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Effectiveness of using Learning Factories to impart Lean principles in mining employees

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Abstract

An urgent need exists to drive operational excellence in mining operations. Lean philosophy can improve productivity and efficiency when implemented holistically. There is therefore an incentive to build embedded, Lean capability in mining to consistently drive meaningful business results. Learning Factories have been used in other industries to effectively develop this competency at all hierarchical levels. Anglo American has recently developed a training facility in South Africa, using the Learning Factory concept to teach Lean skills to mining employees. This paper presents the results of a study that investigated the effectiveness of using the Learning Factory in this context. The Kirkpatrick model, for evaluating training effectiveness was used as the analytical framework. Results show that the Learning Factory is effective in imparting Lean skills within a short space of time and that all employees can achieve a similar or higher understanding of Lean regardless of their starting point.

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1. Introduction

While Lean implementations in mining have been slow and fragmented, the industry is making inroads into utilising Lean principles. The industry is yet to realise the levels of success that are comparable to manufacturing and health care [1], [2], [3]. Current challenges in the mining industry are encouraging organisations to consider how Lean

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principles can bring about improved and sustainable operational performance. However, there has been little focus on how sustained competency development can be introduced in these operations to support Lean implementation.

Given that Lean principles originated from manufacturing, and Learning Factories have been used there successfully to build Lean capability [4], [5], [6]; there is a need to investigate if training mining employees in a Learning factory will result in similar success. This research will look at the effectiveness of using Learning factories in imparting Lean skills to mining workforces. It will also consider the effectiveness of this tool across the hierarchy levels in a mining organisation. The research starts with a literature review on Learning Factories, followed by description of case study context. From there, the research method, results and discussion are presented.

2. Lean capability building using Learning Factories

Manufacturing companies needed to be able to quickly adapt to new market conditions and remain competitive in meeting changing customer requirements [5], [7]. Effective methods for developing employee competencies are required as traditional methods show limited effects [4]. Given the current turmoil in the mining industry, there exists a need to adapt quickly to change, remain competitive and build Lean competency fast. Learning factories offer a possible alternative to meet these requirements given their proven success in manufacturing.

By definition, a Learning factory refers to a small scale factory which closely mimics a real factory where participants can learn by doing [5]. This type of learning has been proven to be more effective as it leads to greater retention and greater ability to apply the learnings [6]. Studies reviewed on problem-based and action orientated learning suggest it is possible to increase educational effectiveness and efficiency compared to traditional educational sources [6]. This is further supported by the learning pyramid that shows that the recall rate of learners who learn by doing is higher than those who learn by what they hear and see [6].

A study that investigated the learning success of engineering students in a Learning Factory, showed that students have a greater application-performance and a higher degree of action-substantiating knowledge after being taught in a Learning Factory compared to a conventional lecture (characterised by highly abstract content and methods) [4].

This prior research of application of Learning Factories in manufacturing motivated this study to see if similar results can be obtained with mining employees.

3. Case study

3.1. Training approach taken by Anglo American

A centre was developed by Anglo American to train employees in Business Improvement (BI) including Lean principles, using experiential learning to maximize knowledge retention. To encourage effective learning, a three tier learning approach across different training zones is used. The first zone, the Foundation Zone introduces Lean principles using a Learning Factory, simulating a manufacturing environment. Participants then progress to the Application Zones with authentic mining experiences such as maintenance and drilling to bridge the gap between theory and practice. Lastly, the participants are expected to apply their learning in their work environment doing site-specific BI projects where they receive coaching.

One of the most widely used frameworks for evaluating training effectiveness is the Kirkpatrick Model [8]. Evaluation considers four levels of reaction, learning, behaviour and results. The three-tier approach used at the centre is mapped against the Kirkpatrick model in Table 1 **Error! Reference source not found.**, to measure the effectiveness of the training. The Kirkpatrick Level one and two evaluation of reaction and learning can be evaluated in the Learning Zones. The Kirkpatrick Level three and four evaluation of behaviour and results respectively can be evaluated back at the operation during implementation of BI projects. This study will look at the Level 2 evaluation of effectiveness of learning and this is highlighted in Table 1. The proposed measure for these criteria is the use of before-and-after training assessments.

Table 1: Mapping of the training centre approach onto the Kirkpatrick model

Training centre approach		1. Foundation Zone		3. Fieldwork	
		2. Application zone			
Kirkpatrick Model [9]	Criteria Measure	1. Reaction	2. Learning	3. Behaviour	4. Results
		Course evaluation	Assessment before and after training	Improved results in immediate place of work	Improved organisation financial results

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