

Chapter 8

Implementing Lean in Engineer-to-Order Manufacturing: Experiences from a ETO Manufacturer

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ABSTRACT

This chapter reviews the state of the art in engineer-to-order production and non-repetitive production to give an overview of existing research and applications of Lean in this sector. Afterwards, a real case study at a medium-sized ETO manufacturer shows an approach to implement Lean Production in such a non-repetitive manufacturing environment. The experiences from the case study illustrate that the suitability of certain lean methods, such as value stream mapping or Kanban is limited, while other lean methods, such as 5S, CIP, or a material-oriented layout, brought significant changes. In the consolidation phase of the Lean production system, the authors defined a Lean-Toolset with the most suitable lean methods for engineer-to-order manufacturing systems. A core aspect of the Lean implementation was the desired mind-change of the employees. The chapter closes with a short description of the achieved results in the case study and gives an outlook to further research activities.

INTRODUCTION

Industrial production can be classified according to different market interaction strategies (Browne et al., 1996): (1) make-to-stock, (2) assemble-to-order, (3) make-to-order and (4) engineer-to-order. Lean implementations are no longer limited to high-volume production and are becoming in-

creasingly common at low-volume, high-variety non-repetitive companies, such as make-to-order or engineer-to-order productions (Portioli-Staudacher & Tantardini, 2012). Companies in the Engineer-to-order (ETO) sector are characterized by their complexity and customer specificity of the products (Bertrand & Muntslag, 1993; Gidado, 1996) as well as by the uniqueness of their

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products. In Engineer-to-order (ETO) companies the number of products or parts is usually very low if not reduced to a single product. The design and manufacture of complex Engineer-to-order products is determined by uncertain operation durations and multilevel product structures (Earl et al., 2003).

Manufacturing provides the elements from which buildings, bridges and houses are constructed. Various elements, from which these buildings are constructed, are engineered-to-order. These ETO products are produced by fabrication shops, which sit squarely at the intersection of manufacturing and construction (Ballard & Arbulu, 2004). In the steel construction sector usually every project is different from each other. The industrialization in form of prefabrication of modular elements increased and led to a higher impact of pre-assembly in the manufacturing hall. Industrialization can be seen as a structural means for eliminating, or at least drastically reducing, on-site activities in construction (Koskela, 2003). An industrialized construction would increase the value-adding activities during production and, to a large extent, eliminate the non-value-adding activities such as waiting times, transports or controls. The ETO industry is also in the process of adopting this approach to industrialization (Girmscheid, 2005) and efficiency improvement methods.

Less well run organizations that do not have efficient and effective processes and will have to reduce assets to survive, resulting in brands being traded as a means of survival. Lean enterprises will dominate their chosen markets (IFS, 2004). By modern concepts such as Lean Production and Lean Construction, waste and lead times should be reduced (Höök & Stehn, 2008; Matt et al., 2013; Ballard & Howell, 2003; Green & May, 2005; Jorgensen & Emmitt, 2009). While in the automotive or aerospace industry the application of Lean Manufacturing methods is common nowadays,

the ETO-environment is lagging behind these developments (Matt et al., 2013). Because of the low repeat frequency of similar or equal building elements and the high variance of manufacturing processes, the implementation of Lean manufacturing systems is quite challenging. Lean tools and methods are usually known from repetitive production environments, such as series production with a low-mix high-volume production, while there are only few experiences in the use of these methods at Engineer-to-order manufacturer. One of the major issues still needed to be tackled is unfolding the full potential of Lean in other non-repetitive manufacturing environment (Papadopoulou & Özbayrak, 2005). Recently also some research has been done in a high-mix small-lot size environment (Horbal et al., 2008; Portioli-Staudacher & Tantardini, 2008). Several works challenged the applicability and performance of lean scheduling in non-repetitive production systems (Singh & Brar, 1992; Chang & Yih, 1994; Levasseur & Storch, 1996; Andijani, 1997; Nagendra & Das, 1999; Geraghty & Heavey, 2005; Papadopoulou, 2013). Especially in those companies, working in the field of construction or construction supply, where the customer order usually determines and triggers the design and consequently the production, Lean tools and methods known from repetitive production usually do not fit (Romero & Chávez, 2011). They require different manufacturing approaches and improvement methods for so-called project manufacturing or engineer-to-order (ETO) manufacturing (Yang, 2012).

The purpose of this chapter is to present the experiences gained from a real industrial case study of implementing Lean Manufacturing in a craft-production oriented mid-sized facade manufacturer from the ETO-sector and to derive from the findings recommendations for the implementation process as well as a Toolset of suitable Lean methods for the design of Lean engineer-to-order production systems.

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