Chapter 16
Sustainable Production Planning Supporting Entrepreneurial Success and Environmental Friendliness

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ABSTRACT

This chapter proposes the use of modified algorithms for production planning that support both cost optimization as well as environmental friendliness. The key element is the implementation of non-linear cost functions based on ecological considerations for lot-size planning. Lot-size planning is an essential part of industrial production and integral part of ERP-systems. The classical approaches of lot-size optimization, which are widespread in industries, the Wagner-Whitin algorithm and the Part-Period Balancing heuristic, are enhanced with so-called eco-factors. These eco-factors allow an optimization based on cost as well as ecological factors. This eco-enhanced approach combined with the introduced concept of eco-balancing helps to reduce overall production costs. Simultaneously, the environmental impact is significantly reduced, resulting in a better carbon footprint.

INTRODUCTION

Production planning and scheduling (PPS) is crucial for industrial enterprises. An important part of production planning is material requirements planning (MRP) and in particular lot-size planning. It determines how many net requirements of a product are merged into a single batch (lot) in order to minimize production costs. Beyond the cost-centric perspective of production planning itself, the ecological consideration is mostly unobserved. Legal guidelines, rising prices for energy, and customer demand for environmental transparent products affect the industries. This affects all energy consumers, especially the energy-intensive manufacturing and heavy industries. New strategies such as the concept of sustainability as well as the Green-IT approach are facing these emerging challenges and opportunities. Whereas business strategies adapt to these global changes...
the area of production planning, especially lot size optimization, is lagging behind. This provides the basic motivation for all activities related to sustainable process improvements and reduction of environmental impacts.

The manufacturing industry has by nature an environmental impact on the ecology of this planet. Against the background of the Kyoto Protocol it is not hard to acknowledge that there is a crisis when fossil fuel energy costs are at an all-time high and the emissions from processing and using this energy are getting into the atmosphere. This affects all energy consumers, especially the energy-intensive manufacturing and heavy industries. With the implementation of green strategies costs can be saved on the long run. Moreover areas such as power consumption that cause costs on the first place can eventually become cost savers. However there has to be a balance in business-driven green initiatives in order to be cost-justified and feasible. Careful resource management is fundamental to the success of every enterprise and becomes increasingly critical for the planet. In consideration of these facts a rethinking within industries is needed in order to focus on more environmentally friendly concepts and sustainable strategies. The basics for the new approaches and methods affecting business decisions come from the relatively young environmentally sound practices of Green-IT (Velte, Velte, & Elsenpeter, 2008), Sustainability, Cleaner Production (CP) (Mulholland, 2006), and Environmental Management Accounting (EMA) (Jasch, 2006), (Mia, 2006). In this work these approaches are adapted in the area of PPS, in particular lot-size planning. This results in enhanced lot-size planning where ecological cost factors beside the classical ones are introduced. Furthermore the approach of eco-balancing is introduced which ensures the optimality character of the eco-enhanced lot-size planning. This leads to a significant environmental and monetary impact via mathematical algorithms in the manufacturing industry sector. Key element is the modification of classical lot-sizing problems (LSP) algorithms so that they are enabled to include non-linear cost-factors.

**BACKGROUND**

Efficient production planning is essential for industrial enterprises. The same is increasingly important for ecological and sustainable business behavior. There is a change in entrepreneurial thinking due to the sensitivity about climate change, carbon emissions and rising energy prices. This new perspective has to be considered in all areas of an enterprise, especially the manufacturing area. As it is not possible to simply exchange or upgrade the existing machinery in production sites with more energy-efficient power supplies or ecological friendly systems, a new strategy has to be applied, covering the enhancement of production planning and scheduling approaches, especially the lot size planning, in order that eco-factors are considered when generating production schedules. As eco-factors occur during any production process, they cause costs – the so called eco-costs – that need to be considered. If these costs are ignored during planning they would anyhow affect total costs. The clearest example is the consideration of power consumption. The higher the energy consumption of a resource the higher the energy costs. If the energy consumption can be optimized with simultaneous lot size optimization, this would result in lower total costs. Therefore it is reasonable to take this parameter into account when creating allocation plans via lot size planning.

Taking all eco-factors that are relevant for production planning into consideration when performing lot size planning leads to the following benefits:
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