Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 9 (2017) 347 – 353

Procedia MANUFACTURING

7th Conference on Learning Factories, CLF 2017

Learning environment to support the product development process

Klaus Schützer[a]*, Leticia Francischini Rodrigues[a], Julia Andrade Bertazzi[a], Luiz Fernando C. S. Durão[b], Eduardo Zancul[b]

[a]*Methodist University of Piracicaba – Lab. for Computer Integrated Design and Manufacturing, Rod. Luis Ometto (SP 306), Km 24, Santa Bárbara d´Oeste, 13451-900, Brazil*

[b]*University of São Paulo – Polytechnic School, Av. Prof. Luciano Gualberto, 380, São Paulo, 05508-010, Brazil*

Abstract

The competitive global market creates challenges like shortened product life cycles and high level of customization with lower costs. Therefore, it is necessary to make investments to achieve competitive gains. In this scenario, qualification of human resources is a factor of success in the global competition. To fulfill this requirement, a new way of learning that integrates education in a real factory environment was developed. This concept is called Learning Factories. It brings an environment that encourages the experimental learning, simulating the key features of a real production environment in an academic setting. This teaching strategy reduces the gap between the knowledge (University) and the action (industry). This paper describes a learning factory testbed environment supporting the product development process, which was implemented at the Methodist University of Piracicaba, Brazil. This new learning environment simulates a real product development process for undergraduate and postgraduate programs. The application of Learning Factory shows in practice the tools applied in the product development process and involves design teams, product management, engineering changes request and, during the entire process, the communication and workflow features of the product data management tools used in the implementation of the environment.

Peer review under responsibility of the scientific committee of the 7th Conference on Learning Factories

Keywords: Learning Factory; Product Development Process; Competency Development; Experimental Learning.

1. Introduction

All Industrial Revolutions changed the way the workers interact with the manufacturing system [1]. Every technical development of these revolutions led to profound changes in society combined with massive gains in productivity. The work is no longer developed in a handmade way - it is now standardized on advanced factory sites. Knowledge transferring on manufacturing techniques, in the same way, changed from a master-apprentice approach to being taught in schools and universities, becoming more theoretical. However, industrial learning requires practical approaches to provide a complete understanding of manufacturing processes culminating with the development of learning factories.

Learning factories were created to encourage and develop experimental learning on manufacturing process improvements, simulating a real manufacturing environment and decreasing the gap between knowledge and practice [2]. The learning factory term is related to interdisciplinary projects in partnership with industry. This model emphasizes the practical experience applying

* Corresponding author. Tel.: +55 19 3124-1792; fax: +55 19 3124-1810.
E-mail address: schuetzer@scpm.unimep.br

Peer review under responsibility of the scientific committee of the 7th Conference on Learning Factories
doi:10.1016/j.promfg.2017.04.018

theoretical knowledge to solve real industry problems. Recently, learning factories are becoming popular. It may have different sizes, sophistications, and have the will to improve learning experience [3].

Introducing factory concepts at academic environment is related to the practical side of engineering teaching process, balancing the design experience, manufacturing theory and production systems at the product development process (PDP) [4]. With those targets, the learning factories are aligned with industry requirements for a fast answer to market challenges, reduced product lifecycle, and customized products [5].

The growing demand for customized solutions requires innovative concepts and solutions for manufacturing systems. Flexible processes, agile technologies and flexible manufacturing systems are increasingly needed and relevant in the industry, increasing the diversity of learning factories [6].

Therefore, the objective of this paper is to present the Learning Factory environment implemented by the Laboratory for Computer Integrated Design and Manufacturing (SCPM) at the Methodist University of Piracicaba (UNIMEP) in Brazil. The testbed at UNIMEP is a learning environment on product development process that simulates a real process of designing a new product for both undergraduate and graduate study programs, combining theoretical and practical learning. The use case at UNIMEP shows that the application of product development and manufacturing process in practical scenarios decreases the gap between industry and academy.

The paper is structured in four sections. After the introduction of the research topic in Section 1, Section 2 provides an overview of the SCPM-Learning Factory. In Section 3, the product development approach used at SCPM is presented. The conclusion and an outlook on further research needs are discussed in Section 4.

2. Learning Factory for Product Development

2.1. Motivation

Due the economic crises that have occurred in recent years, there is a tendency for reindustrialization of the developed economies. In this regard, countries like Germany, the United States, and England seek to qualify their workforce to work in industrial environments. In the new industrial environments, the products and systems of production are in fast and constant change. Thus, it is fundamental that engineering students are introduced to these concepts quickly. Universities need to look for a new way of balancing theoretical engineering education and practical teaching, giving students a faster learning curve [7]. Through learning factories, it is possible to bring industrial environments to the university, preparing the new engineers more effectively to enter industrial networks [8].

Learning factories are being developed to transmit process and method knowledge to students and industry professionals through a simulated real production environment [9]. There are several initiatives of learning factories in the world. A brief review of the literature on the subject allows to highlight the Center for Industrial Productivity (CiP), implemented by PTW at TU Darmstadt, as one of the pioneer learning factory in this area [10]; the Learning Factory for Advanced Industrial Engineering (aIE) at the Institute of Manufacturing and Industrial Management (IFF) at the University of Stuttgart [6]; iFactory, at the University of Windsor, Canada [6]; and a learning factory with focus on PLM (Product Lifecycle management) at EAFIT University in Colombia [11].

When analyzing the studied factories, it is observed that the implemented learning factories have the focus on the various aspects of production, starting from an already structured product for manufacturing in flexible manufacturing systems. However, companies need multidisciplinary training, including here all stages of the product development cycle and its tools. In this sense, it is also necessary to set up learning industrial environments that work in the stages prior to product realization that is, focusing on the product development cycle and its tools, such as Product Lifecycle Management (PLM), CAD, CAM, CAE, etc.

Engineering activity is related to problem-solving using analysis and design [12]. Therefore, a major purpose of engineering education is to train engineers for designing [13] and dealing with the designing tools for product development. This was the motivation for SCPM to conceive a learning industrial environment focused on the product development process. This environment should offer all the digital tools applied in the product development process, including its management with the resources available in a PDM system. The initiative focus, therefore, on resources needed to simulate an engineering environment of a learning factory.

2.2. A Short History of SCPM

The Learning Factory for Product Development Process was developed and implemented by the Laboratory for Computer Integrated Design and Manufacturing (SCPM) of the Methodist University of Piracicaba (UNIMEP).

The laboratory has been active for more than 20 years and has a full-time research team consisting of a full professor, PhD. students, master students, undergraduate students and technical support staff. Its purpose is to enable scientific development through projects to be developed by students under the supervision of professors.

The adopted strategy is to develop research projects close to industries enabling a rapid implementation of the obtained technological results. The laboratory also has strong partnerships with other universities, like the Polytechnic School of the University of São Paulo, which results in research works focused in the learning process, as the presented in this paper. For these activities, the laboratory possesses modern hardware and software resources.