

CM ProWork – A Software Tool for the Management of Worker Competences in Production Systems

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Abstract: *A software tool for the management of competences in the production sector was developed in the framework of an EU project. The tool can be used to compare the task- and process-related competences of production workers on an industry-wide basis. The paper demonstrates how the measurement results are used and how competences can be effectively managed with the use of additional tool functions.*

1. The CM ProWork tool

The first version of the tool was developed in an EU Leonardo pilot project from 2005 to 2007. Development work will continue on the tool in the context of an EU Leonardo innovation transfer project (project number DE/08/LLP-LdV/TOI/147120) until 2010. This paper concentrates primarily on the basic concept and explains the statements which can be made about worker competences and how the tool can be used to manage competences in production companies.

Version 2.2 (or higher) of the tool is available under a license agreement (www.cmprowork.eu). The databased tool runs under MS Windows XP (and higher) as a standalone application. Although the user interface language is English the multilingual tool is set automatically to the operating system languages German, Spanish, Slovakian, Italian and Norwegian.

1.1 The tool development objectives

The main objective of developing the tool was to record and measure the competences of the target group: industrial production workers. This group of workers may or may not have completed formal vocational training, they may be engaged in performing relatively simple tasks or deployed as technical specialists. Organisational and planning activities are also recorded.

Although these competences can, to some extent, be acquired or honed in formal training, most of the relevant know-how, at whatever level and however pronounced, have been developed on the job. However, the actual way in which the competences have been developed is not examined in any greater detail. The focus is solely on the competences themselves – and specifically on those competences associated with successful work in a production setting. General competences are not taken into account as

- they play a relatively insignificant role in the management of competences in the production sector;
- special training is needed to record and present them;
- and because there are often legal impediments to their exploitation in the company.

Concentration on the outputs of learning processes corresponds with the aims of EU education and training policy, which is to identify and present the results of “nonformal learning” (refer to the EU’s “Copenhagen Declaration”). This is also the most helpful approach for the most important group using the tool: production managers, the people who hold main responsibility for developing the competences of workers who may or may not have been professionally trained. Production managers also have direct influence on how, for example, new and more challenging tasks are assigned.

1.2 What does the tool identify and how does it show findings?

The tool helps to identify actional competences. These are located in two important and interlinked fields of practical production work:

- (a) Successful performance and completion of work tasks
- (b) Successful fulfilment of specific requirements which arise from demands embedded in common work processes

The competences in action field (a) are referred to as task-related competences. The tool distinguishes between three task-related competences.

Competences in action field (b) are referred to as process-related competences. These are subdivided into four different types of process-related competences. Figure 1 shows the two types of competence and the seven competence categories.

The **three task-related competences**:

- **Task responsibility**
- **Task capability**
- **Task knowledge**

describe the motivational, actional and cognitive prerequisites needed to perform industrial production tasks. They become increasingly expressed

- the more responsibility a worker assumes for quite different types of work task;
- the better various tasks are mastered by the worker in even difficult situations;
- the more very difficult (knowledge-dependent) work tasks can be performed by a worker.

The **four process-related competences**:

- **Learning readiness**
- **Cooperation readiness**
- **Communication competence**
- **Social competence**

relate to the requirements a worker must fulfil for the purposes of cooperation, communication and ongoing learning in the work process and as part of the overall workforce. While these competences are not narrowly tied to the performance of work tasks, they are not removed from work activities either. They are, above all, most expressed when workers are willing and able

- to learn changed or new tasks and to acquire the related knowledge;

- to take active part in cooperation and self regulation in teams and in the production department;
- to take active part in communicating about work and company-related matters;
- to make an active contribution to social cohesion, even where interests in teams or areas of work diverge.

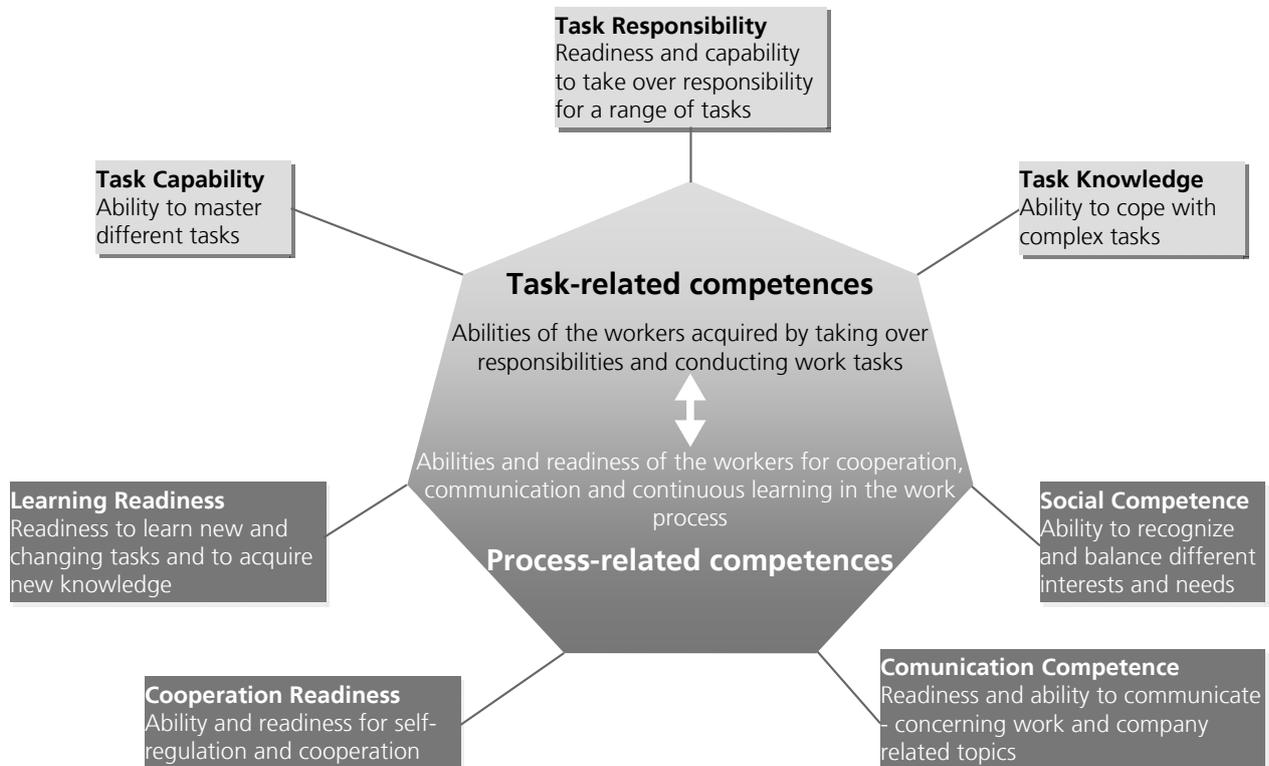


Figure 1: Competence types and categories

All seven competence categories are uniformly rated along a scale from 1 to 4 and presented in a joint competence report. The characteristic values (degrees of expression) mean the following:

- 1: Low or minimally expressed competence
- 2: Rather low competence
- 3: Rather high competence
- 4: Very high or maximally expressed competence

A deliberate decision was taken to assign competences to only four values and to exclude average values so as not to suggest a degree of measurement precision which would not be achievable in a shop floor process. It is essential to bear in mind that the minimum characteristic value of 1 also represents a degree of not inconsiderable competence

It is very important to understand that the competence characteristic values are produced in different ways in both competence areas:

- Task-related competences cannot be entered directly but are calculated by the tool. The tool's calculations draw on special input which does not relate to competences, but to objective activity and task characteristics.

- The characteristic values of process-related competences, on the other hand, are entered directly by the user and reproduced in the same way in the competence report. The user can make use of descriptions when classifying the characteristic values of competences.

Competence values had to be presented in different ways as there was no objective and simple means of identifying process-related activities. In contrast it was possible to fall back on experiences with tried and test analysis procedures for task-related activities. Figure 2 outlines the CM ProWork Tool input/output structure generated in this way:

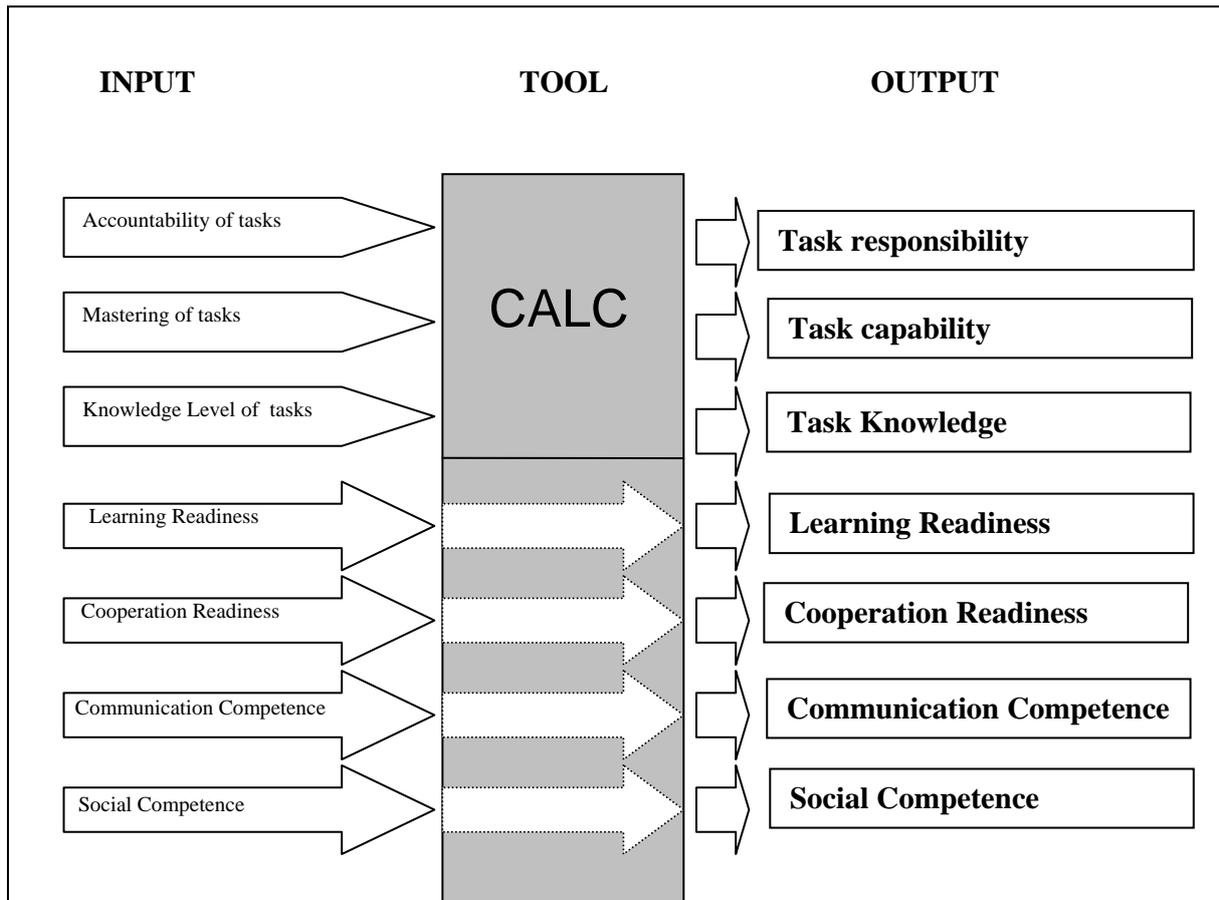


Figure 2: The input/output structure for presenting competences in the tool

This explanation clearly shows that the CM ProWork Tool works with a requirement-oriented competence model. The competence dimensions and their characteristic values were derived from production work demands. The fact that the tool works in this way limits to some extent the way competences are presented. When applied in an industrial production setting, this conceptualization can be very advantageous, however, particularly when it comes to putting the results to use.

1.3 The tool's task inventory

One of the functions of the tool is to help identify task-related requirements and to calculate the values for task-related competences from the input values. To do this it needs the most comprehensive and most broadly transferable list possible of the

tasks which have to be undertaken and mastered in a modern production process. The tool consequently includes an extensive task inventory consisting of a total of 96 single tasks. These tasks have been derived from a model which takes account of the processes for preparing and carrying out production orders as well as their monitoring and improvement (refer to Figure 3).

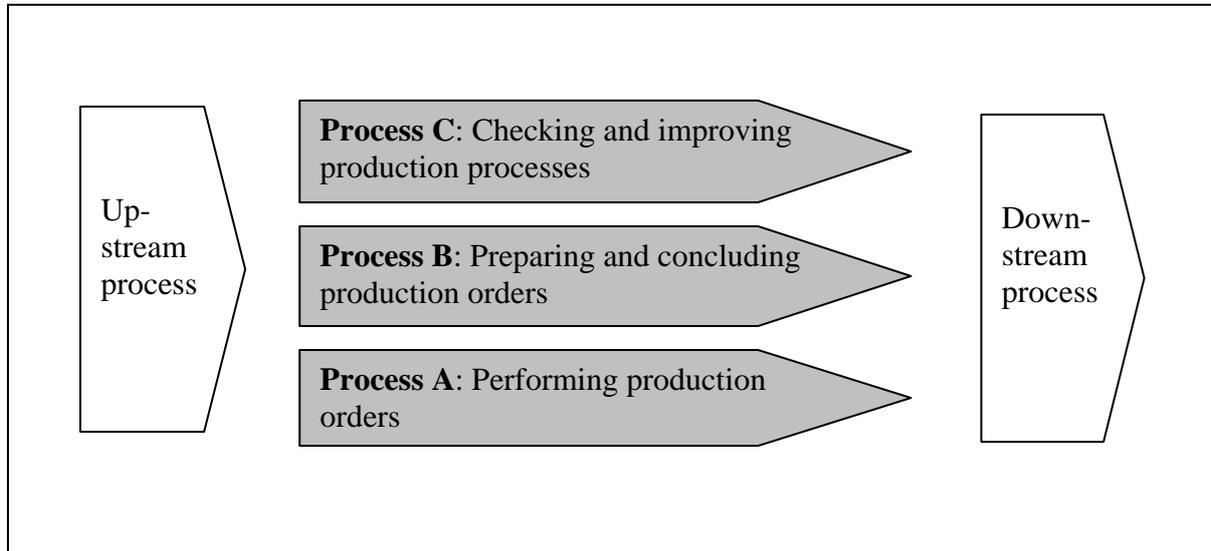


Figure 3: Process-related structure of the task inventory

Every process is made up of 2 sub-processes. These sub-processes are subdivided into several task fields which encompass the 96 single tasks. The sub-processes and their task fields result in the following task inventory structure:

Sub-process 1: Producing

- Task field 1.1: Operating machines
- Task field 1.2: Performing manual steps of production
- Task field 1.3: Maintaining machine functions
- Task field 1.4: Collecting data in process

Sub-process 2: Ensuring order flow

- Task field 2.1: Ensuring material flow
- Task field 2.2: Coordination of work flow

Sub-process 3: Scheduling production orders

- Task field 3.1: Checking and ensuring availabilities
- Task field 3.2: Allocating and coordinating personnel
- Task field 3.3: Distribution and scheduling of orders

Sub-process 4: Preparing performance of production orders

- Task field 4.1: Providing production documents
- Task field 4.2: Proving stock / materials
- Task field 4.3: Setting up machines
- Task field 4.4: Setting up measurement equipment
- Task field 4.5: Setting up handling and transport equipment

Sub-process 5: Assuring quality and productivity

Task field 5.1: Analysing data
Task field 5.2: Conducting audits
Task field 5.3: Establishing instructions

Sub-process 6: Improving quality and productivity
Task field 6.1: Improving quality assurance
Task field 6.2: Improving productivity

This task inventory can be used to identify the activities of workers with very different qualifications who are deployed in different ways - beginning with the simple fitter through to skilled industrial workers, technical specialist and lower management personnel, such as team coordinators and shift managers. The activities of production managers, such as foremen, production managers and specialists in up and downstream departments are only partly taken into account. The tool is not therefore recommended for use with these target groups.

The tool does not require a particular form of work organisation and is consequently suitable for use in labour intensive mass production, such as teamwork, or any other hybrid form of organisation. Tasks undertaken in the framework of continuous improvement systems or Kaizen concepts are also integrated as improvement tasks.

When applying the tool it is possible to work directly with the task inventory:

- It is possible and appropriate to tailor the standard tool inventory to the applicable structure in the production system. New tasks can also be integrated or existing tasks specified. Non-definitive tasks can be “hidden”.
- Information must be provided which specifies whether responsibility for each single task has been assigned to and mastered by each worker included. These entries are made separately along a simple, tried and tested three-level scale.
- In addition to the mandatory entries on the as-is status of task accountability, it is also possible to enter to-be task accountability values.

2. Competence management functions

2.1 Tasks and training management with the tool

The entry and adaption options in the task inventory provide a number of important task and training management options. This means that workers’ task profiles can be continually modified to take account of changes in the production process and workers’ abilities. At the same time, workers’ training requirements must also be determined and the necessary training organised. This task and training management is very important in developing worker competence.

The tool can be used to show highly differentiated as-is and to-be task profiles. The tool inventory and worker entries (task accountability and task mastery) can be transferred to MS Excel and processed as required by means of an export function.

A special evaluation function supports training management in two ways:

- The tool calculates a numerical learning relevance value for each single task. The more workers who are assigned the relevant task despite their lack of

appropriate mastery, the higher the learning relevance value will be. This function provides a task-related overview of the urgency of training – in terms of both as-is and to-be status.

- The tool can show the learning needs each specific worker has for each single task. These learning needs exist whenever the worker to whom the task is assigned has little or no mastery at all of the relevant task.

In this way the tool provides day-to-day task and training management similar to that offered by a worker/tasks table, but on a much broader scale. As a rule this is the responsibility of foremen and other management personnel directly involved in the production organisation. The tool has therefore been designed in a way that it can be installed in the production system and is easy to use on a day-to-day basis. No other task and training management resources are required. The usual proliferation of disparate forms and tables which can make comparisons so difficult is also avoided.

2.2 Competence management with competence reports

The competence report is the most important form of tool output and presents individual values in all 7 competence categories (refer to Figure 2 – in the numerical range 1, 2, 3, 4).

Together the three task-related competences and four process-related competences make up workers' work-related actional competences (refer to Figure 4).

- The motivation-related TASK RESPONSIBILITY category specifies the tasks which have been transferred to a worker and the extent to which the worker has fulfilled this responsibility. The more tasks are transferred to the worker from various sub-processes, the higher the characteristic value for this category is.
- TASK CAPABILITY shows action-based, practical competences. The more work tasks are mastered in various sub-processes (regardless of current task accountability), the higher the characteristic value for this category is.
- TASK KNOWLEDGE refers to the ability of a worker to master tasks which require relatively extensive know-how. The greater the mastery a worker has of such tasks, the higher the characteristic value for this category is.
- LEARNING READINESS refers to the willingness to respond to ongoing changes in the production process by acquiring new skills and knowledge. The greater the willingness to learn new and difficult tasks is, the higher the characteristic value for this category is.

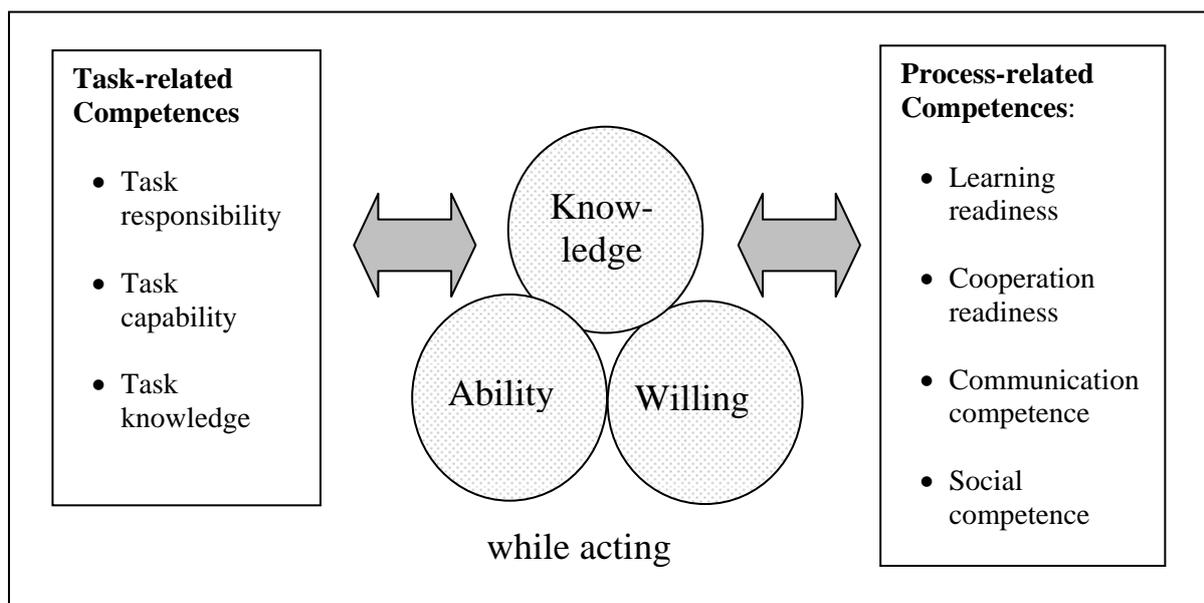


Figure 4: Actional competences in relation to competence categories

- **COOPERATION READINESS** is of growing importance in modern production processes. This category is highly pronounced for workers who are willing and able to take the initiative themselves and to cooperate in specific situations.
- **COMMUNICATION COMPETENCE** refers to the willingness and ability to share knowledge and experiences about work and company-related matters. It is particularly important that this category has a high characteristic value whenever there are plans to deploy workers as trainers or facilitators.
- **SOCIAL COMPETENCE** is the ability to identify and negotiate different interests and needs. It is particularly important that coordinators and team leaders are assigned high characteristic values in this category.

All seven competences for all the observed workers are shown in tabular form in the competence report. This table can be exported to and modified in MS Excel; graphics are also supported. Figure 5 shows a practical evaluation example which compares the percentage totals for three workers' task-related and process-related competences. This form of evaluation presents the competence profile in a readily assimilable and yet highly informative form. The figure also clearly shows that highly expressed task-related competences are not necessarily associated with highly expressed process-related competences. A differentiated comparison can be made, of course, if the focus is on single values rather than totals. This makes it very easy to identify the areas of competence in which a worker or group of workers has strengths and in which areas additional competences must be acquired. This development requirement can also affect the operational side, in other words task and process management. High values for competence categories cannot be achieved if task profiles are too narrowly conceived, if there are too few learning needs or if there are only very limited opportunities for cooperation and communication.

To-be competence values can also be created in addition to the as-is competence values. This is done by entering a fictive to-be worker and using the workers' assigned characteristic values as a comparative yardstick.

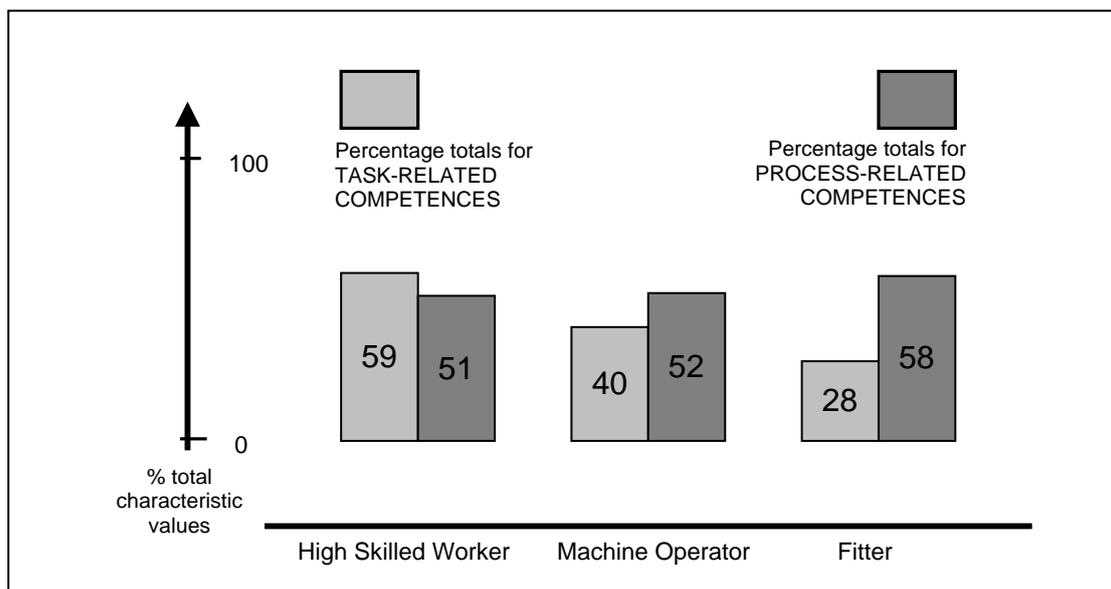


Figure 5: Percentage totals for competence values

Competence profiles are something quite new – particularly in production departments. Their introduction and use depends not only on interest but also on empathetic insight. Anxious and defensive reactions can be avoided by taking the following issues into account when informing workers about the tool and the tool output:

- CM ProWork does not show or compare any general, person-related competences.
- The competences shown are work related and amenable to further development through job design and learning.
- The entries on task accountability and task mastery are objective and can be made transparent.
- The tool is designed in a way that also enables direct involvement of the worker in the data entry process.

2.3 Competence management with positions

The tool can be used to define positions and to calculate how well suited workers are to defined positions even without extensive additional training input. This function far exceeds the usual options provided by competence measurement tools and is of eminent importance for collaboration between human resources and production departments in particular.

Positions are defined in the tool using work tasks which are selected from the tool inventory or taken on by real workers. These person or position-specific task profiles can also be exported and used in job descriptions, for example.

Whenever positions are defined, the tool calculates the suitability of selected workers to fill the relevant position. The calculation is based on the entries on the task mastery of these workers. If these entries are made at different times, learning-dependent developments can also be shown with the help of the export function in MS Excel (refer to Figure 6).

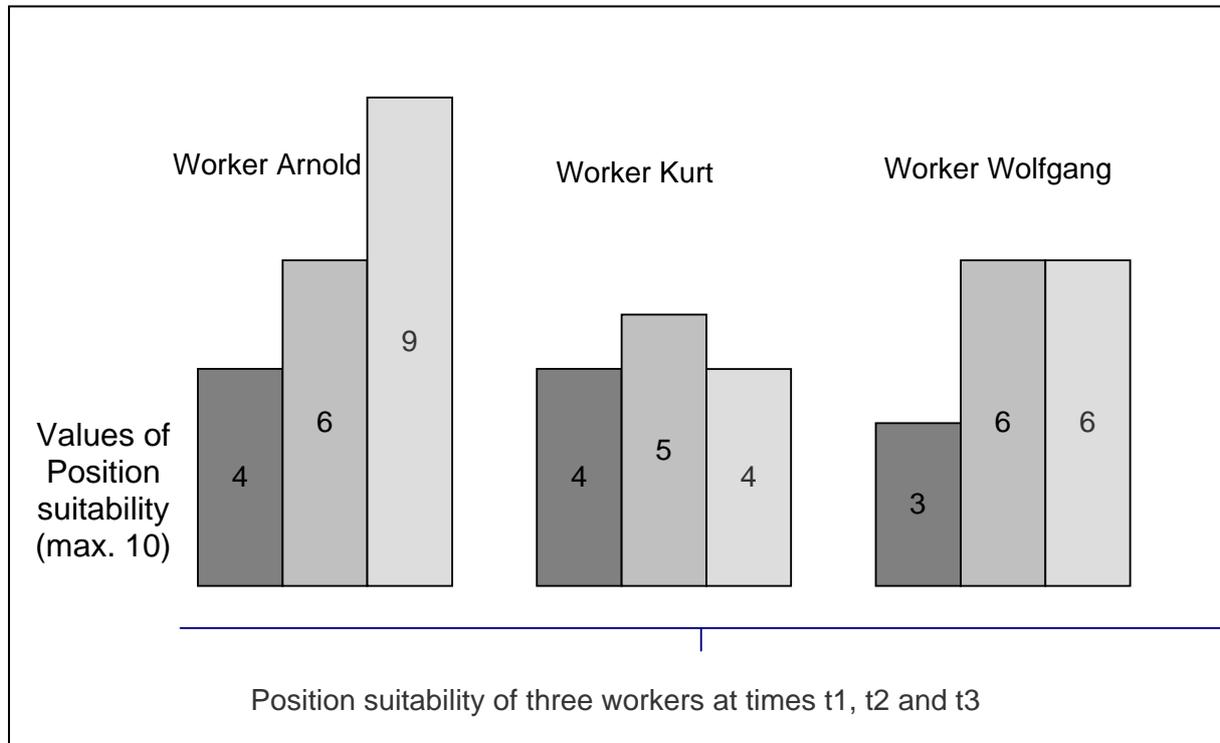


Figure 6: Presentation of changes in position suitability

An up-to-date position report can be extremely useful when planning transfers of staff to cover vacation leave. However, a great deal more is possible using the tool functions for positions and position suitability:

- Company-specific competence measurements can be carried out. Special positions are defined for this purpose and the relevant positions suitability values scored as competence values. Even if these values only result from the task mastery entries, they enable very interesting comparisons to be made in the company itself.
- Specially defined positions can also be used for benchmarking purposes. The task profiles for these benchmark positions may be very realistic or entirely abstracted from any real jobs in production. Further processing in MS Excel generates very interesting evaluation and comparison options.
- Combined evaluations of competence values and benchmark values are suitable for competence audits in production systems in particular.

3. Joint use for production and human resources management

Not only must a great deal of persuasive work be done before the tool is implemented for the first time, manpower must also be made available to make the necessary entries. Single production departments will rarely be able to take on all this work on their own. If they are not too large (maximum of 50 workers), they may however prove to be suitable pilot projects. If they are used as pilot projects, however, they should always be supported by higher management.

While the tool is powerful, it can only deliver usable results if the entries are accurate and are updated on a regular basis. The implementation and ongoing tool updating work will only pay off if there are plans to make appropriately ambitious use of the tool. Ideally the corresponding objectives should be defined in collaboration between the human resources department and the production department. Ultimately, the envisaged emergence effect (the outcome is more than the sum of its parts) will only be produced if joint – albeit varying - use is made of the CM ProWork tool.

Production managers are most likely to be interested in the tool whenever competence bottlenecks among workers threaten to have a negative impact and there is no effective discrete remedial action which can be taken. Good examples are unstable processes, limits on the flexible deployment of workers or expensive quality problems. Human resource managers primarily regard the tool as an opportunity to integrate production departments and worker target groups into the company's overall strategic competence management. The interests of both functional areas overlap so strongly at the following points that shared forms of use such as the following become feasible:

- Effectuation of management and training measures in production:
 - » Tool reports can be used, for example, to improve the preparation of target agreement meetings, argue more effectively for redeployments, improve the tailored planning of training courses and enhance the coordinated deployment of new employees or trainees.
- More accurate coordination of organisational and human resource development measures in response to weak points and bottlenecks in worker competence:
 - » The tool can be used to identify weak points in the assignment of tasks, for “hard” (task-related) and “soft” (process-related) competences with absolute precision. There is no longer any need to come up with roughly defined ‘one-size-fits-all’ measures.
- The impact of measures on organisational and human resource development can be measured with much greater precision:
 - » In many cases it is unclear what measures have had what effect. The tool can be used to measure effects on employees’ competences.
- Development of meaningful and up-to-date job descriptions:
 - » The tool delivers highly differentiated task profiles “at the touch of a button” which can also be stored and retrieved as standardised positions.

- Identification of human capital in production departments and the development of this capital:
 - » Knowledge of performance output is not enough when evaluating the potential performance of production systems. Dependable statements about human capital in particular are required in order to estimate and compare their development potential. CM ProWork supplies the meaningful data needed for this purpose.
- Development of competence standards for production activities as orientation points for personnel recruitment and human resource development:
 - » Testimonials and training course certificates will increasingly be complemented by competence descriptions. Learning in work processes plays a key role in production activities. For this reason it makes particular sense to present learning outcomes and expected results as competences.

Apart from the main effects, the accompanying effects of jointly practised competence management in production can also be beneficial. Improvements in worker competences can, for example, take the pressure off skilled production workers and management personnel and create greater freedom of scope for them to play more innovative roles. Existing continuous improvement systems and company suggestions schemes can only benefit from more effectively developed worker competences.

Human resources development professionals are also able to develop and test out more accurately tailored and innovative training courses for production workforces. They can target their interventions more accurately and receive more precise feedback. The “production” black box becomes more transparent as a result.