

Preface

Production systems are of utmost importance for any manufacturing organization or even a national economy as a whole. Even if a product were well designed and demanded in the market, unless it is produced well, the economic benefits would belong to others – companies or countries manufacturing it more efficiently. The flat-panel display manufacturing is a good example: being invented and designed mostly in the U.S., today practically none is produced in this country. Indeed, making production systems efficient is an important problem.

This book is intended to provide an avenue for solving this problem by making production systems smart.

A production system is called smart if it is capable of self-diagnosis and autonomous design of continuous improvement projects, leading to the desired by management productivity improvement, with minimal equipment modifications and analytically predicted results.

To make any production system smart, it must be equipped with a “brain” capable of diagnosing its “health” and calculating steps for continuous improvement. Such a “brain,” or an AI device, has been recently developed in Smart Production Systems LLC (U.S. Patent No. 11,861,739, Jan. 2, 2024) and referred to as *Programmable Manufacturing Advisor* (PMA). Programming a PMA for and installing it at any production system makes it smart. No

similar technology is available on the market today. A demo of PMA is available at <https://www.smartproductionsystems.com> by selecting the *Products* tab.

PMA is based on analytics (rather than on computer simulations). These analytics have been derived in the research on Production Systems Engineering (PSE) carried out at the University of Michigan starting from 1985. The main results of this research and its practical applications are summarized in the textbook by J. Li and S.M. Meerkov, *Production Systems Engineering*, Springer 2009 (Chinese translation 2012) and in subsequent journal publications. These analytics and the associated PSE Toolbox have been used by PSE-trained personnel for design of continuous improvement projects at GM, Ford, Chrysler, Toyota, Visteon, Kroger, Kraft, Generac, etc., consistently leading to 10%-30% of throughput increase without any capital investments.

PMA automates this process by making it AI-enabled and thus available as a practical, factory floor-level tool for managerial and engineering personnel without training in PSE or analytics in general.

The goals of this book are:

- Introduce the reader to the main concepts and analytics of Smart Production Systems (SPS).
- Provide working knowledge of SPS software (both PSE Toolbox and PMA).
- Most importantly, enable the reader to utilize PMA-based SPS on the factory floor for operations management and designing continuous improvement projects with analytically predicted results.

This is the only book on smart production systems published to-date.

The intended audience of this book includes managerial and engineering personnel at all types of manufacturing organizations;

PREFACE

software developers in the area of smart manufacturing; and college students interested in manufacturing. It can be used either for self-study, or as a textbook for industrial short courses on Smart Manufacturing, or for undergraduate and graduate courses in engineering and business schools.

No specific prerequisites are required for this book. A college degree and some industrial experience would be desirable, but not necessary.

It is our hope that this book will prove to be useful for both seasoned practitioners and beginners in the field of production systems, as well as for college students, and will provide a practical route for AI-enabled productivity improvements.