A review and reappraisal of electronic performance monitoring, performance standards and stress allowances

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There is a growing trend toward electronic performance monitoring (EPM) to track the performance of workers engaged in computer-based tasks. Despite the possible productivity advantages of this approach to work management, the use of EPM may produce stress through work overload, negative computer feedback, loss of incentive pay and threat of job loss. These stress effects are most likely to occur among workers who have difficulty meeting work standards (eg, forms processed per hour) enforced through EPM. A stress allowance is proposed as a new category of work allowance for adjusting EPM work standards so as to minimize imbalances between task demands and the worker's resources to adapt.

Keywords: Performance appraisal, electronic monitoring, stress allowance, task overload, work standards

Introduction and overview

Advances in microelectronics and the rapid computerization of office work have facilitated the expanding use of electronic performance monitoring. The Office of Technology Assessment (Anon, 1987) has defined electronic performance monitoring (EPM) as the 'computerized collection, storage, analysis and reporting of information about employees' activities.' It is estimated that EPM is used in the performance evaluation of approximately six million clerical office workers (Anon, 1987). The number of workers who are electronically monitored is expected to increase rapidly due to the growing economic pressures to improve the efficiency of customer service work and office work.

EPM is used to monitor keystroke production and error rates in word processing and data entry tasks. Customer service operators, airline reservation clerks and directory assistance operators are monitored by computers to determine how long it takes to assist customers and to measure the amount of time between calls. Freight haulers are using computers to monitor driver speed and fuel consumption, and tyre manufacturers are electronically monitoring the productivity of rubber workers. EPM is increasingly being used to establish performance standards, track employee performance, compare actual performance with predetermined standards, and administer incentive pay programmes based on these standards (Anon, 1987).

Historically, employers have always attempted to improve methods for measuring employee performance, particularly in the industrial workplace. In this sense, the use of computer technology to monitor employee performance is not a new development. What is new, however, is the use of computer technology in office settings to capture employee performance on a second-by-second keystroke-by-keystroke basis so that work management in the form of corrective action, performance feedback, delivery of incentive pay or disciplinary measures can be exercised at any time (Smith, 1988). These dramatic changes in the management of office work have focused public attention on the implications of electronic monitoring for privacy, fairness and work stress.

Advocates of EPM assert that continuous tracking of work activity is essential to high performance and productivity in the modern office. They contend that electronic monitoring enables managers and supervisors to organize and control human, material and financial resources. Specifically, EPM provides for: (a) increased control over performance variability; (b) increased objectivity and timeliness of performance evaluation and feedback; (c) efficient management of large office operations through the electronic supervision of work; and (d) establishment and enforcement of performance standards (eg, number of forms processed per hour).

Supporters of electronic monitoring also claim that, from the worker's perspective, there are several benefits. Electronic monitoring, for example, can provide timely feedback of work performance which enables workers to take corrective action when necessary.

Regular feedback also may satisfy the worker's need for self-evaluation and reduce performance uncertainty (Landy and Farr, 1983).

Nevertheless, concerns have been raised by government agencies, worker representatives and the public news media that certain monitoring practices are abusive and constitute an invasion of employee privacy (Anon, 1987). Privacy has become an issue, particularly when workers do not know when or how they are being monitored. Since work organizations often do not share performance data with workers, a related privacy issue is whether workers have access to their own performance records or the right to question incorrect information.

Workers also have raised objections to the manner in which monitoring systems have been implemented (Smith *et al*, 1986; Westin, 1986). In some workplaces, monitoring is perceived as an unfair labour practice when it is used to measure individual, as opposed to group, performance. Workers and unions have particularly taken exception to the use of monitoring to enforce compliance with performance standards. There is also concern that electronic monitoring can make the work process more impersonal by replacing a human supervisor with an electronic supervisor. In addition, there is an apprehension that the over-emphasis on production may encourage workers to compete instead of cooperate with one another (Anon, 1987).

There is a theoretical basis (Smith *et al*, 1986; Anon, 1987; Amick and Smith, 1992) and some empirical evidence (Smith *et al*, 1986; Westin, 1986; DiTecco *et al*, 1992) suggesting that EPM work management methods can alter basic job dimensions (eg, workload and task control) and produce an imbalance between task demands and a worker's resources to adapt. In particular, electronic monitoring is likely to be stressful when it is used to enforce compliance with performance standards that workers have difficulty meeting. Under such conditions, workers may experience stress through work overload, negative computer/supervisor feedback, and threat of job loss.

To investigate and control the stress effects of EPM, the National Institute for Occupational Safety and Health has initiated a research project, 'Electronic Performance Monitoring: Stress Prevention Strategies,' (Schleifer, 1991). One possible strategy currently under investigation is a stress allowance. A stress allowance is proposed in this paper as a new category of work allowance for adjusting EPM performance standards so as to maintain a balance between task demands and a worker's resources to adapt.

Electronic monitoring, performance standards and stress

Recognizing that fairness of performance standards is an important factor in whether monitoring will be stressful, it is essential to have a better appreciation of how standards are established. There are several informal and formal methods for setting performance standards. (See Shell (1986) for a description of these methods.) One informal approach used by supervisors or managers is called 'judgment estimation'. For example, based on one's experience, an estimate is made regarding the number of production units that a worker should be able to accommodate over a specified period of time (eg, forms processed per hour).

Apart from obvious questions regarding the accuracy and consistency of performance, a major problem with judgment estimation is that an unknowing or unprincipled manager may use electronic monitoring to enforce compliance with production quotas that impose excessive workload demands. Under these conditions, short-term economic gains may be realized at the expense of the worker's long-term well-being. In effect, the worker is exposed to chronic work overload due to the use of work standards that are based on production requirements, as opposed to the human factors principle of fitting the task to the worker.

A more formal and widely accepted approach to establishing performance standards involves the use of work measurement methods developed by industrial engineers. Work measurement is "a generic term used to refer to the setting of a time standard by a recognized industrial engineering technique, such as time study, standard data, work sampling or predetermined motion system" (Industrial Engineering Terminology Standard, Z94.12). For example, time study is one of the most widely used work measurement methods for setting performance standards. According to Nolan (1983), time study can be defined as follows:

> ". . . a process of observing an operation while utilizing a timing device, and rating the pace or performance of the individual performing the operation in order to establish a standard for that operation. It involves defining a job or task in terms of its elements and making careful observations – usually using a stopwatch – to establish the time required for the element (p 132)."

Predetermined time systems are another commonly-used work measurement technique. Perhaps the most well-established predetermined time system is Methods-Time Measurement (MTM). MTM has been defined as follows (Maynard *et al*, 1948):

> "Methods-Time Measurement is a procedure which analyzes any manual operation or method into the basic motions required to perform it and assigns to each motion a predetermined time standard which is determined by the nature of the motion and conditions under which it is made (p 14)."

Under the work measurement approach to setting performance standards, 100% performance is defined as a 'fair day's work pace.' This is the work pace "at which an average well-trained employee can work without undue fatigue while producing an acceptable quality of work" over the course of a workday (Nolan, 1983). A 100% performance is not maximum performance; it is the normal or average pace for a group of workers. By way of comparison, the 70% benchmark is generally regarded as the minimum tolerable level of performance, while the 120% benchmark is the incentive pace that the average worker should be able to attain when provided with a bonus of 20% above the base rate of pay (Nolan, 1983). While a number of incentive plans have been established using the 120% benchmark, this value varies among plans. The general

design criteria recommended for wage incentive plans give workers the opportunity to earn approximately 20–35% above base rate if they are normally skilled and execute high effort continuously (Niebel, 1988).

It is important to note that normal or average performance is not standardized; it varies from organization to organization. Several factors can influence what is considered normal within a given organization, including geographical location, type of work methods or technology employed, nature of the task, quality assurance standards, and the abilities and skills of the available work force (Shell, 1986). The industrial engineer takes these factors into consideration when establishing the performance standard for a given work group.

Despite the inherent appeal of a 'fair day's work for a fair day's pay,' some possible stress problems exist with a work measurement approach to setting performance standards. Performance standards are fixed in reference to the normal or average performance of a given work group (ie, work standards based on group as opposed to individual performance). Thus, by definition, a large segment of those working at a task will fall below average (ie, the 100% performance benchmark) generating a demand–resource imbalance. Workers who have difficulty meeting performance standards enforced by EPM are likely to experience stress through work overload, negative supervisor/computer feedback, and threat of job loss if they consistently perform below the work standard.

Electronic monitoring and stress allowances

Once normal performance criteria are established through work measurement studies, adjustments or work allowances are applied to determine the work standard (Niebel, 1988; Shell, 1986). Work allowances are expressed as a percentage of the normal time for a task. For example, a 15% addition to the normal cycle time is commonly applied for personal time, rest breaks, machine delay and physical fatigue. In some tasks involving high levels of mental concentration and visual demands (eg, machine-paced work and inspection), work allowances also have been used occasionally for psychological fatigue (Konz, 1987). Conventional categories of work allowances, however, have been established primarily for physical tasks performed in an industrial workplace.

To control the stress effects of electronic performance monitoring in the office workplace, it may be useful to adjust performance standards with a stress allowance. A stress allowance would be a new category of work allowance for addressing the psychological and physiological stress effects of mental tasks performed in an electronic office. It would be applied to those workers who have difficulty meeting an EPM work standard (ie, demand-resource imbalance), since these workers are most likely to experience stress due to work overload and negative performance feedback.

By optimizing workload demands, a stress allowance is consistent with an ergonomics approach to work design. It promotes worker well-being by balancing the productivity advantages of EPM against the stress effects of this approach to work management.

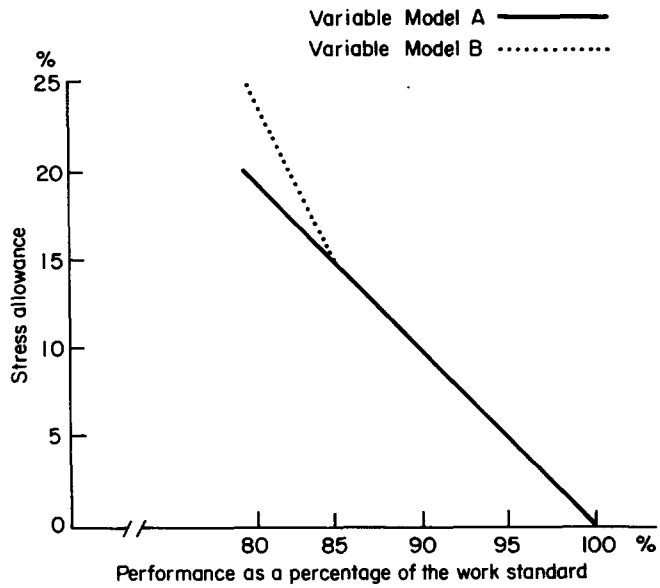

Figure 1 Variable stress allowance models as a function of performance.

Computation of allowance time for stress

The methodology for computation of the allowance time for stress should be based on established industrial engineering and ergonomics practices, as is the case with any work allowance. This computation can be accomplished through worker output measurement and worker evaluations of workload demands and stress based on standardized questionnaires (eg, see Hurrell and Mclaney, 1988). An important factor in determining the allowance time for stress is the extent to which tasks vary in their workload demands. For example, tasks that require high rates of information processing demands may require a larger stress allowance than tasks that require moderate rates. Ideally, the allowance time for stress should enable workers to comply with a performance standard without generating excessive workload demands and stress.

Stress allowances can be either uniform or variable in time duration. Under the uniform approach, all workers who have difficulty meeting a work standard would be assigned the same allowance time (eg, a 10% reduction in a work standard) regardless of the level of performance. With a variable approach, allowance times would vary as a function of differences in performance and perceived workload demands. The variable approach is based on the premise that workers differ in the extent to which they experience stress as a function of their performance, and that some workers will need a large stress allowance while others will require only a small allowance.

As a hypothetical example, workers who perform at 85% of a work standard might receive a 15% stress allowance while workers who perform at 95% of a work standard might receive a 5% stress allowance (see Figure 1, Variable Model A). In other words, the stress allowance is exactly proportional to the shortfall in performance from the 100% work standard. Another possible variable approach is shown in Figure 1, Variable Model B. Inspection of Model B indicates that at 90% and 100% performance the stress allowances are

the same as for Model A. However, at 80% performance the stress allowance would be 25%, compared with only 20% for Model A. Model B is based on the premise that in the 'low' performance range the required stress allowance is proportionally greater than the discrepancy between task performance and the 100% work standard.

While a uniform allowance is easier to administer than a variable allowance, a disadvantage of the former approach is that it can result in over- or under-estimation of the allowance times for stress. Over-estimation would result in a work standard that contributes to a loss of productivity while under-estimation would result in a work standard that imposes excessive workload demands. By comparison, a variable approach can minimize the occurrence of these problems by assigning allowance times as a function of individual stress levels and/or different performance outcomes in relation to a work standard.

Practical issues

The feasibility of a stress allowance strategy is contingent upon addressing several employer and employee concerns. Are employers willing to provide stress allowances if they result in a reduction in quantitative work output? Will employees who perform above a work standard view stress allowances as a form of preferential treatment for workers who perform below a standard? Regarding the first concern, employers might be willing to accept stress allowances since any reduction in the speed of work may be offset by a corresponding increase in the accuracy of work, particularly given the performance bias in EPM work management toward speed rather than accuracy. Such an improvement in the quality of work output can be expected on the basis of the well-established negative relationship between speed and accuracy in task performance (Pachella, 1974). In effect, stress allowances may reduce errors of commission by optimizing the speed or pace at which a task is performed. Stress allowances also may reduce errors of commission by optimizing the level of physiological arousal (Frankenhaeuser and Johansson, 1974). In addition, stress allowances may actually result in an overall gain in productivity by reducing worker turnover rates, absenteeism and training costs.

Regarding the matter of preferential treatment, this concern can be addressed by offering a bonus pay plan to workers who exceed a work standard. Another possible approach is to provide a stress allowance for workers both above and below a work standard, particularly if such an allowance improves qualitative performance. Again, employers might be willing to accept stress allowances for all workers given the possible productivity advantages of an EPM approach to work management.

Finally, it is important to note that a stress allowance is not a panacea for 'poor' work design. A stress allowance should not be provided to alleviate the stress effects of work overload (eg, 'unfair' performance standards) or an onerous supervisor. Instead, the 'unfair' performance standards or the abusive managerial style should be modified. A stress allowance is not a substitute for restructuring jobs that are incompatible with a worker's capacities or limitations. It should be limited to addressing the stress effects of using EPM to enforce compliance with 'fair' performance standards.

Recommendations for research

A stress allowance is a new concept for possibly controlling stress effects resulting from the use of electronic performance monitoring for work standard compliance. Research is needed to characterize the stress effects of electronic performance monitoring and to develop the most efficacious strategies for the design and administration of stress allowances, thereby promoting worker well-being and facilitating the motivational advantages of an EPM approach to work management. NIOSH is currently conducting research to assess the stress effects of EPM work management on mood state, somatic comfort and cardiovascular-respiratory reactivity, and to evaluate the efficacy and practicality of a stress allowance strategy (Schleifer, 1991). This research may facilitate the application of a stress allowance strategy by work organizations that have adopted an EPM approach to work management.

References

Anon. 1987. 'The Electronic Supervisor: New Technology, New Tensions'. Office of Technology Assessment, Congress of the United States. (OTA-CIT-333). Washington, DC. Government Printing Office.

Amick, B., and Smith, M. 1992. *Applied Ergonomics*, 23.1, 6–16. Stress, computer-based work monitoring and measurement systems: A conceptual overview.

DiTecco, D., Cwitco, G., Arsenault, A., and Andre, M. 1992. *Applied Ergonomics*, 23.1, 29–34. Operator stress and monitoring practices.

Frankenhaeuser, M., and Johansson, B.. 1974. 'On the Psychological Consequences of Understimulation and Overstimulation.' Reports from the Psychological Laboratories, University of Stockholm, (Supplement 25), Stockholm.

Hurrell, J., and Mclaney, A., 1988. *Scand J Work, Environ and Health*, **14**, supplement I, 27–28. Exposure to job stress – A new psychometric instrument.

Konz, S. A. 1987. 'Work Design: Industrial Ergonomics' (2nd Edn), Publishing Horizons, Inc, Columbus, Ohio.

Landy, F., and Farr, J. 1983. 'The Measurement of Work Performance'. Academic Press, New York.

Maynard, H. B., Stegemerten, G. J., and Schwab, J. L. 1948. 'Methods-Time Measurement'. McGraw-Hill, New York.

Niebel, B. W. 1988. 'Motion and Time Study' (8th Edn), Irwin, Homewood, IL.

Nolan, R. 1983. 'Work measurement'. In: Lehrer, R. (Ed), White Collar Productivity, McGraw-Hill, New York. 111–158.

Pachella, R. 1974. 'The Interpretation of Reaction Time in Information Processing Research'. In: B. Kantowitz (Ed), 'Human Information Processing: Tutorials in Performance and Cognition. Lawrence Erlbaum Associates Inc, Hillsdale, New Jersey.

Schleifer, L. M. 1991. 'Electronic Performance Monitoring: Stress Prevention Strategies'. Unpublished Project Protocol, National Institute for Occupational Safety and Health, Cincinnati, Ohio.

Schleifer, L. M. (in press). 'Electronic Monitoring and Stress in Computer-based Office Tasks: A Review of the Literature and Recommendations for Further Research. Proceedings of

the 5th Mid-Central Ergonomics/Human Factors Conference. Dayton, Ohio, 23–25 May, 1991.

Shell, R. L. (Ed). 1986. 'Work Measurement: Principles and Practice'. Industrial Engineering and Management Press, Georgia.

Smith, M. J. 1988, *Human Factors Soc Bull*, **31** (2), 1–3. Electronic performance monitoring at the workplace: Part of a new industrial revolution.

Smith, M. J., Carayon, P., and Miezio, K. 1986. 'Motivational, Behavioral, and Psychological Implications of Electronic Monitoring of Worker Performance (NTIS PB88–156369). National Technical Information Service, Washington, DC.

Westin, A. 1986. 'Privacy and Quality of Work-Life Issues in Employee Monitoring' (NTIS PB88–156851). National Technical Information Service, Washington, DC.