Software to manage allocation of workers on manufacturing productive units

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It’s well known that the European working population is ageing rapidly, because of the demographic trend and the retirement age policy of European countries. According to statistics and researchers, ageing worker groups show a percentage increase of individuals having one or more specific disabilities that lead to difficulties in the performance of tasks of working and everyday life. At today, managing the ageing labour force, by taking into account individual functional capabilities, limits, disabilities, physical characteristics and skills represents one of the main challenges for companies and yet an important step to improve the working conditions and the satisfaction of workers. The paper describes a step by step approach developed by Fiat Chrysler Automobiles to help allocating workers focusing on their whole characteristics in suitable workstations. The approach was implemented in a software called SGA (Allocation Managing System). The software collects data coming from risk assessment of workstation: chemical, rumors, vibrations, microclimate, biomechanical overload, additional factors and personal data of workers: medical data and skills. These data are transposed in a chart and the software, according to rules agreed upon occupational doctors, give an optimized match among workstations and workers. The output will be used by occupational doctors to correctly allocate workers in a simplified and quicker way especially in case of absenteeism or loan managing among productive units. Results underline the importance of the ergonomics mapping of each workstations and workplace for a proper allocation worker-workstation, contributing to fully utilize workers’ skills, in respect of their specific needs. Authors will presents input, outputs and basic assumptions used in the software and the deep collaboration among ergonomics specialist, health and safety specialist and occupational doctors.

1. Introduction

It’s well known that the European working population is ageing rapidly, because of the demographic trend and the retirement age policy of European countries. Already now, and more so in the future, a large part of the workforce is middle age or past middle age; considering that the commonly recognized age at which someone is considered an older worker is 45 years. Aging affects each individual at the personal, organizational, and societal level; in fact it refers to changes that occur in biological, psychological, and social functioning through time.
According to statistics and researchers, ageing worker groups show a percentage increase of individuals having one or more specific disabilities that lead to difficulties in the performance of tasks of working and everyday life.

At today, managing the ageing labour force, by taking into account individual functional capability limits and disabilities, represents one of the main challenges for companies and yet an important step to improve the working conditions and the satisfaction of workers. This is especially so in consideration that the work organization modes are increasingly work-intensive with a major consequence: the tightening of time constraints. These sharp time constraints are age-selective: they reinforce ageing workers’ deficiencies, alter the benefits of their experience, and can drive them away from certain work situations or prevent them from working altogether [3]. At present, the process of protection and improvement of the working quality of older workers can be helped by ergonomics methods and actions.

The paper presents a step by step approach developed by Fiat Chrysler Automobiles to help allocating workers focusing on their whole characteristics in suitable workstations according to legal requirements. The approach was implemented in a software called SGA (Allocation Managing System) that shows high reliability and human error removal. The aim of the procedure can be synthesised as ‘fitting the workstation to the worker’.

The step by step approach is characterized by four phases: the workstation phase, the worker phase, the allocation phase and the doctor approval phase. Figure 1 depicts the four phases of the step by step approach.

![Diagram of SGA steps procedure](image)

SGA works using data coming from document of workplace risk assessment, based on Dlgs. 81/08 legal requirements that relates on the evaluation of possible risks of the workplace, as for example: chemical, ergonomics, vibration, noise [4].
2. SGA application guidelines

As illustrated in the previous paragraphs, the SGA system supports resources allocation on stations along the production lines, taking into account: station general characteristics, residual risks for assembly tasks and health prescriptions for specific workers. To achieve this goal, the system uses sets of data listed below:

- Workers data (“Anagrafica risorse”): it contains all the general information of the workers (gender, age, physical characteristics, etc.)
- Line balancing (“Saturazioni/ Ergodichiarazioni”): it contains the description of the workplace in terms of working area measurements (geometry), work tasks characteristics (for example weights of parts manually moved), execution times, etc. Coupling these information with ergonomic analysis tools according to the Ergo-UAS system, experts from the Industrial Engineering Department are able to create preliminary line balancing
- Health&Safety Information (“Sala Medica”): it contains general information about each worker's health (in this way, the system knows if a worker can be assigned to a specific working task or not according to his eventual physical diseases)
- Safety responsible (“R.S.P.P.”): it contains all the information related to safety risks related to each single working station (chemicals, vibration, weights, repetitive tasks, etc.)
- Worker skills: it contains information about each worker's training

Figure 2: SGA – Databases.

To achieve the above described goals, SGA works on its databases with some evaluation modules:

- Time Counter – it is a simulation tool that allows to define the duration of each working tasks and the number of actions performed by the worker for that task
- Human Model – it is a simple 3D virtual manikin that allows to perform basic postural analysis according to the worker’s anthropometric measurements (percentile, sex) and according to the geometrical description of the working area.
• Matrix Builder – it is a numerical system that combines information about workers with the working station characteristics. The result is a preliminary allocation matrix where non available stations for specific medical prescriptions are emphasized.
• Worker Mapper – it performs the automatic allocation of workers along allowable stations.

Figure 3: SGA – Evaluation Modules

SGA is used for production organization. When production has to be changed or a new line balancing is requested (for example in case of mix variations), a new line organization is created. Safety experts have to check the resulting working conditions and have to perform risk assessment procedures. Results from these evaluations oblige to apply risk reduction techniques: technical solutions, individual safety equipment specifications, workers training. Stations are improved for safety conditions but residual risks are always present. All these information are then given in input to SGA in order to create an allowable allocation map for each worker. This process is based on the respect of detailed constraints:

• the ability of the worker in performing working tasks requested in the station
• the compatibility of any medical prescription for the worker with residual risks still present in the station

When the process reaches convergence and reduction / elimination of risks is complete, the new line balancing and the new resource allocation map are adopted so the Plant can start production according to the new organization.
3. **Case study: an example of SGA facilities**

As reported before, the allocation phase consists in the grouping of worker-workstation according to the inabilities codes of workers and the inabilities codes that characterize the workstations.

In the following figure, it is possible to see workers data used to match worker/workstation by the software.

![Figure 4: SGA application during Production](image)

In addition, the worker matrix contains information about training and skill of workers. A proper allocation is to reduce the risk factors as repetition, force and awkward posture and extreme joint movements, tasks requiring exertion of high muscular forces such as lifting, lowering, carrying and pushing.
pulling of moderate to heavy loads as well as environmental risk such as chemical, vibration and noise ones. Each workstation is characterized by proper codes reporting. Moreover each workstation is characterized by metabolic rate indications to classify labour in heavy, medium and light one. So a matrix reporting all workstation data is parallel built, as shown in the following figure.

![Matrix Reporting](image)

Figure 6: Examples of joint angles measurement.

An example of the output provided by the program is shown in figure 4. The output of the application routine reports the name and surname of each worker and identification name of each workstation in the workplace.
The crossing square between each worker and workstation is coloured using a Boolean logic: red – workstation not suitable for the worker, green – workstation may be suitable for the worker. Black square means that worker is not trained on those workstations.

4. Conclusions

Ergonomics is a key point for production organization, especially when workers with inability codes has to be allocated on working stations. FCA has developed a specific procedure for this purpose based on an internal software called SGA. Using this approach, worker's information (anthropometrical data, inability codes, skills, etc.) and risk assessment data are coupled to find all the stations where workers can be allocated. Results underline the importance of the ergonomics mapping of each station for a fully use of workers’ skills, in respect of their specific needs.

References

[Hägg G.M., 2003, Corporate initiatives in ergonomics— an introduction, Applied Ergonomics 34, 3-15,