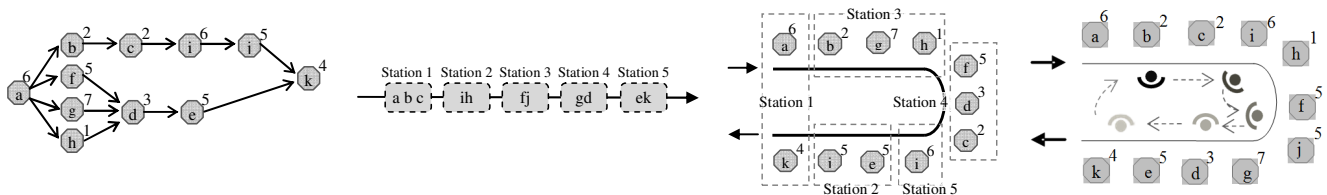




Application of discrete event simulation to assess the effect of operation variability in the performance of assembly lines and work cells

Paulo Peças*, Raquel Folgado, Luís Oliveira, Elsa Henriques

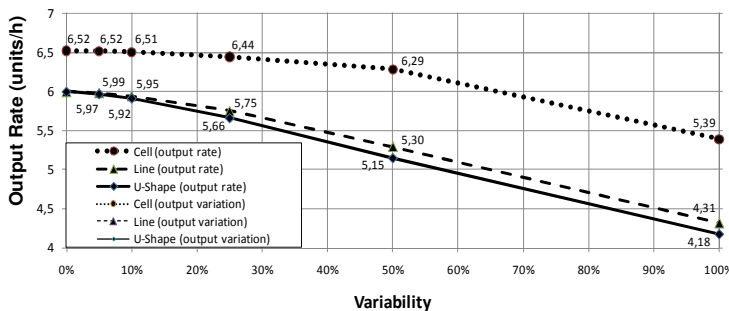
Abstract: Assembly lines and work cells are the basic configuration of most production systems. During the last decades important developments have been accomplished by several researchers on the understanding and modelling of the mechanisms that most influence the behaviour of those systems. The implementation of the solutions and procedures in the shop-floor must deal with “production noise variables”: operation time variability, random operator efficiency or motivation, space constraints and line feeding inconsistency. This paper compares the effects of the “production noise variables” in the performance of three types of production systems: straight and U-shaped assembly lines and work cells. The systems performance is assessed through the use of simulation software, comparing the effect of “production noise variables” in the throughput time, cycle time, work-in-process, etc. Additionally, several types of buffers are inserted between work stations in order to evaluate their effect with an increased variability in the operations time. The results from the research work permit to identify the critical values of the noise variables, the ones that if surpassed will cause significant damages in the production system performance. The distinct effects in assembly lines and in work cells are identified, as well as the standard solutions to minimize the problems and keep the robustness of the production systems.



Precedence graph of Jackson 11-task assembly problem and studied configurations: straight line, U-Shape line and work cell.

Results Obtained

The U-shape assembly line output rate is the lowest one while the work cell is the highest, nonetheless the work cell starts out with a higher value.



| Configuration | % σ (relative to average task time) | | | | |
|---------------|--|------|-----|-----|------|
| | 5% | 10% | 25% | 50% | 100% |
| Straight Line | 100% | 99% | 96% | 88% | 72% |
| U-shape Line | 100% | 99% | 95% | 86% | 70% |
| Work Cell | 100% | 100% | 99% | 96% | 83% |

The relative variation for the work cell is the lowest one, while for U-shape line is the highest variation – about 30% for a standard deviation of 100%.

The introduction of buffers on the assembly lines configuration shows that it allows compensation of the variability of the task times until a certain point.

Moreover, the U-shape line requires more WIP to compensate the task time variability.