

International Conference  
on Industrial Engineering and Systems Management

**IESM' 2009**

May 13 - 15, 2009

MONTREAL - CANADA

## Constrained economic design of a SPC procedure in a manual multi-task workstation<sup>\*</sup>

Giovanni CELANO<sup>a</sup>, Antonio F.B. COSTA<sup>b</sup>,  
Maysa S. DE MAGALHÃES<sup>c</sup>, Sergio FICHERA<sup>a</sup>

<sup>a</sup> *Dipartimento di Ingegneria Industriale e Meccanica, University of Catania, Italy*

<sup>b</sup> *Department of Production, FEG-UNESP, Guaratingueta, Brazil.*

<sup>c</sup> *Instituto Politecnico (IPRJ), Universidade do Estado do Rio de Janeiro, Brazil.*

---

### Abstract

Often the workload balancing of a manufacturing line prescribes that the working and the inspection tasks on components / subassemblies should be performed locally within a workstation by just one worker: thus, the design of a Statistical Process Control procedure employed to make the inspection activities cannot leave several constraints out depending on the internal workstation configuration. The aim of this study is to design economically a local SPC inspection procedure by selecting one among several Shewhart control chart strategies to be manually managed by a worker: constraints related to the dimension of the processed batches of parts and to the respect of an assigned value of the workstation cycle time are taken into account. A robust approach is taken into account which models as a random variable the shift of the controlled parameter mean. The outcome of the SPC procedure design also allows the decision maker to get knowledge about the amount of workload needed to perform the inspection tasks. A benchmark of 64 examples investigating the effects of several process operating parameters has been organized. The obtained results show that the selection of the best performing SPC inspection procedure is not straightforward and it strongly depends on the process capability index and the batch dimension.

*Key words:* Quality Control; Manufacturing; Manpower Planning; Robustness and Sensitivity Analysis

---

### 1 Introduction

Workload balancing of a flow line is a strategic issue to avoid the occurrence of bottlenecks, increased lead times and work-in-process (WIP): it performs the tasks assignment to workstations with the goal of minimizing the cycle time under a constraint fixing the number of the workstations or, conversely, minimizing the number of workstations given an assigned value of the cycle time, [1]. Often, technological or labour resource constraints require that a worker within a workstation should perform both the working and inspection tasks on a batch of manufactured parts. Some examples of these manufacturing stages are represented by small enterprises producing electronic components / subassemblies, merchandising and customized items and the garment industry. The inspection tasks can involve one or several Critical to Quality parameters and can be performed by implementing

---

<sup>\*</sup> This paper was not presented at any other revue. Corresponding author G. Celano. Tel. +39 095 7382423. Fax +39 095 7387923

*Email addresses:* gcelano@diim.unict.it, (Giovanni Celano), antonio.costa@pq.cnpq.br (Antonio F.B. Costa), maysa.magalhaes@ibge.gov.br (Maysa S. De Magalhães), sfichera@diim.unict.it, (Sergio Fichera)