Martina Jakob, Potsdam-Bornim, and Ulf Steinberg, Berlin

Application of the Key Indicator Method for Manual Work Processes in Agriculture and Horticulture

The key indicator method (LMM) was developed for a practically oriented assessment of loads occurring in an enterprise. At the moment there are three fields of application, i.e. for lifting and for carrying, as well as for pulling and pushing heavy loads and repetitive manual work processes with smaller action forces. The method for manual work processes was recently evaluated and published as a draft in 2007. Its application as an assessment instrument for manual tasks in agriculture is elaborated on in this paper and is presented with examples. The pros and cons of the new method are discussed.

Dr. Martina Jakob is a scientist at the Leibniz-Institut für Agrartechnik Potsdam-Bornim and Dipl. Ing. Ulf Steinberg is member of the staff of Bundesanstalt für Arbeitschutz und Arbeitsmedizin Berlin, Nöldnerstraße 40-42, 10317 Berlin;
e-mail: *steinberg.ulf@baua.bund.de*

Keywords

Risk assessment, manual work processes, key indicator

Work related musculo-sceletal-disorders as well as upper limb disorders are of great importance worldwide. The key indicator methods were developed to carry out risk assessment in practice. The existing methods were recently completed by a third attempt regarding the manual work processes, published in 2007 as a blueprint. Its application for manual work processes in agriculture is exemplified in this article.

As part of the method development, a literature research was carried out. 37 risk assessment tools were found, published in German or English, evaluating the upper limb exposure. The new key indicator method is based on the knowledge gained from the literature research, on the results of studies carried out by the Federal Institute of Occupational Safety and Health as well as on time and motion studies and exposure levels relevant for the German working population. The aim of this approach was to enable the employee to carry out a risk assessment, focussing on key characteristics related to the exposure level.

Farm work is a physically demanding occupation covering a large variety of different work tasks. The ongoing mechanisation has changed the tasks for the workers often creating man-machine interfaces. A remainder of tasks still done by hand is repeated more often and machine paced. Stultifying, highly repetitive actions often go along with unfavourable working postures, unpleasant climatic factors or noise. To improve the situation, to redesign work tasks or to avoid unfavourable settings it is necessary to carry out a risk assessment. The described tool was developed on the demand of many practitioners.

Method

The basic idea of the method is to evaluate task characteristics. The assessment is conducted only for partial activities and always refers to a full work day. The key indicators of importance for manual work processes are:

- Duration of the partial activity regarding a full shift
- Type, level and frequency of applied force
- Body posture
- Posture and movement of hand and arm
- Work organisation
- Working conditions

The assessment of the individual rating is done according to the tables which also provide examples. For the determination of the rating points, only dominant attributes have to be considered. High scores go along with critical situations. A differentiated inspection of each category identifies parts of the body being stressed in particular. In the final evaluation the rating points of the key indicators are added-up and then this sum is multiplied with the time rating points, leading to the points of the risk score. This value allows the assessment of the partial activity that has been rated on the basis of a simple rating point scale.

Although the mathematical conjunction of different biological impacts is seen as problematic, it is carried out for practical reasons. The risk assessment is aiming to name the probability to suffer from musculo-sceletal-disorders. The transitions between classes are smooth. The final rating should not exceed 25 points.

Table 1: Rating points for the key indicators for the activity „milking" regarding different settings

Key indicator	holding arm (no service arm)	attaching holding arm (with service arm)	active arm (service arm has no influence)
Type of force	3	2	1
Work organisation	1	1	1
Conditions	1	1	1
Body posture	2	2	2
Posture of hand / arm	1	1	1
Σ • time	8 • 5	7 • 5	6 • 5
Points	40	35	30
Load	25 - < 50 points clear increased load		

Literature

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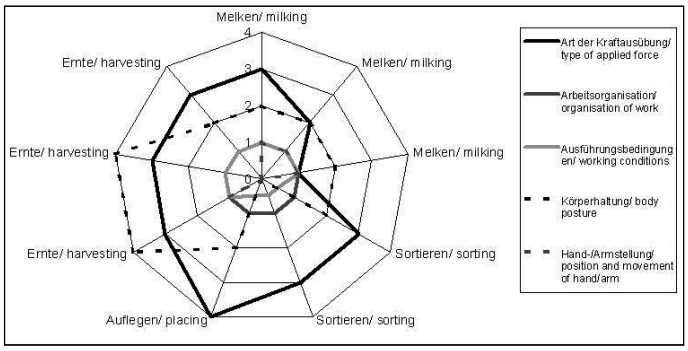

Fig. 1: Rating points for the key items of the different activities

Results

The following chapter shows examples of the application of the key indicator method.

Example 1 – Attaching the milking unit
The example shall represent the work of a milker in a loose housing system during milking. Apart from udder preparation the milker has to attach the milking cluster to the udder. A rate of 60 cows per hour was assumed. The milking unit weighs around three kg and has to be positioned underneath the udder while attaching the cups one after the other. The milker has little freedom of action. A high work pace is demanded. Depending on the outside temperatures it can be very cold or very hot, apart from that the worker gets wet and dirty. The work is done solely standing. To reach the udder the worker needs to bend forward and lift and stretch the arms.

Example 2 – Sorting at the conveyor belt
The processing of fruit and vegetables often contains simple manual actions like moving or positioning of light material. Very little movements are necessary embedded in the processing line and influencing its overall capacity. The climatic conditions are often unfavourable rather regarding the needs of the products. These are also often wet from being washed. Seats are usually not provided. The area of reach is close to the body.

Example 3 – Hand harvest of fruit or vegetables
Hand harvest for fresh fruit marketing is still very common due to quality reasons. Many of the products grow at ground level forcing the worker to bend over. A high work pace is demanded. Outdoor work can be coupled with cold, heat or rain. The short time-frame of optimal harvesting date goes along with long working hours.

Table 1 to 3 show the rating points for the key indicators, the time rating points and the final evaluation. Each described example is represented by three activities. In all cases the final ratings exceeded the limit of 25 rating points, resulting in an increased or high load situation. The assumed time rating points were kept at the bottom level for sorting and harvesting, therefore the risk might be higher regarding the long working hours during the harvesting season. The working hours for the milkers are realistic. The most important key indicators regarding the high ratings were the application and frequency of force and the body posture. Simple ergonomic solutions may improve the situation.

Discussion

In conclusion it can be stated, that the new key indicator method offers a workload approach, which can be easily applied by the farmers themselves or the farm consultants. All described work tasks were classified as increased or high load situations. Individually differing capabilities can influence the load and strain situation. Nevertheless the assessment allows an immediate decision, which aspects of the work task cause higher risks for physical strain. The comparison of tasks after improvement allows calculating the impact of the change. Ergonomics can be "measured".

A high work pace results in high repetitions of actions causing high rating points (*Fig. 1*). Another important risk factor is the unfavourable body posture while harvesting products at ground level. Long working hours increase the risk. Since all work tasks were rated above the recommended limit, the necessity of actions seems to be given. Six of the described work tasks are only carried out for a certain period of the year. This is of course limiting the explanatory power of the method. Combined assessment of several different activities carried out by the worker all year round would be necessary. Nevertheless the impact of long working hours should be kept in mind.

In correspondence to the high rate of work absenteeism amongst milkers [1] an increased load situation was found. Since milking is carried out all year round, the necessity of improvement is desirable.

The rating procedure described in this article slightly differs from the general idea behind the method, because the cases do not relate to one specific work place. As a matter of course there might be differences from enterprise to enterprise. Nevertheless the characteristic features of the described work tasks have been considered representing a plausible evaluation.

Table 2: Rating points for the key indicators of the different jobs at a conveyor belt

Key indicator	sorting out of bad products (standing)	sorting out of bad products (with standing help)	puting asparagus on a conveyor belt
Type of force	3	3	4
Work organisation	1	1	1
Conditions	0,5	0,5	0,5
Body posture	2	0	2 (with st. help 0)
Posture of hand / arm	0	0	0
Σ • time	6,5 • 6	4,5 • 6	7,5 • 6 (5,5 • 6)
Points	39	27	45 (33)
Load	25 - < 50 points clear increased load		

Table 3: Rating points for the key indicators for the harvest of asparagus and strawberries

Key indicator	asparagus (arm with knive)	strawberry (without helpful means)	strawberry (with sitting vehicle)
Type of force	3	3	3
Work organisation	1	1	1
Conditions	1	1	1
Body posture	4	4 (Hocken)	2
Posture of hand / arm	1	0	0
Σ • time	10 • 6	9 • 6	7 • 6
Points	60	54	42
Load	high load	high load	increased load