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Transfer of Model of Innovative Smart Factory to Croatian Economy using Lean Learning Factory

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Abstract

Croatia's manufacturing industry faces many problems and obstacles that have a large impact on its competitiveness. Insufficiently educated and unskilled personnel, particularly in the production and management fields, are decreasing competitiveness that is necessary for survival in the global market. Objective of project Innovative Smart Enterprise is to establish a special learning environment in one Laboratory asLean Learning Factory, i.e. simulation of a real factory through specialized equipment. The Lean Learning Factory's mission is to integrate needed knowledge into the engineering curriculum. Therefore, Lean Learning Factory at University of Split is in continuous developing process to support practice-based engineering curriculum with possibility of learning necessary tools and methods, using didactic games or real life products and equipment. Solution proposal for best balance between toys and real products consider design and production line development for product Karet. It is a traditional and original product from Croatia, so it will raise enthusiasmin learning process in both students and industry employees. Two assembly lines will be developed, one traditionally equipped and one intelligent, networked, flexible, and fully improved by Lean tools. By deeper analysis of both assembly lines, hybrid assembly lines could be designed, to balance on one side assembly tact time according to customer demand and total cost of installation and running on the other side. Methods and tools adapted and implemented, in both design and analysis process for optimization of this hybrid assembly line would be scaled and adjusted for industry use as part as knowledge transfer from university to enterprises.

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Keywords: Lifelong Learning; Product Lifecycle Management; Assembly line balancing; Didactic simulation games; Product development

1. Introduction

Manufacturing is today, as it always has been, a cornerstone of the economy of developed nations. Having a strong base of manufacturing is important to any advanced country because it impels and stimulates all the other sectors of the economy. It provides a wide variety of jobs, both blue- and white-collar jobs, which bring higher standards of living to many sectors in society, and builds a strong middle class.

Croatia's manufacturing industry faces many problems and obstacles that have a large impact on its competitiveness. The initial plan during the last fifteen yearswas to restructure the economic subjects efficiently and to become competitive enough in order to compete efficiently in the domestic as well as in the export markets.Unlike projections, the Croatian manufacturing industry has not been completely and efficiently restructured. On the other hand a recent dramatic drop in customer demand leading to reduced working hours, layoffs and idle factories.

Croatian economy is still burdened by previous economic system inherited anomalies and some transitional problems. Low productivity is additionally burdened by a great number of employees and obsolete technology. Insufficiently educated and unskilled personnel, particularly in the production and management fields, decreasing competitiveness necessary for survival in the global market. There is a predominant lack of products and services which are demanded by developed markets. The government meddling with development of strong economy. Grey economy is growing encouraged by infirm justice andunstable tax administering during recent

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years. However, public property and enterprises privatization, which is a sine qua non prerequisite for sound market basis establishment and prospective growth, has not been successfully implemented. Most public enterprises completely disappeared in the privatization process, and those that managed to survive, have undergone numerous recovery programs or have gone into liquidation. In these conditions, small and medium-sized enterprises development could not have support by big industrial systems.Therefore, economic development has been mostly turned to the service sector, especially tourism.

There is the lack of a unique and commonly agreed economic strategy at the national level. One of the primary strategic goals is to develop a competitive, diversified, technologically advanced and environmentally sustainable economy that will be oriented to enhance the living standard of the local population. Consequently, such clearly defined goals require a radical change of the existing settings, in which an inadequately competitive economy still prevails.

The main question is how to detect competitive advantages of the manufacturing industry and therefore achieve a higher level of export competitiveness in the regional and the international markets, like the market of the European Union. Croatia's manufacturing industry participates in a large proportion in the gross domestic product, employing a large proportion of the entire workforce, is one of the greatest generators of tax revenues in the country, and is one of the most propulsive export industrial branches of the economy of the Republic of Croatia [1]. Generally speaking, during the transition process there was no industrial development whatsoever, particularly there were no new technologies or new products introduced. Cooperation between economy and science was rather weak, and the accompanying infrastructure required to support technological development and innovations was developing rather sluggishly. Taking all this into consideration, a basic prerequisite for making a turnaround to a successful economic development in Croatia is to restructure its economy.

In order to set things in motion, the following priorities have been defined:

- to strengthen cooperation between research institutions and entrepreneurship that will enable new technologies implementation and technologically innovative products production,
- to restructure organization in traditional manufacturing sectors, agriculture, fishing industry and tourism, in order to achieve bigger competitiveness,
- to support export-oriented, specialized production of products and services with higher VAT,
- to encourage regional and inter-regional integration processes (including transnational ones) and to support cluster organizations in order to strengthen overall synergetic impact in the sectors and between them,
- to ensure business, entrepreneurial and managing training,
- to increase employment opportunities.

In the future the overriding objectives in Croatian enterprise will be flexibility, agility and scalability, in order to survive turbulences caused by erratic customer behaviour and market turbulences on a large scale.

2. Innovative Smart Enterprise project objectives

Croatian Science Foundation (CSF) is financing the project Innovative Smart Enterprise (INSENT) according to the priority to strengthen cooperation between research institutions and entrepreneurship.

Manufacturing enterprises are in the main focus of this project. Vision of Innovative Smart Enterprise for with long term sustainability can be summarized into following features:

- Lean,
- Flexible,
- Agile,
- Efficient,
- Responsive,
- Information enabled,
- Predictive,
- Safe.

The main objective of this project is to develop Croatian model of Innovative Smart Enterprise (HR-ISE model). The aim is to develop model for regional fit, i.e. to harmonize Innovative Smart Enterprise model with specific regional way of thinking, manufacturing and organizational traditionand specific education. Its resultsshould help Croatian enterprises to bridge the gap between their competencies and EU enterprises' competencies and capabilities. Following objectives are crucial to achieve main objective of this project:

- Objective 1 (completed): It was important to perform the analysis of the current state of Croatian manufacturing industry with regard to Industry 4.0 concept. It shown that Croatia is far away from Industry 4.0. An average industrial maturity level of Croatia calculated in [2] was estimated to 2.15 which represents second industrial generation, i.e. middle of 20th century. It means that in Croatian manufacturing practice technology and organizational concepts are still similar to those 50-60 years ago. This research reveals current state of Croatian manufacturing enterprise and answers on the question: "Where are we?"
- Objective 2 (to do): A synthesis of analysis of Croatian manufacturing enterprises will be done through development of Croatian model of Innovative Smart Enterprise (HR-ISE model). HR-ISE model will be based not just on State-of-the-art theoretical models but also on State-of-the-art practical models like Lean Management philosophy from Toyota Production System. A special efforts will be made to bridge the cultural and mentality gaps between State-of-the-art models and current Croatian model. It will be the answer on the question: "Where we want to be?"
- Objective 3 (to do): A special learning environment will be established in one Laboratory. It will be a Learning Factory, i.e. simulation of a real factory through specialized equipment. Laboratory will be organized to simulate factory based on HR-ISE model. Hence, Laboratory will be learning environment not just for