



Sustainable quality assurance by assuring competence of employees

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ARTICLE INFO

Article history:

Received 28 December 2010
Received in revised form 9 July 2011
Accepted 21 February 2012
Available online 1 March 2012

Keywords:

Continuous education
Competence management
Assistance system
Manufacturing metrology
Life Long Learning

ABSTRACT

Adequate actions have to be taken to assure sustainably that all employees are sufficiently qualified for their respective working fields. To implement the principle of Life Long Learning in a company and thus enhance a process of continuous improvement, it is necessary to provide a solid base to start from. Therefore, an assistance system has been developed which supports the adequate selection of training offers for manufacturing metrology oriented on the existing demand of each employee. To avoid the neglecting of basic competences, interdependencies between application and fundamentals have been identified and described in typical competence profiles. By this comprehensive view on advanced education, a sustainable learning effect is enhanced and it is assured that the competences gathered by a learner can be augmented via informal learning processes, thus enabling a sustainable base for Life Long Learning processes.

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1. Introduction

The economic success of a company is determined by the fact how the offered products are rated by costumers. To achieve a positive ranking and thus assure a high level of perceived quality, the company has to find a suitable position in the triangle of conflicting requirements on quality, costs and time [1]. Accordingly, measures of modern quality management aiming for sustainable success do not only mean to avoid the delivery of defective products to the customer but seek to establish maximum efficiency in the performance of all processes of the company. With such optimized procedures, products of high quality can be provided with minimum effort of time and costs.

If this vision can be realized is determined by the employees. Their knowledge and competences for the execution of their respective tasks is the most valuable asset of a company. Together with the motivation, the capability of an employee for his or her field of working will determine the performance. Whereas the responsibility

for motivation of employees by incentives for high performance is recognized as a fundamental duty of leadership, the importance of an adequate competence management as a prerequisite for successful working and effective quality management is still not fully noticed. In Germany, less than 20% of the enterprises implement systematic measures for the management of human resources [2] – besides the fact that this is one of the basic requirements of ISO 9001:2008 [3] on a quality management system to assure product conformity and most industrial enterprises are certified according to that standard. To assure the matching of competences and tasks is seen rather as a duty of the employee than of management. Yet, for the sustainable assurance of a high performance, an adequate competence management is required, implementing the idea of Life Long Learning.

2. Measures of competence management

The view to regard competence development as an employee duty is based on the traditional paradigm of improving performance steadily with growing experience. It is assumed that an employee has achieved all necessary skills and knowledge to perform the assigned task in basic

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vocational education for the considered profession, covering education in school and a following apprenticeship respectively higher level education in universities. The application on a given problem and thus its successful solution is seen as depending mainly on the willingness and basic talent of the employee. With increasing experience, the available basic skills will be honed and the performance will become more efficient and smooth. Yet, nowadays rapid development of technology and increasing complexity of tasks demand for further education and training of employees as it is not possible to develop competences as fast as new requirements will arise out of new methods and tools. This problem is – among other fields – especially evident in manufacturing metrology, as there development of novel measurement devices and improvement of existing techniques is very fast due to the need to provide reliable information on increasingly complex workpieces with increasingly narrow specifications, but at the same time most metrologists do not have a specific vocational training for this field.

Considering tasks where the required competences exceed the level of skills and knowledge of typical employees charged with the execution, there are two main possibilities to enhance the proper and efficient execution: As a direct and specific measure for a given task, the level of demand can be lowered to meet the existing competences, e.g. by partial automation or user guidance; as a broader and more general approach, competences of the employees can be amended by adequate training.

For easing the execution of measurement tasks in order to reduce the level of competence required for the performance, assistance solutions (i.e. facilities aiming at the support of a user during a given task) of various kinds are offered to support the planning, execution or interpretation of measurements (e.g. [4,5]), ranging from general advice for programming over simulations to help the user select parameters of the measurement setup to automated generation of inspection plans. This approach enables an immediate ease to the execution of measurement tasks and is often regarded as efficient and economical as the costs for qualified employees may be reduced.

But enabling a performance of complex, knowledge-intensive tasks without qualifying the employee for the underlying procedures and concepts provides only a short-term benefit as it is likely that the employee will not be able to execute the work correctly if even a slight deviation from the usual routine occurs which is not covered by the assistance facility [6]. Especially in metrology, the operator is held responsible for the delivered measurement result. The ability to explain the way, how a measurement result was gathered, is an indispensable prerequisite for the traceability and reproducibility of measurement results. If an operator has no understanding and control of the performed procedures, these fundamental requirements for reliable measurement results are not met. This even might lead to unnoticed or uncared for propagation of erroneous measurement results, as working steps may easily be carried out wrongly or half-heartedly, if the reason is not understood. Furthermore, errors in the measurement software – which do occur [7] – or in a programmed routine may not be recognized even if the results are implausible.

Also, a basic understanding of the matter at hand is a necessary requirement to be able to learn self-directed and thus improve performance and transferability of gained skills with increasing experience [8], by critically reviewing one's way to execute tasks and its conjunction to eventually arising problems, by exchange with colleagues or other practitioners or by using other random, unplanned opportunities for informal learning, occurring in every working environment, e.g. maintenance of machines by an external expert or visits to trade fairs.

Still, assistance facilities provide a valuable option to increase efficiency and reduce cost if they are used as an amendment, helping to avoid common mistakes. But to sustainably assure accurate, reliable measurement results and enable a process of continuous self-improvement, it is necessary to provide a solid base for the proper execution of tasks by sufficiently educating the employees [9].

To qualify metrologists for their tasks, a large variety of training offers is provided by the manufacturers of measuring machines, imparting the proper handling and programming of the specific machine, as well as by universities or other institutions, imparting basic knowledge (e.g. [10,11], among many others).

A training adapted to the learning requirements will result in well-funded knowledge as a base for the diligent and well reasoned execution of tasks, thus influencing significantly positive and sustainably the quality of gathered results [2]. Yet, what competences an employee has to gather in addition to existing education, varies strongly with tasks and also with previous education. Thus, the specific demand of a learner will rarely be met by a ready-made training concept as it is adapted to the requirements of an abstract user group described by typical constraints and average abilities. In order to qualify the employees in a way that is both economically sound and sufficient in regard of learning effect, a selection and combination of courses in an individual, demand-oriented training concept is required.

It can be very difficult for the learner or his superior to identify adequate courses and define an optimal training concept – all the more so, if there is only small basic knowledge about the considered area to start from. This situation results in a self-selectivity of employees asking for further training: Only those quite sure of their needs and their standing, being basically well-educated, will ask for additional courses, whereas those with real gaps will rather hide them [12]. Thus, it is necessary to support the identification of existing need for further education and the according selection of appropriate training offers based on objective criteria, considering holistically the gain of the company by properly educated employees due to the reduction of quality costs, not only the costs for training. For this, an assistance tool can be used which accompanies the necessary steps to define an individualized training concept oriented on the specific demand.

3. Concept of an assistance system for individualized training concepts

In advanced vocational qualification, the never ending demand for continuous improvement usually is envisioned

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