

ERGONOMICS IN THE SOUTH AFRICAN MANUFACTURING INDUSTRY

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OPSOMMING

Die studie is daarop gemik om 'n beeld te vorm oor die toepassing van Ergonomika in die Suid-Afrikaanse vervaardigingsnywerheid. Inligting is ingesamel oor die aard van plaaslike ergonomiese aktiwiteite, die soort ergonomiese inligting wat gebruik word sowel as die wyses waarop sodanige inligting verkry word. Die resultate van die studie word oorweeg in die lig van enkele faktore wat van wesenlike belang is in die Suid-Afrikaanse konteks.

In the study of man's work behaviour, Ergonomics represents the area which is associated with 'fitting the task to the man'. This somewhat crude description of Ergonomics becomes more meaningful when viewing in greater detail those features of the 'task' and characteristics of 'man' which affect their fitting together into a productive system.

Within an ergonomic framework 'the task' is usually defined by machines, equipment and tools. The operation of these depends upon activation (through switches, knobs, handles and the like) to deliver a particular kind of output; the quality and quantity of which is displayed either indirectly (through dials, meters and so on) or directly.

The features of the activation (input mechanisms) and display aspects are determined during task design and are the major areas in which human intervention takes place. Man intervenes through his perceptual, mental and response mechanisms. For example, dial readings are perceived, mentally compared with prescribed standards and, if required, adjustments are carried out on relevant switches. Man's capacity to perform these activities, however, is limited in terms of his anthropometrical, physiological and psychological make-up.

In 'fitting the task to the man', ergonomists are involved not only in determining man's capabilities and limitations, but also in translating these into appropriate design decisions. Three categories of such decisions may be distinguished. The first category represents decisions made in the actual design of hardware or jobs. Decisions in the next category are

concerned with dimensions of the physical environment in which the 'man-machine' system is to operate. Ergonomics practised in these two categories may be described more accurately as 'preventative ergonomics'. The third category represents decisions that are made to compensate for deficiencies in the design of hardware. In many cases this implies some modification in the skills behaviour of operators. Ergonomics on this level may be termed 'corrective ergonomics'.

As is the case in most fields of scientific enquiry, shifts in emphasis are also apparent in Ergonomics. Singleton (1971), for example, identifies the following phases in the deployment of Ergonomics. Initially, that is during and shortly after World War II, endeavours centered on efficient 'man-machine interface design'. During the Cold War the concept of 'system ergonomics' evolved, with a view to shortening overall development time by the simultaneous development of hardware and human components. More recently, as a result of the requirements of the aeronautic industry, the activities of ergonomics seem to focus on the reduction of human error and, consequently, improving human reliability.

Although military considerations played a significant role in establishing Ergonomics, industry has not only benefited from, but also contributed to its development. For example: Mills & Sinclair (1976) investigated aspects in a knitwear company; Shinar & Acton (1978) studied population stereotypes in the control-display relationships on a four-plate stove; Mourant & Rockwell (1972) examined the strategies of visual search adopted by novice and experienced motorcar drivers; Sell (1977) performed an ergonomic analysis of crane cabs; Crockford provided design solutions for protective clothing; Fox (1977) studied problems related to the quality control of minted coins and Shackel et al. (1971) studied the ergonomics of automated meat handling.

It is evident, when reviewing the journals on Ergonomics, that this list is by no means exhaustive: mention should also be made of Sommer (1974, 1977), who has extended the application of Ergonomics into the fields of architecture and interior decorating.

From the above it appears that Ergonomics abroad is well established, developing and actively contributing to the designing of tasks for men. At present little seems to be known about ergonomic activities in South Africa - evidenced to some extent by the comparative rareness of South Africa publications in this field. More information, particularly regarding the practical application of Ergonomics, appears therefore to be needed. This study is aimed at securing such information through which a clearer picture regarding Ergonomics in South Africa is expected to emerge.

THE AIM OF THE STUDY

The study is directed at the South African manufacturing industry and aimed at:

- clarifying the nature of ergonomic involvement in the manufacturing industry;
- assessing the use of different kinds of data in ergonomic analysis;
- determining the manner in which ergonomic data is collected and used;
- determining the degree of educational support for Ergonomics in the manufacturing industry.

METHOD

The selection of participants

From the remarks in the preceding paragraphs there would appear to be opportunity for the application of Ergonomics in most industries. Although it would be interesting to assess the actual application of Ergonomics in industries such as physical health (i.e. in hospitals), transport, retail and the like, the scope of this study is limited to the manufacturing industry. It was felt that this industry - and in particular members producing hardware goods such as washing machines, tools and so on, which are used by operators - would provide an apt indication of ergonomic activity. 600 firms were selected randomly from among the top 20 percent of consumers of electricity in the manufacturing industry to participate in the study.

The method of data collection

In order to obtain the kind of data needed to achieve the aims of the investigation, use was made of the postal survey method. In formulating the survey questionnaire, care was taken to overcome some of the difficulties associated with the postal method of data collection. For example, a brief description of the concept of 'Ergonomics' was included so as to provide a common basis for responding to the questions. Furthermore, the number of items in the questionnaire, all of which were structured, was limited to 20. On 15 items a yes/no response was required, whilst a forced choice rating response had to be made with regard to five items.

RESULTS

Reaction of participants

Of the 600 questionnaires mailed to participants, 142 (23,7 percent) were returned. Of these 136 had been completed and were subsequently analysed. The remaining 6 (4,2 percent of the returned questionnaires) had not been completed by participants.

The nature of Ergonomic involvement

Responses to the nature of ergonomic involvement in the manufacturing industry are summarised in Table 1.

TABLE 1

THE NATURE OF ERGONOMIC INVOLVEMENT

(1) KIND OF INVOLVEMENT	(2) DIMENSIONS	(3) APPLIED OWN PRODUCTION SYSTEM			(4) APPLIED TO MANUFACTURED PRODUCTS			
		% YES	% NO	% SPOILED	% YES	% NO	% NA	% SPOILED
HARDWARE/ DESIGN	Allocation of function: men/machine	54,4	41,2	4,4	29,4	22,8	44,1	3,7
	Control display arrangement	60,3	33,8	5,9	26,5	21,3	49,3	2,9
	Specify features of displays	40,4	54,4	5,2	20,6	28,7	47,0	3,7
	Specify features of controls	66,2	28,7	5,1	30,9	14,7	50,0	4,4
ENVIRON- MENTAL	Specify physical parameters	76,5	22,0	1,5	31,6	20,6	44,1	3,7
	Specify workplace lay-out	81,6	14,7	3,7	43,4	16,9	35,3	4,4
OPERATOR SKILLS	Specify selection criteria	62,5	36,0	1,5	22,8	23,5	50,0	3,7
	Specify training requirements	75,7	22,8	1,5	39,7	18,4	38,2	3,7
	Specify operator procedures	86,0	11,8	2,2	50,7	10,3	33,8	5,2

Whilst the dimensions are grouped according to the kind of ergonomic involvement in Table 1, they were presented in random order in the questionnaire. In column 3 of Table 1 responses regarding the production system used by participants are shown. An inspection of the three kinds of ergonomic involvement (column 1) reveals that they differ markedly. Column 4 in Table 1 shows responses to ergonomic involvement listed in column 1 with the products which participants are manufacturing. These data also indicate that the kind of ergonomic involvement differs appreciably.

The kind of data used for Ergonomic analysis

The kind of data base used for analysis is derived from the interdisciplinary nature characterising ergonomic enquiries. Table 2 reflects the responses of participants regarding their utilization of psychological, physiological and anthropometrical data.

TABLE 2

THE KIND OF DATA USED FOR ERGONOMIC ANALYSIS

KIND OF DATA	% YES	% NO	% NA	% SPOILED
Anthropometrical	12,5	77,9	7,4	2,2
Physiological	24,3	67,6	6,6	1,5
Psychological	22,1	69,9	5,1	2,9

The results of a chi-square analysis suggest that the proportion of 'yes-responses' differs significantly across the different kinds of data ($X^2 = 7,1$; $df = 2$; $p < 0,05$).

The manner in which Ergonomical data is secured and used

Two primary means of securing ergonomical data may be distinguished. These are the conducting of either literature surveys or research projects. The involvement of participants in these data collection methods is shown in Table 3. The table also reveals whether participants have an explicitly planned procedure of translating ergonomic information into practice.

TABLE 3

THE MANNER OF SECURING AND USING ERGONOMIC DATA

MANNER	% YES	% NO	% SPOILED
Research	7,3	91,2	1,5
Literature survey	16,9	83,1	0,0
Explicit plan exists to use data	9,6	90,4	0,0

From the Table it can be seen that the majority of participants (91 and 83 percent) does not undertake research or literature surveys while 90 percent do not plan explicitly to incorporate ergonomic data in their activities.

The degree of educational support

The responses of participants indicating their degree of support for training in Ergonomics are summarised in Table 4 (a) and (b). Table 4 (c) indicates the distribution of responses according to the degree to which participants felt that they needed more information on Ergonomics.

TABLE 4

THE DEGREE OF EDUCATIONAL SUPPORT

DIMENSION	RESPONSE	%
(a) Ergonomics should be taught at higher educational institutions	Agree fully	22,1
	Agree	64,7
	Disagree	6,6
	Disagree fully	0,0
	Spoiled	6,6
(b) Cooperation with educational centers on ergonomic training welcome	Definitely yes	8,8
	Yes	38,3
	Possibly yes	48,5
	Definitely no	2,9
	Spoiled	1,5
(c) Need more information on Ergonomics	Definitely yes	25,8
	Yes	44,1
	Possibly yes	23,6
	Definitely no	4,4
	Spoiled	2,1

From Table 4 it can be seen that participants revealed a favourable disposition to training in Ergonomics.

DISCUSSION

While there is some indication that differences exist between the kinds of data used by participants in their ergonomic activity, these differences appear to have a statistical rather than practical significance. Of concern in this set of findings, however, is the small proportion of participants who indicated their use of ergonomic data.

The data presented in Table 3 seem to suggest that most ergonomic activity tends to be intuitively motivated and directed. Indeed very few participants appear explicitly to plan for ergonomic analysis or to secure reliable information through literature or laboratory/field research.

The findings reviewed to date, in addition to prevailing ergonomic theory, pose important questions regarding the nature of ergonomic involvement in the manufacturing industry. For example, there are more participants involved in the application of Ergonomics than there are participants either using or securing relevant ergonomical data. The quality of ergonomic involvement may therefore be seriously questioned. Also alarming is the tendency to be less involved in the design of hardware items - particularly those intended for customer use. This may, by implication, perpetuate an unnecessary need for the 'corrective ergonomics' discussed in the introduction, which should be avoided from a theoretical point of view. The advantages of including ergonomic considerations in initial design specifications are self evident and emphasised in theoretical Ergonomics.

The unfavourable impression created by the above is counter-acted to some extent by the fact that most participants appreciated the need for and supported the idea of training in Ergonomics.

CONCLUSION

In this study information relevant to the application of Ergonomics in the South African manufacturing industry was gathered.

As already indicated the picture which emerged, though reasonably clear, does not appear to be a promising one. Rather than speculate on possible negative productivity effects it may be desirable to contemplate the results of the study in the light of anticipated events. For example, it is doubtful that the present level of ergonomic activity will be sufficient to assist with the re-allocation of jobs to members of the different population groups or to cater for expected increases in the demand for self-sufficiency in the manufacturing area.

This study would seem to suggest that insufficient knowledge may be an important cause of the generally low level of local ergonomic activity. The importation of 'protective ergonomics' in the form of finished products or product blueprints does not necessarily reduce the need for the fitting of jobs to South African employees.

While the manufacturing industry may be a good indicator of ergonomic activity, care should never-the-less be taken in generalizing the results of the study, and particularly in relating them to other industries.

SUMMARY

The aim of this study is to obtain a picture of the application of Ergonomics in the South African manufacturing industry. Information was gathered concerning the nature of ergonomic activity, the kind of data used for ergonomic analysis as well as the manner in which such data are obtained. The result of the study are considered in the light of some factors of particular importance in the South African context.

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