Part II
Decision Making for Manufacturing Systems

Part II Overview

Manufacturing plants and lines are highly complex systems, with large numbers of interacting components required to not only produce products, but to do so in an efficient, cost-effective, and reliable manner. A manufacturing system extends beyond the machines or equipment used to create or assemble parts into products, but extends into the business processes, decisions made, people involved, and wider supply network. With the increasing adoption of digital manufacturing or "Industry 4.0" technologies, systems are getting exponentially more complex and difficult to understand. What is more, it is rare for a manufacturing system to be in a steady state. New products must be manufactured, tooling wears or fails, supply quality can vary. Understanding the current state of a manufacturing system is a significant challenge, predicting the future state even more so.

Understanding how all these elements interact and effect each other is key to effective decision making. Without understanding the system, it is not possible to make the correct decisions at the correct time to keep the manufacturing enterprise productive and profitable. Key to this understanding is the process of analysis – examining the system, understanding the current state, identifying what factors influence the state of the system, and using these to move the system towards an improved state.

The next three chapters of this book represent a progression through levels of sophistication of manufacturing systems analysis, from static mathematical methods focusing on the key performance indicators of the current state of the system, through to digital modelling and simulation to predict the outcomes of proposed changes, and into a tightly integrated real-time digital twin that mimics the current system and can update the model to improve the accuracy of simulations.

This is not to say, however, that this part details methods from bad to good. Traditional mathematical manufacturing analysis has been used for decades and provides effective and useful results. It is recommended that if you have not started formally analysing and modelling your manufacturing systems that you start with production analysis first, and then progress to modelling and beyond.

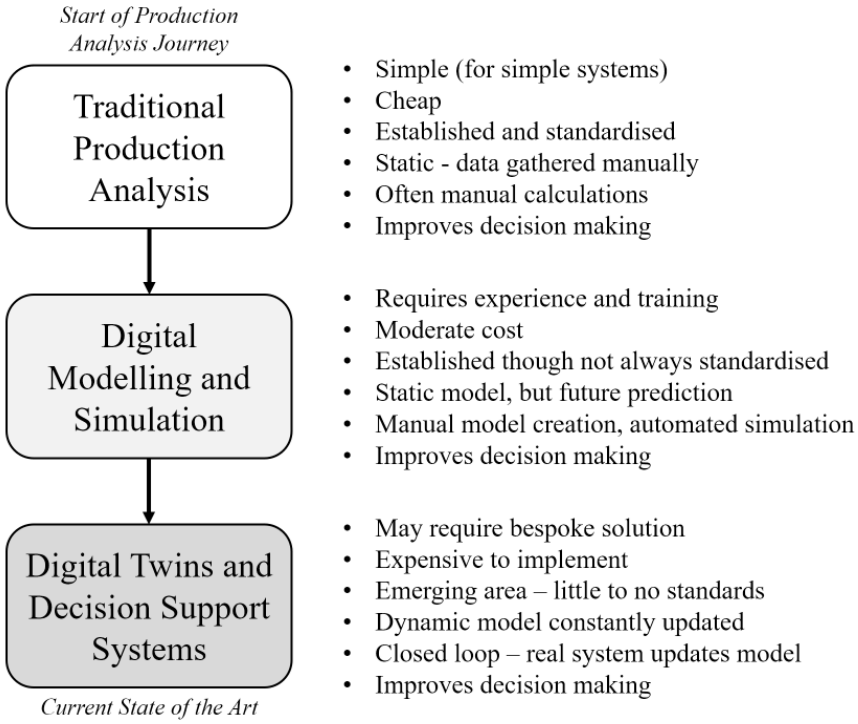

Figure II-1 Production systems analysis is not a choice of different technologies, but more of a journey. Each step gives richer data in a more automated fashion, but also typically costs more and is more complex. Every stage of the journey improves decision making, and there is no obligation to continue to the end. For many companies, digital modelling is sufficient, and a digital twin would not be cost effective.

These chapters introduce the concepts of analysis and decision making and breaks them down into formal processes which can be followed. The first chapter (Chapter 4) introduces conventional decision making – methods for analysing manufacturing systems and networks to calculate key performance indicators or to identify areas of concern. The limitations of these methods are discussed, and Chapters 5 and 6 discuss modern methods for manufacturing systems analysis, using offline modelling and simulation (Chapter 5) and state-of-the-art integrated digital twins and decision support systems (Chapter 6).

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