PRODUCTION MONITORING – A PROVEN PRODUCTIVITY TOOL

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Production executives in modern factories are concerned with standards, real production and schedule maintenance, and with having early foresight into problem areas. The use of digital computers in the factory has for many years been largely divided between “closed-loop control” and “data processing” (DP), but today there is a growing need for “closed-loop information control” (CLIC). This paper describes a system for implementation of this concept using exclusively industry-standard hardware, and its application within smaller industrial operations rather than the industrial giants (although their need may indeed be greater). For many such smaller companies, production monitoring may be a first venture into CIM. Rather than “control” or “data” being the key, “information” is the cornerstone of the system described.

The word “information” conjures up a variety of ideas in its normal use, but a visit to a real factory forces a closer look at its meaning, if the CLIC concept is to be even worth considering. Repeatable and verifiable data sources are very difficult to obtain on the factory floor. Physical compatibility is a real concern, because equipment that operates in the usual controlled DP environment is not usually reliable on the factory floor. The operating conditions demanded by much of today’s DP equipment preclude heat, vibration, electromagnetic interference and the generally hostile conditions which are prevalent in many factories. Consequently, any factory-floor system is fraught with unique problems all the way from data capture, through communications, into efficient data structures and meaningful graphic presentation.

This paper describes such a system and summarises its effect on productivity as proven by application in several factories in the US and Canada.

Keywords: Automated data collection; Closed-loop systems; Hardware; PLC interface; Production monitoring; Production sequencing; Software

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1. Introduction

Manufacturing facilities have become a prime target for vendors of computer systems, and rightly so. The repetitive nature of the production processes promotes the use of automation, operations research, production aids and tools, and planning software. Material requirements planning (MRP) software can be used to process data from most areas of a factory operation [1] and to produce intelligent schedules for production control and inventory and raw material ordering, based on some notion of standard performance and expectations. Orlicky [2] attempts to relate the “plan” to “reality” by defining the master schedule as follows: “The master production schedule should be a statement of what can and will be produced, rather than what management wishes had been produced in the past and/or would like to be able to produce in the immediate future.”

However, in most instances, the actual moment-by-moment sequencing of production processes is still not considered before actual production takes place and the pertinent data are not keyed into the appropriate MRP input module ahead of needs. Leland Kneppelt, of MSA Inc., addressed this problem, particularly in “just-in-time” (JIT) environments [3]. Basically, his assessment of the situation was that most decision software does not address the real need, and that making adaptations to standards “after the fact” was often incorrect and misleading. For example, a poor job performance due to a broken part in a machine should not require standards to be adjusted once the part is replaced and the machine retuned and/or serviced. However, a history of machine failures should be kept so as to focus attention on the machine, with a view towards more serious preventive maintenance (PM) or possibly eventual replacement. Kneppelt introduced a closed-loop information concept which was further developed by Russell [4].

The system to be described in this paper has the architecture shown in Fig. 1, and comprises a central processor, a programmable logic controller (PLC) and a variety of “ruggedised” peripherals for data entry, display and capture.

2. System Architecture

The primary data functions are summarised in the Yourdon-method context diagram shown in Fig. 2.

2.1 Data Capture on the Factory Floor

Automatic data collection is enabled by direct wiring of signals from the factory-floor machinery to the I/O modules on the PLC. If the cycling rates are above 1 s⁻¹, a prescaler can be attached, for instance to give one rate in five. These signals are picked up directly from secondary contact closures inside the machine’s motor-control centre. The PLC program monitors cycle times, counts, analogue signals, etc. and preprocesses the data for collection by the system computer.