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WORKPLACE ERGONOMICS FOR PEOPLE WITH DISABILITIES

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Abstract: *The physical, sensory and mental faculties vary from one person to another. Some differences can be from birth or as a result of accidents or disease. At young population level, there are special schools for people with disabilities, based on an adequate educational and therapeutic rehabilitation process. In the clothing field, in order to increase the efficiency of the practical activity of those pupils, the quality of the workplace design consists mainly of the maximisation of the interface operator – machine. The papers objectives are ergonomic configuration of the workplace, correlated with the anatomic particularities of the users. The case study was developed in a Romanian school workshop for pupils with disabilities; the results can be extended in clothing companies so that people with disabilities are employed.*
Key words: *Disability, Sewing, Workplace Configuration, Ergonomic, Clothing.*

1. INTRODUCTION

The term "disabled person" has been defined for the first time in 1975 when the General Assembly of United Nations adopted the Declaration on the Rights of Disabled Persons [9]: *"… any person unable to ensure by himself or herself, wholly or partly, the necessities of a normal individual and/or social life, as a result of deficiency, either congenital or not, in his or her physical or mental capabilities*". The Standard Rules on Equal Opportunities for Persons with Disabilities, approved in 1993 by the UN General Assembly defines the disability as "*losing or limiting the chances of taking part in the life of the community on equal footing with its other members*".

The European Disability Strategy 2010-2020 focuses on eliminating barriers for disabled people, and the European Commission has identified eight main areas for action: Accessibility, Participation, Equality, Employment, Education and training, Social protection, Health, and External Action. From the employment point of view, the statistics reveals that the rate of employment for people with disabilities is only around 50%. To achieve the EU's growth targets, more people with disabilities need to be in paid employment on the open labor market. Among the EU measures and recommendations to act at national level are (i) development of active labor market policies, (ii) making the workplaces more accessible, and (iii) development of services for job placement, support structures and on-the-job training [12].

According to the statistical data of National Authority for the Rights of Persons with Disabilities, Children and Adopts, at 31st of December 2019 over 846.000 people (3.82%) of Romania's population was registered as disabled, almost double the figure registered in 2006 [11].

Furthermore, according to Law no. 448/2006 on protection and promotion of the rights of persons with disabilities, the types of disability are physical, visual, aural, deaf-blindness, somatic, mental, HIV/SIDA, associate, rare diseases [10]. In Romania, according to the statistical data at 31st of December 2019, the highest rate is represented by the physical handicap (206.505 persons), the somatic one (151.072) and mental deficiencies (124.451) [10]. Some differences can be deepened with age or/and social condition, can be from birth or as a result of accidents or disease.

According to the duration, people can be with different types of disabilities [3]: (a) persons with permanent disability; (b) persons during the

recovery period, after an accident; (c) persons with special conditions – pregnant women, people caring children in baby strollers, or people caring objects.

The statistical data analysis and the general recommendations previously presented confirm the opportunity of the study presented in this paper which is focus on the necessity of the ergonomic and customized workplaces design, according to the special needs of the operator.

The complex challenge of the research consists in the interdependence between the demand of improvement of workplace design in safety and health conditions according to the principles of lean production and many other significant priorities: illness and injury prevention, environmental sustainability, psychological risks mitigation, corporate social responsibility, compliance with regulatory and insurance requirements [3].

A big number of companies are acknowledging the fact that the expenses for health and security at the workplace are money well spent. They realize that the social cost of the work incapacity is translated in a cost of the national economy and an immobilized worker is a burden for the community. To invest in the work place design, especially to adapt the workplaces and/or in supplying of special equipment means, in many cases, not to transform these people in assisted persons [2].

At young population level, there are special schools for people with disabilities, based on an adequate educational and therapeutic rehabilitation process.

Particularly in the clothing manufacturing industry, in order to answer to its particularities (mostly manual-mechanical work, the strong dependence between the operations of the technological process, the high importance of the human factor in the products' final quality) [5], it is necessary for the pupils to know the activity from the point of view of the work method, place in the process and the necessary technical endowment.

2. EXPERIMENTAL RESEARCH

In clothing manufacturing industry, to increase the efficiency of the practical activity of the pupils with special needs, the quality of the workplace design consists mainly of the maximization of the interface operator – machine. This is very important for maintaining the health, already affected, of those young pupils [3].

In this way there can be used two ways of designing the work places for persons with disabilities:

- Workplace configuration similar with the one for the persons with standard anthropometric size,
- Dedicated or customised configuration, for persons with severe handicap, designated only for one person or for a small group of persons.

Using one of these methods is influenced especially by the age when the handicap occurred. A person, an accident victim at adult age, will not be significantly different, on anthropological level, from a healthy person. This fact will allowed that the person with disability will be considered in the group of workers with average anthropometric dimensions. On the other hand, a small child, an accident victim, will very likely have a very different anthropological development.

The workplaces design, from the ergonomically point of view [4], [5], follows the one or more steps:

- Changing the workload by splitting the workload in smaller workloads, easier to handle;
- Changing the working tools;
- Compensating the pupil incapacity with supplementary ergonomic endowment or with help from other people;
- Designing customised working tools.

The efficiency of these measures depends on technical aspects and functional changes that will be integrated in the new configuration.

The papers objectives are:

- The selection of the workplaces in which the pupils can have long time efficiency, using their capabilities, so that they will be able to earn their living with this job,
- Ergonomic configuration of the workplace, correlated with the anatomic particularities of the users.

The case study was made in a ready-made cloth school workshop for people with

disabilities. The pupils of one classroom with combined deficiencies were studied.

The methodology used in the paper consists of the following steps:

1. Establishing the load of the human body at every workplace from the workshop. Knowing these specific professional factors is of high importance for finding the best correlation between the pupils' personal symptomatology and the professional factors (generated by the workload type, the working environment and the workplace configuration);
2. Correlating the work tasks of every pupil with his health, the possibility to work at alternative or dedicated workplaces (for pupils with severe disabilities);
3. Re-configuration of the workplaces, according with the anthropometric dimensions of the pupils. The reconfiguration is based on the standard ISO/DIS 14738: *Safety of machinery - Anthropometric requirements for the design of workstations at machinery* [6].

The pupils from the studied classroom were split in the following groups:

- Pupils with mobility deficiency (subject 1 does not have one arm, caused by an accident when he was a teenager, subject 2 has diabetes, with a suppurated plague at one leg), without mental problems;
- Pupils with vision problems, associated with mild mental problems (subject 3 and subject 4);
- One pupil (subject 5) with uneven legs, without mental problems;
- One pupil (subject 6), physically normal, with mental problems regarding movements coordination;
- One pupil (subject 7) in a wheelchair.

Design constraints, based on the collected data, were treated for the same reason and according with the same data as for the healthy subjects.

The methodology used in the paper consists in acquiring the following data:

- Pupils' anthropometric profile;
- Biomechanical data (moving range, physical load etc.);
- Ergonomic measures that can be applied at the existent workplaces;
- Identification of the safety measures for every workplace.

3. RESEARCH RESULTS

By applying the research methodology there have been collected the following data and information:

a) All the pupils were measured, and their anthropometric profile was made, using the sizes necessary for the sewing workplace configuration (Table 1).

b) Work tasks were allocated, correlated with the subjects' wealth, as follow:

1. For pupils with movement and without mental problems, the ergonomic design was made according with pupils' typo-dimensions, also using the rotation principle for compensating the movement problems; pupils were allocated to the lockstitch and overlock machines (Figure 2 and Figure 3).
2. For the pupils with vision problems, associated with mild mental problems, the ergonomic configuration considered the sight limitation and there were used sewing machines with low speed, according with their physical capabilities (Figure 4).

Table 1

Pupils' anthropometrical dimensions (sequence).

Anthropometrical dimensions	Sizes subject 1 (cm)	Sizes subject 2 (cm)
1. Leg length	53	48
2. Body height, standing	168	150

Fig. 2. Subjects' working position at the lockstitch sewing machine


Fig. 3. Subjects' working position
at the overlock sewing machine


Fig. 4. Workplace configuration
at sewing machines with low speed

3. For one pupil with uneven legs (subject 5), without mental problems, the workplace is orthostatic, with support on the gluteal region (see Figure 5).
4. For one pupil with mental problems regarding movements coordination (subject 6), a customised workplace was designed, for chalk signing, in orthostatic position (as seen in Figure 6),
5. For one pupil in wheelchair (subject 7) a customised workplace was designed, according with the anatomical particularities of this pupil and the limitations imposed by the wheelchair.

Fig. 5. Orthostatic configuration, with buttock support,
for subject 5

Fig. 6. Work place adapted for subject 6 size

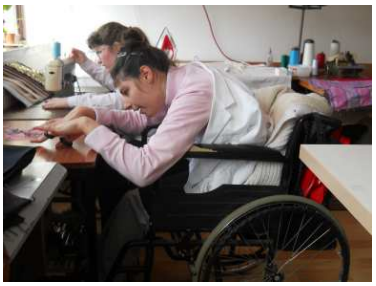
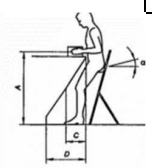
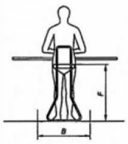


Fig. 7. Dedicated workplace
for pupil in wheelchair

Subject 7 has also major physical problems and has limited access to the most sewing machines from the workshop. As the aim is mostly occupational therapy, the customized workplace has a working table situated at elbow level, for cutting the fabrics on the table. The scissor is light (150 g) for reducing the hands stress and it is not very well sharpened (as seen in Figure 7).

Table 2

Orthostatic position, with middle support for subject 5 (sequence)

Position	Code	Value (cm)	Value Significance
	A	1,3x88=114,4	Working height: A= k.h_4(P95) k = 1,1 ÷ 1.3, according with visual acuity. h_4=elbow height
	B	27+35=62	Space width for legs: B=a_{1Y}(P95)+y a_{1Y}=width between hips y=350mm, for legs movement

For the customized workplace, the wheelchair dimensions were considered [7].

- At re-configuration of the workplaces, the most complex case was for the pupils with alternating positions at two different sewing machines (lockstitch and overlock), where, for a proper configuration: initially the two pupils' dimensions were compared; "*enough*" dimensions (percentile 5) and "*fitting*" dimensions (percentile 95) were selected for the specific workplace,

- The necessary data were introduced in the calculus tables from ISO/DIS 14738, *Safety of machinery - Anthropometric requirements for the design of workstations at machinery*, for orthostatic and sitting position (Table 2) and considering also, ISO 11226, *Ergonomics - Evaluation of static working postures.*

The same procedure was applied for all the other groups of pupils.

4. CONCLUSION

The case study in the paper emphasize the fact that small investments (foot stands, chairs for alternate positions, form other workroom, wood pieces etc.) can significantly facilitate pupils' activity and increase the level of work security. For example, for the first group, as the pupils are working alternatively on both machines:

- Comparing with the sewing machine's table of 71 cm and the overlock machine's table of 73.5 cm, the lockstitch machine must be raised with 3 cm.
- The machines should have feet support, with adjustable height, between 0 cm for subject 1 and 4 cm for subject 2.

The procedure presented in the paper can be enlarged to other fields, according with the anthropometric particularities and the specific symptomatology.

Future research will be dedicated the communication effectiveness during the trainings sessions and to the prevention of occupational risks and diseases [1; 13; 14].

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Ergonomia locurilor de muncă pentru persoane cu dizabilități

Rezumat: Facultățile fizice, senzoriale şi mentale variază de la o persoană la alta. Cu toate acestea, anumite diferențe pot fi adâncite de vârstă şi/sau de condiția socială, pot fi înnăscute sau pot rezulta ca urmare a unor accidente sau boli. La nivelul populației tinere funcționează școli dedicate elevilor cu dizabilități, care se bazează pe un proces instructiv-educativ şi terapeutic recuperatoriu adecvat. In domeniul confecțiilor, pentru a crește eficiența activității practice a acestor elevi, calitatea proiectării locului de muncă se materializează, în primul rând, în maximizarea interfeței utilizator – mașină. Obiectivul lucrării este configurarea ergonomică a locului de muncă în corelare cu particularitățile ergonomice ale operatorilor. Studiul de caz s-a realizat într-un atelier școală din domeniul confecțiilor textile din România, acesta fiind deservit de elevi cu dizabilități. Rezultate studiului realizat pot fi extinse pentru cazul companiilor de confecții pentru a facilita angajarea persoanelor cu nevoi speciale.

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