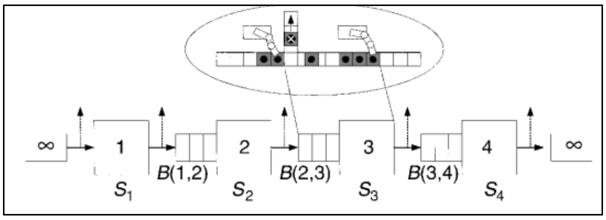

Fig.l Model of a Flow Line.

The processing times at station I are generally distributed random variables with mean bi and coefficient of variation CV_i . The material flow is asynchronous.

Processing at station i is imperfect with probability y_i. A subset k 2 K of stations may be assigned a quality inspector who checks the parts immediately after processing at station k and who with certainty detects all defectives resulting from processing since the last quality control within the line.

The stations may be subject to random failures, which are assumed to be operation dependent. When there is a failure the currently processed part remains at the station during the repair time, after which the operation is completed.

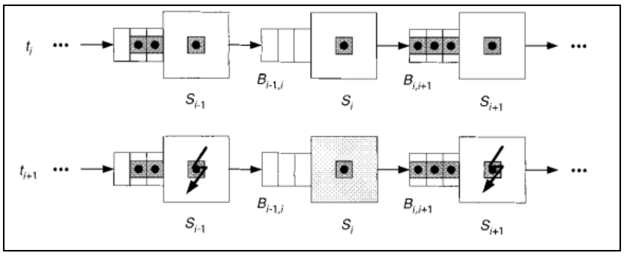

Fig.2 Evaluation of unbalanced flow lines.

3. PREVIOUS WORK

A great number of researchers have studied FPSs with many different characteristics. Comprehensive surveys are provided by Dallery and Gershwin (1992) and Gershwin (1994). These reviews include the literature onreliable two-station systems with synchronous transfer, on flow lines without buffers as well as on approximation methods for systems with more than two stations. Algorithms for the analysis of systems with stochastic processing times are summarized in the textbooks of Buzacott and Shanthikumar (1993), Papadopoulos et al.(1993) and Altiok (1997). Earlier reviews are presented by Koenigsberg (1958), Buxey et al. (1973) and Buzacott and Hanifin (1978). There are relatively few publications on FPSs withstations prone to failures and imperfect production. Shanthikumar (1980) analyzes synchronous systems with deterministic processing times assuming unlimited buffersizes. Shanthikumar and Tien (1983) consider synchronous two-station systems with deterministic processing times and limited buffer sizes. Their approach has been adopted to longer lines by Jafari and Shanthikumar (1987). Asynchronous systems without buffers and systems with unlimited buffer sizes are considered by Bulgak and Sanders (1990) and Buzacott and Shanthikumar(1993) under the assumption of deterministic processing times. Asynchronous systems with exponentially distributed processing times, limited buffers and scrapping of defective parts are modeled by Pourbabai (1990), however, under the assumption that a part is scrapped after blocking of a station. The influence of defective parts on the performance of two-station systems is studied in detail by Gopalan and Kannan (1994a,b,c) and Gopalan.

4. SIMULATION

Simulation is the act of reproducing the behavior of a system using a model that describes the process of the system. Once the model has been developed, the analyst can manipulate certain variables to measure the effects of changes on the operating characteristics of interest. A simulation model cannot prescribe what should be done about a problem. Instead, it can be used to study alternative solutions to the problem. The alternatives can be used to in the model, and the relevant operating characteristics are recorded. After all the alternatives have been tried, the best one is selected.

4.1 Reasons for using simulation

Simulation is useful when waiting-line models become too complex. There are other reasons for using simulation for analyzing processes. First, when the relationship between the variables is nonlinear or where there are too many variables or constraints to handle with the optimizing approaches, simulation models can be used to estimate operating characteristics or objective function values and analyze a problem.

Second simulation models can be used to conduct experiments without disrupting real systems. Experimenting with a real system can be very costly. For example, a simulation model can be used to estimate the benefits of purchasing and installing a new flexible manufacturing system without first installing such a system. Also, the model could be used to evaluate different configurations or processing decision rules without disrupting production schedules.

4.2Uses of simulation

The availability of special-purpose simulation languages, massive computing capabilities at a decreasing cost per operation, and advances in simulation methodologies have made simulation one of the most widely used and accepted tools in operations research and system analysis. Simulation can be used for the following purposes:

a. Simulation enables the study of and experimentation with the internal interactions of a complex system or a subsystem with in a complex system.
b. Informational, organizational and environmental changes can be simulated and the effect of these alterations on the model’s behavior can be observed.
c. Simulation can be used to experiment with new designs or policies prior to implementation so as to prepare for what may happen.
d. By simulating different capabilities for a machine, requirements can be determined.
e. Simulation models designed for training allow learning without the cost and disruption of on-the-job learning.
f. Simulation can be used to verify analytic solutions.
g. Animation shows a system in simulated operation so that the plan can be visualized.

4. PROPOSED METHODOLOGY

The items being processed in a discrete-event simulation model are often physical products, but they might also be customers, paperwork, drawings, tasks, phone calls, electronic messages, etc. These items proceed through a series of processing, queuing and transportation steps in what is termed a process flow. Each step of the process may require one or more resources such as a machine, a conveyor, an operator, a vehicle or a tool of some sort.

Some of these resources are stationary and some are mobile, some resources are dedicated to a specific task and others must be shared across multiple tasks. We shall consider here two main performance measures of any manufacturing system, which are indicative of its competitive status in the manufacturing world. These are

1.Throughput

2.Work-in-process

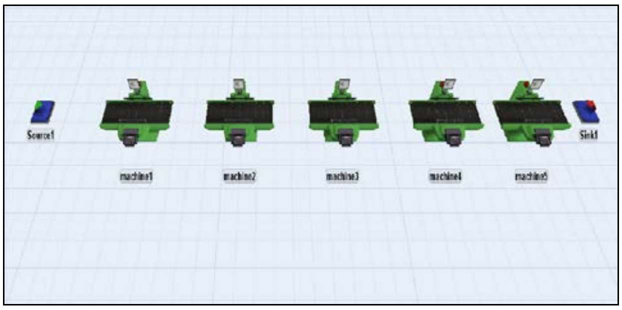

Fig.3 Flexsim Model of Balanced line.

5. SIMULATION/EXPERIMENTAL RESULTS

Lines Without breakdown and defective parts (with buffer)

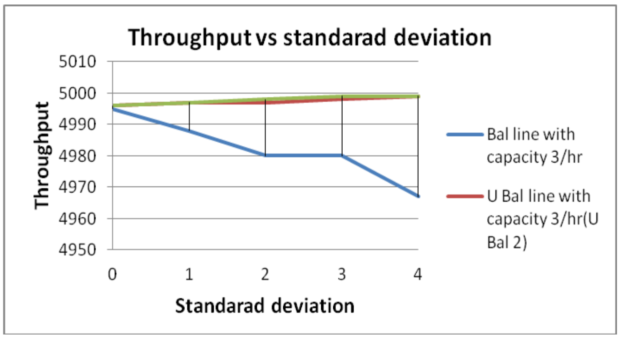

Fig.4 Variation of throughput with standard deviation

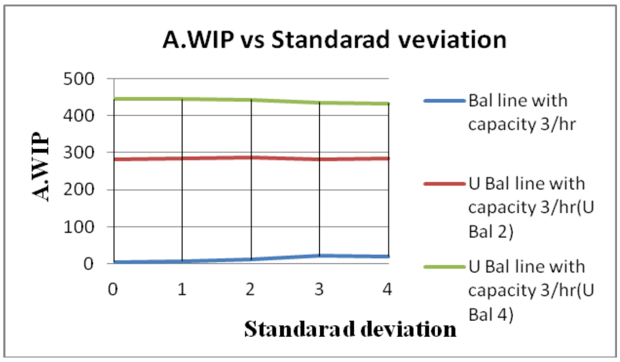

Fig.5 Variation of A.wip with standard deviation

In this case the throughput and a.wip is almost the same when the amount of variability is increased. Lines Without breakdown and defective parts (without buffer)

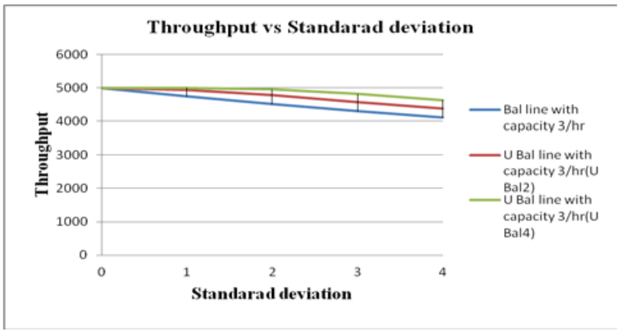

Fig.6 Variation of throughput with standard deviation.

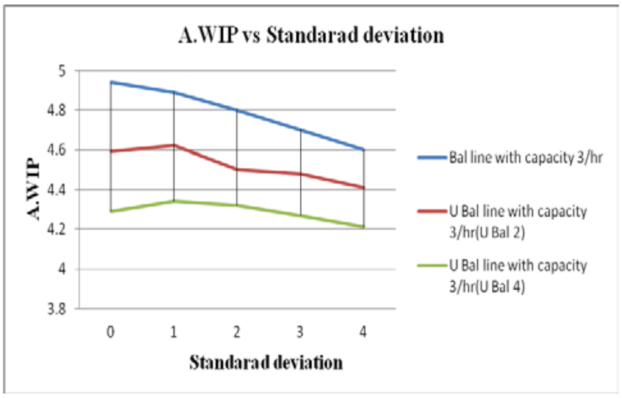

Fig.7 Variation of A.wip with standard deviation.

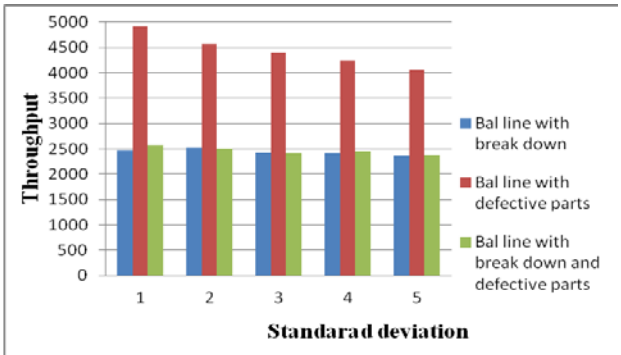

Fig.8 Variation of through put in balanced line

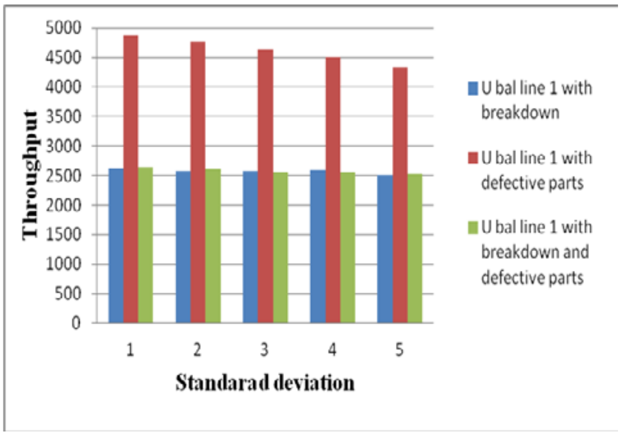

Fig.9 Variation of through put in unbalanced line(U Bal 2)

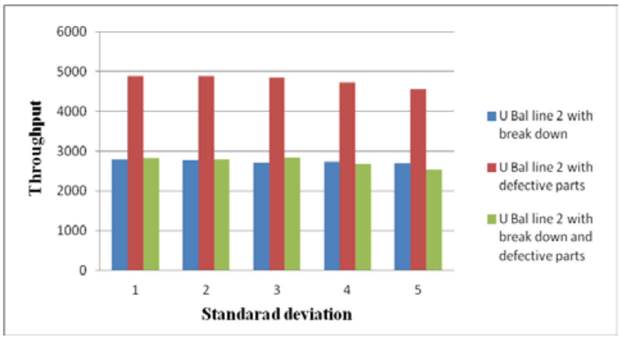

Fig.10 Variation of through put in unbalanced line(U Bal 4)

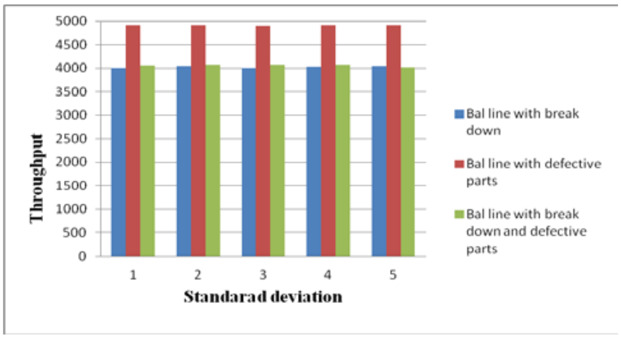

Fig.11 Variation of through put in balanced line (with buffer)

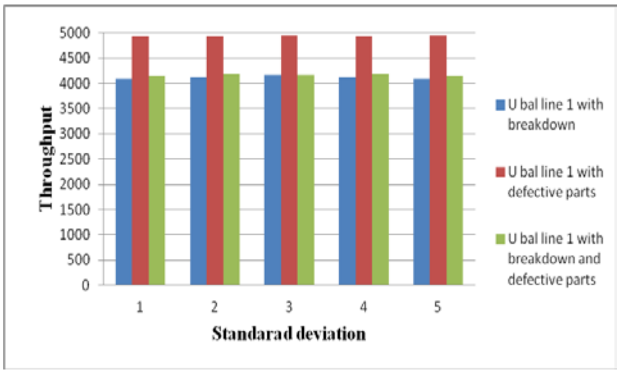

Fig.12 Variation of through put in unbalanced line1 (with buffer).

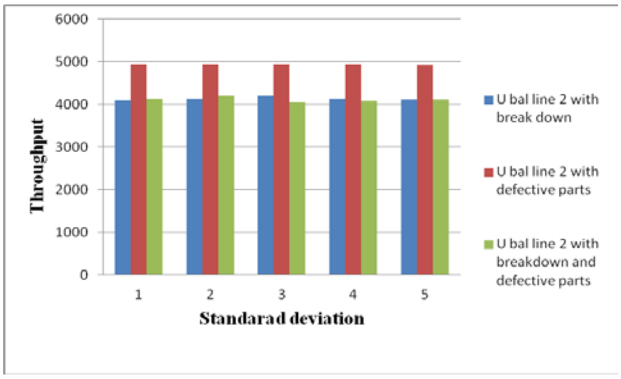

Fig.13 Variation of through put in unbalanced line2 (with buffer)

6. CONCLUSION

The throughput is almost the same in the with buffer case for both the balanced and unbalanced line when the amount of variability is increased, but in the without buffer case there is a certain amount of reduction in throughput when the amount of variability is increased for both the balanced and unbalanced line. The throughput is inversely proportional to the variability .When the breakdown and defective parts conditions are applied to all the machines in balanced and unbalanced line the reduction in throughput is same for both the lines, even when the amount of variability is increased the reduction in throughput for the balanced and unbalanced lines is almost the same due to breakdown and defective parts production of all the machines in the line.

REFERENCES

[1] Altiok, T. (1997) Performance Analysis of Manufacturing Systems,Springer, New York.

[2] Automation, Production systems and computer integrated manufacturing By Mikell P.Groover.

[3] Bulgak, A. and Sanders, J. (1990) An analytical performance model for assembly systems with automatic inspection stations and repairloops. [1] Computers and Industrial Engineering, 18, 373±380.

[4] Burger, M. (1997) Konfigurationsplanung flexibler Flieûproduktionssys-teme, Galda und Wilch, Glienicke/Berlin, (in German).

[5] Buxey, G., Slack, N. and Wild, R. (1973) Production flow line systemdesign ± a review. AIIE Transactions, 5, 37±48.

[6] Buzacott, J. and Hanifin, L. (1978) Models of automatic transfer lines with inventory banks a review and comparison. AIEE Transac-tions, 10, 197±207.

[7] Buzacott, J. and Hanifin, L. (1978) Models of automatic transfer lineswith inventory banks a review and comparison. AIEE Transactions, 10, 197±207.

[8] Buzacott, J., and Liu, X.-G. and Shanthikumar, J. (1995) Multistageflow line analysis with the stopped arrival queue model. IEE Transactions, 27, 444±455.

[9] Buzacott, J. and Shanthikumar, J. (1993) Stochastic Models of Manufacturing Systems, Prentice Hall, Englewood Cliffs, NJ.

[10] Dallery, Y. and Gershwin, S. (1992)Manufacturing flow line systems: a review of models and analytical results. Queueing Systems, 12, 3±94.

AUTHOR'S PROFILE

Sriram Bharath has received his Master of technology degree in Mechanical Engineering from NIT Warangal , Under Computer Integrated Manufacturing Specialization in the year 2011. At present he is pursuing Ph.D. in Gitam University. His area of interest Manufacturing, Supply Chain Management.