Assessing health impairment in workers on the basis of the ART Work Budget and work hardness groups

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Summary

Work-economics data from work and production processes up to overall farm operation can be calculated and compared using the IT-based 'ART Work Budget' model calculation system (Stark R. and Schick M., 2009). These calculations are used as the basis for assessing health impairment in the workforce (Kauke M. et al., 2008). For this, each task element is assigned to an appropriate 'work hardness' groups (whg) in the model calculation. The whg are a categorisation of task elements and provide information on physical workload. The assignment of tasks to these groups is an easy way of ensuring full traceability, and of enabling simple error corrections and additions where necessary. Individual work processes can be allocated to different workers, allowing precise and differentiated observation and assessment of the farm and the workforce. Interfaces enable data transfer. The ART Work Budget is available in four languages, and is therefore an internationally usable tool for assessing workers, working-time requirement and work organisation on a farm. In Switzerland, the ART Work Budget is used by the cantonal disability insurance (German abbreviation: IV) agencies to assess illness- or accident-related impairment.

Keywords: working time requirement, work efficiency, work-related physical demand, work budget, model calculation system

1. INTRODUCTION

In the Swiss social security sector, loss of income owing e.g. to an accident or illness is mitigated by disability benefits. The disability insurance (IV) agencies established in the cantons are responsible for clarifying entitlement to benefits and right of recourse against third parties. This requires tools that enable a consistent and objective assessment of the activity performed to date.

The underlying work-economics data for the assessment is the IT-based 'ART Work Budget' (ART-WB) model calculation system. A work budget allows the needs of all tasks on the farm to be forecast for an entire year. The data are determined according to the element method. The classification into whg is a categorisation of task elements, and provides information on physical workload. For example, the elements 'Clean bucket', 'Clean milk tank manually' and 'Pour contents of milk churn into bucket' are assigned to light manual work, moderately heavy manual work and heavy manual work, respectively.

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The Swiss Federal Disability Insurance (IV) module is an additional module for the ART Work Budget. The element method enables the accurate assignment of each task element to a whg. The expert can perform the assessment in the IV module using the whg. After this, the program calculates the efficiency (EFF) of the individual in question. The efficiency determines what measure is taken, or what compensation is due to the insured party.

The introduction of the ART Work Budget with IV module as a standard tool enables the standardisation and objectivisation of the efficiency assessment process. Nevertheless, the system needs to be optimised further. Existing subjective influences must be minimised in order to create an objective basis for assessing health impairment in the workforce.

2. Materials and methods

The models in the work budget are structured according to the element method, and are based on causal data collection. The elements are recorded during direct work observation with the aid of pocket or tablet PCs and a special time-recording software, 'ORTIMzeit'. This enables working time to be recorded according to REFA standards (REFA, 1973).

A beginning, end and content are defined for each task element. Note is made of whether we are dealing here with a cyclical task element, or a task element with a reference quantity. The essential influencing variables are determined and documented during observation of the work. An initial analysis of the working-time studies is performed early on, during the surveys. For cyclical measurement segments, the arithmetic mean, epsilon value and standard deviation are given as a measure of the sample quality. The program also enables a detailed summary of the individual workflow segments. Among other things, the average working time of all recorded measuring points of the task element per reference quantity or cycle is given. In addition, a workflow description is created thanks to which a third person must also be able to track the progress.

Standard times were created with the results of the various measurements. Within a calculation model, these times serve to determine the working-time requirement. In order to prevent the risk of distortion in the calculation of the standard times owing to an outlier, the actual recorded times were statistically analysed. This was done with the help of the Excel table-calculation program. The arithmetic mean, median, minimum/maximum value, standard deviation, variance and variation coefficient were analysed. Following the further statistical analysis of the obtained data, the latter were entered into a standard-time database.

This element-oriented approach with its precisely defined starting point, end point and content, enables the task elements to be assigned to work hardness groups. The scheme and classification of the whg were applied in this form in the assessments. A distinction is currently drawn between the following whg:

- Setting-up work for machinery using 1-man method
- Tractor driving with negligible manual work
- Tractor driving with occasional light manual work

- Tractor driving with occasional heavy manual work
- Inspection and mental tasks
- Manual work without fairly long walking distances
- Light manual work
- Moderately heavy manual work
- Heavy manual work
- Manual work at ground level
- Strawing and dung removal in animal housing with automation
- Strawing and dung removal in animal housing without automation
- Milking in a bucket milking system
- Milking in a pipeline milking system

Logical connections are made between task elements and influencing variables based on the workflow descriptions created during the direct observation of work. The ART Work Budget database serves as the basis for this. This database contains all of the elements with standard times and influencing variables. Both task elements and influencing variables are available for every process. In this way, it can be guaranteed that all calculations are performed on the basis of the same data, and that the current data are always available.

The ART Work Budget software is also used for the modelling. Here, task elements and influencing variables are logically connected. The connection is made on the basis of both the observation of the work and the workflow description at the work-process level. The work processes are incorporated into production processes which are in turn combined into production branches. Overall operations are then derived from the production branches (Schick M., 2006). This approach permits traceability at all levels. It also allows the adjustment of settings according to the level in question. In this way, for example, implementation periods and number of repetitions can be taken into account on an individual farm basis.

The ART Work Budget software not only enables the calculation of the expected working-time requirement, but also permits the farm's available workforce to be recorded. Fixed periods during which the workforce is available to the farm can be assigned to the workforce when their numbers are recorded (see Figure 1). In addition, it is possible to record a worker with a lower level of employment. This makes it possible to balance working-time requirement and available labour.

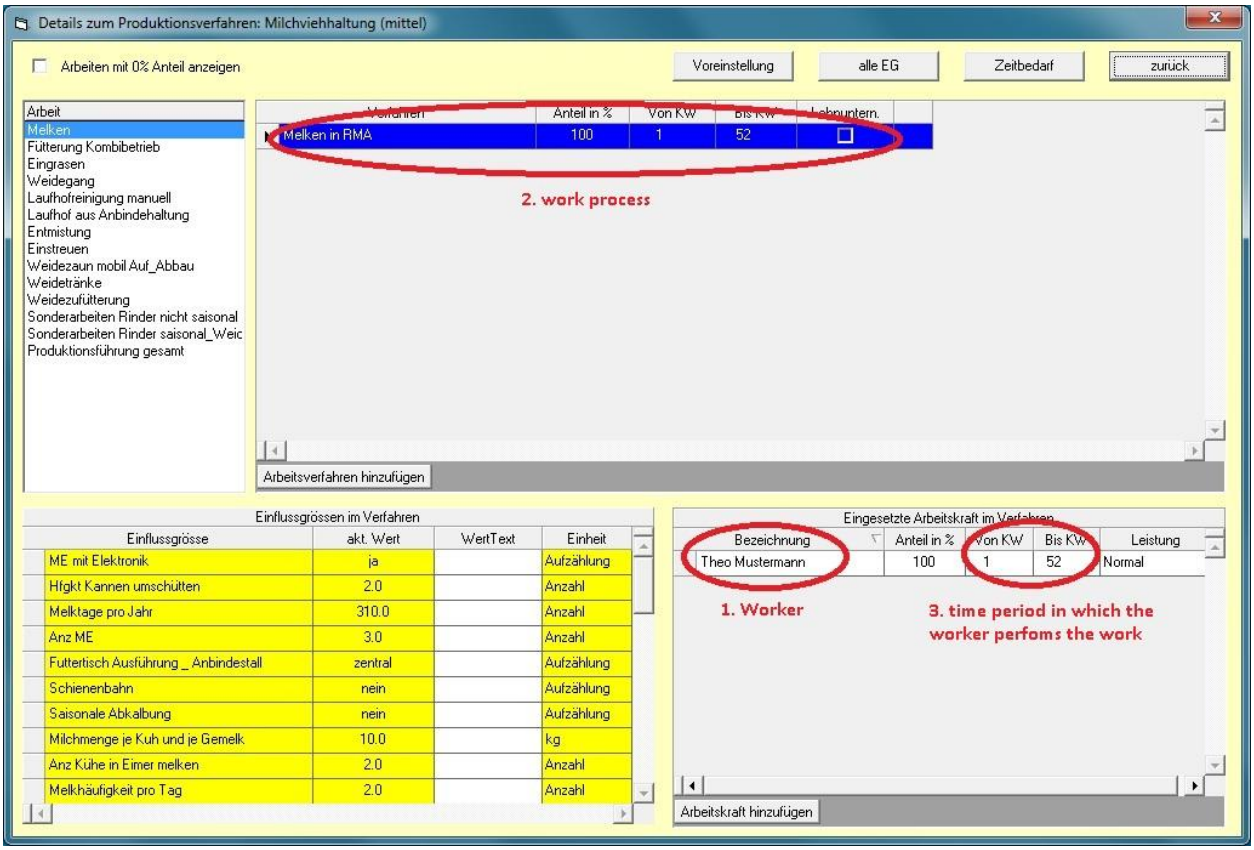

Figure 1: Details on the production process, with allocation of a worker (1) to a work process (2) and to the time period in which the worker performs the work (3).

If several workers are available to a farm, it must be known what task is performed by the person to be assessed. The ART Work Budget allows one or more persons to be assigned to a single work process. Moreover, it is possible to determine the relative share of a work process carried out by a worker, and in which time period the work is performed. Through this definition of time periods and of a relative share, which is taken into account in the assessment, it is possible to calculate the absolute share (percentage share of IV Work Budget) of a worker's involvement in a specific work process. The following example illustrates how the absolute share is calculated:

A worker is available from calendar week (CW) 1 to CW 9. The work accrues from CW 8 to CW 12. The worker has a 10% share of the work, and is affected during CW 8 and CW 9 only. The relative share of 10% for this period results in an absolute share of 4% of the work process. The formula for the calculation is as follows:

$$\text{Percentage share of IV Work Budget} = (2\ \text{CW})/(5\ \text{CW})*10\%*100 = 4\%$$

The results from the model calculation and the absolute shares feed into the additional module for Swiss Federal Disability Insurance (IV) experts. The results from the model calculation are determined each time the additional module is started up. This approach ensures that changes to the model or to the case to be calculated at present can be taken directly into account. The

disability insurance experts assess the worker's efficiency in the IV module. The assessment scheme – which is geared to whether an activity can be carried out, and if so, how – is as follows:

100% = unimpaired
75% = slowed down
50% = made difficult
25% = made very difficult
0% = non-performable

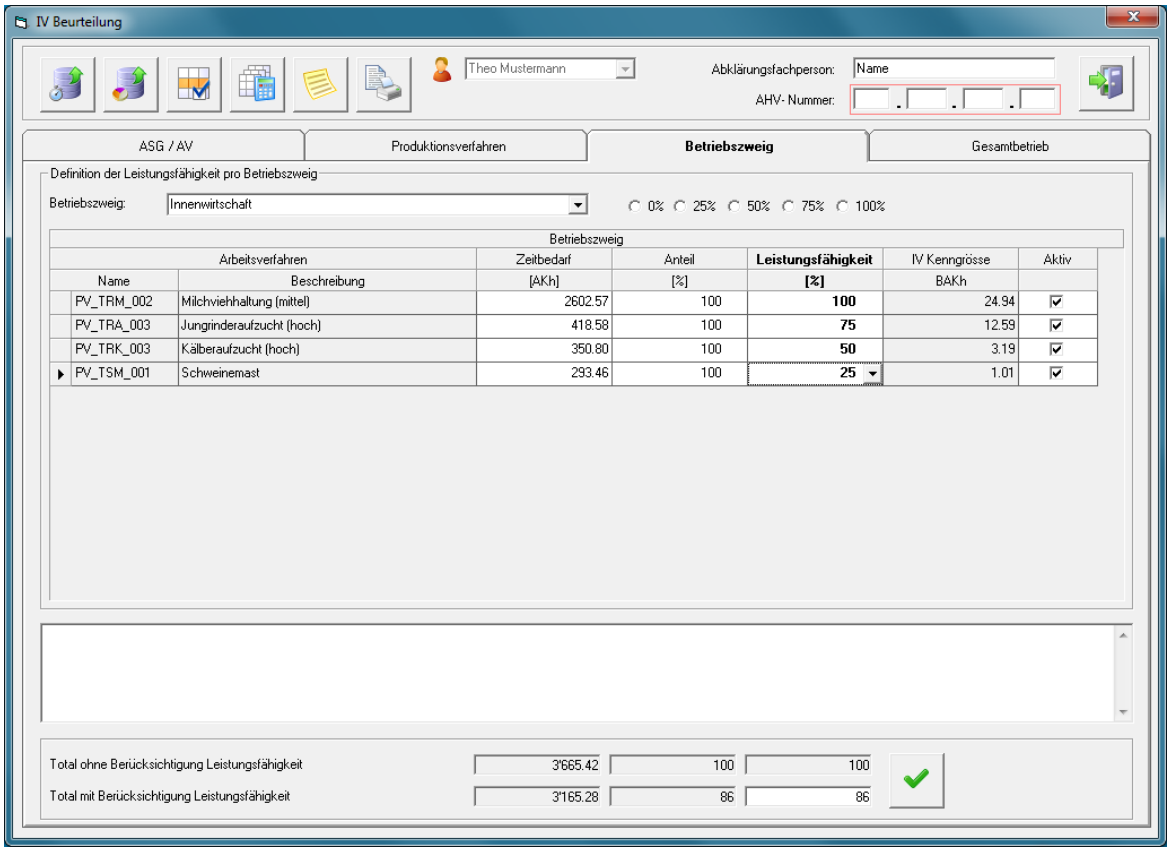

Figure 2: IV-module window with efficiency-assessment form

The disability insurance experts assign efficiency to one of these groups. The assessment can be performed at every farm level, i.e. at the level of overall operations, production branch, production process, work process and work element, or according to work hardness groups. Assessment according to whg has a direct impact on the element level. This means that all elements assigned to the work hardness groups are assessed, and that this affects all of the work processes assigned to the worker.

The worker's efficiency is calculated on the basis of the share of the tasks assigned to him which he performs, and on the basis of the assessment performed by the disability insurance expert. On the one hand, the time requirement for all assessed processes is calculated pro rata and added up.

On the other hand, the time requirement for all assessed processes is calculated pro rata, multiplied by efficiency, and added up. To calculate the worker's efficiency on the farm, the sum of all shares with assessed time requirement bearing in mind efficiency is divided by the sum of all shares with assessed time requirement. The formula for the calculation is as follows:

EFF_{total} [%] = Σ(share [%] * time requirement [%]*EFF [%]) / Σ(share [%] * time requirement[%])

This calculation yields the worker's efficiency on the farm under consideration. The worker's efficiency is the relative share of the efficiency between an unimpaired worker and the assessed worker. This method enables a differentiated examination of the worker, and an assessment of the impact on the farm. A decision on appropriate compensatory measures can be taken on the basis of the difference between a worker with impaired efficiency and one without impaired efficiency.

3. Results and Discussion

The classification and definition of work hardness groups (task elements) is a method that is workable in practice. The combination of this method with the 'ART Work Budget' model calculation system represents a significant step forward in the assessment of disability insurance cases. Available in four languages, the ART Work Budget is an internationally usable instrument for assessing workers, working-time requirement and work organisation within a farm. The use of the ART Work Budget ensures a consistent assessment throughout the whole of Switzerland. Moreover, the assessments are based on a broad and well-founded dataset.

The classification of the different work hardness groups is subjective, and originates purely from real-life assessments of entire work processes. Agroscope has taken up this classification scheme. Through a process of objectivisation and refinement, the system was applied to element level. As a result of the close connection with practice, it has been met with a high degree of acceptance at the implementing agencies. This enables the direct use of the work economics data, which thus directly benefit the agricultural data.

The IV experts' assessment of impaired efficiency is also prone to a certain subjectivity. In order to objectivise the assessment, further parameters are needed for the calculation and assessment of the individual tasks. These parameters should facilitate a systematic classification of body posture, such as the OWAS coding, as well as enabling consideration of the loads moved. A purely mathematical calculation of the work hardness and efficiency, based on objectivisation, should be aspired to.

The method on which the ART Work Budget and the assessment according to whg are based only covers physical workload. Mental stress also poses a challenge, however. Here, the most urgent requirements are to create a reliable definition of stress, as well as a manageable scale for the latter. Furthermore, there is a considerable need for research to determine appropriate parameters for influences and their impacts, such as noise, dust and atmospheric humidity. A requirement for these parameters is a causal survey method for ensuring an objective assessment.

4. REFERENCES

REFA (1973): Methodenlehre des Arbeitsstudiums Teil 1, Grundlagen. Methodenlehre des Arbeitsstudiums. Carl Hanser Verlag, Munich.

Schick, M. (2006): Dynamische Modellierung landwirtschaftlicher Arbeit unter besonderer Berücksichtigung der Arbeitsplanung. Post-doctoral thesis, University of Hohenheim.

Stark R., Schick M. (2009): Software ART-Arbeitsvoranschlag, Agroscope Reckenholz-Tänikon Research Station ART, Switzerland.

Kauke M., Hermanns I., Hoehne-Hückstädt U., Schick M., Ellegast R.P (2008): Analysis and assessment of workload in different milking systems using CUELA. Agricultural and Biosystems Engineering for a Sustainable World: International Conference on Agricultural Engineering & Industry Exhibition, Crete.