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Developing Competencies for Continuous Improvement Processes on the Shop Floor through Learning Factories – Conceptual Design and Empirical Validation

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Abstract

Developing employees' competencies in order for them to be able to solve problems quickly is an essential feature of future-oriented production. The object of research and practice in this field is to develop action-oriented approaches implemented through learning factories. So far, however, these approaches have not taken sufficient account of production workers, even though the development of their competencies is necessary for a broadly based and continuous improvement process. An integrative approach is presented. It enables the development of problem-solving competencies among shop-floor workers during a target-oriented continuous improvement (CI) process with the use of learning cells.

Keywords: Competency Development; Learning Factory; Continuous Improvement (CI)

1. Introduction

The challenges of the market, such as shorter product life cycles, greater numbers of product variants and growing economic volatility, require that, in order to sustain their competitiveness, companies must be able to quickly adapt their production methods to changing market conditions [1,2]. Companies must therefore be capable of continuously improving their production processes and also of developing them further. This means that the extent to which the actors in an organization are able to implement the necessary changes is becoming an increasingly important question [3,4]. This makes the ability of all employees to contribute to improvements a key success factor for the operative excellence of production processes.

The paper introduces a novel and empirically validated qualifying approach, which is part of the research agenda for competency development in the learning factory CiP [5-7].

2. Competency development for continuous improvement

2.1. Competency as a basis for action orientation

Numerous studies emphasize the significance of knowledge for the future viability of modern industrial locations [1, 8, 9]. Knowledge alone, however, is not sufficient; for means of production that are versatile and adaptable, it is necessary to ensure that employees are able to implement new techniques, thus making it possible to work successfully in conditions that are today unforeseeable.

The abilities required for this can be described as competencies, designating the 'capacity for acting independently' [10]. Besides knowledge and expertise, they imply the ability to organize their actions themselves. Competencies are thus the 'demands made of individuals to adapt to new conditions and to modify

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and put into practice their own strategies for acting in concrete situations' [11].

Empirical studies reveal that the disparity between mere knowledge and this kind of competency is smallest when learning environments are designed in a constructivist manner, i.e. when the learners are given opportunities of experiencing and interpreting, thus enabling them to link up new insights with an already existing corpus of knowledge [12]. Learning factories represent a coherent approach for broadening competency in the optimization of production processes.

2.2. Qualifying by the use of learning factories

Learning factories pursue an action-oriented approach in which employees are able to develop competencies for improving production methods from the perspective of lean production. This is done in a highly realistic learning environment in which genuine products are manufactured in a simulated but life-like production setting [13].

It is important to emphasize that the focus of attention here is based on real problems which occur in the running of the learning factory (problem pull) and not theoretical content, for the understanding of which practical examples are merely used when appropriate (problem push).

Developing competency in the methods of production optimization should as far as possible be coordinated among the different functions and hierarchies of a company's personnel. In the CiP learning factory, training curricula are currently available for the graduate training courses in production technology as well as for courses at the management and master craftsman levels. The approach has also proved to be successful at both the skilled worker level as well as at the engineer level [14]. Up to present, however, training has been provided above all for engineers working directly in production areas and auxiliary planning areas as well as for senior personnel ranging from master craftsmen to group leaders and plant managers. By contrast, scarcely any personnel working directly on the shop floor have so far undergone the time-consuming training of the learning factory.

2.3. Action-oriented learning in production practice

For a kind of production that is expected to react swiftly to new demands, a permanent focus on the groups of personnel trained so far would appear insufficient. What must be achieved instead is to establish technical as well as methodological competency on the shop floor of the primary organization in small steps in order to solve problems and develop production further, so that improvement processes can be achieved successfully in day-to-day operations.

Such continuous improvement (CI) processes, however, require that competency development takes place as widely as possible at the level of shop-floor workers. This can seldom be done by means of time-consuming training courses with extensive curricula. Rather, it must be adapted to the specific qualification needs of the employees and be of limited scope. Among other reasons, this is necessary because empirical studies have pointed out that shop-floor workers have difficulty applying what they have learned within everyday CI practice [15]. Therefore, these kinds of competencies for improving production can only be generated and made available beforehand to a limited extent [16, 17]. Instead, learning processes must be established as part of the improvement strategy which further the required technical and methodological competencies.

What is needed here is a clearly structured form of CI which corresponds to the competency development that is intended and which has an underlying curriculum to support it. This approach, in turn, enables problem-oriented learning (problem pull).

3. Competency development along guided improvement processes

Based on empirical findings, a form of CI was designed [18] which meets the requirements of lean production systems: continuity, a high degree of participation, playing a role as an integral part of daily work and being a target-oriented approach [19–21]. To this end, CI contains not only 'top-down' elements, which are the responsibility of the shop-floor manager, but also 'bottom-up' elements contributed by the shop-floor workers.

The CI is supervised by the first line manager, who is in charge of all three forms of control in accordance with [20] with regard to process, goal and contents. The CI procedures, as well as the participants and timeframe, are determined through the steering of the process. This also gives rise to an institutionalization through a daily recurring routine in everyday working practice. CI can be integrated into daily performance meetings or shift handovers as part of shop-floor management procedures through which the continual improvement process runs in defined routines.

On the basis of the state of production to be achieved in future the line manager lays down specific targets; this results in the improvement process shifting from a hitherto more reactive orientation at the shop-floor level (reacting to deviations from the target figures) to a pro-active orientation (moving towards the future state of production) [22]. A CI based on this kind of target orientation is, moreover, the key characteristic of a