

solutions. Part Three offers 'Exercises in Analysis and Conceptualisation'. Although these also introduce some new material, their essential purpose is to deepen understanding of the Part One material. This is done using seven exercises, with accompanying solutions, which start with a rich statement about the system to be studied. These are then probed using causal loop diagramming, stock and flow diagramming and the building of a fully-specified simulation model. The reader is guided into using the models to investigate the link between system structure and dynamic behaviour. In so doing, the book completes the link back to the simple structures of Part One and to examples of shifts in loop dominance which are of practical importance in a wide range of systems.

Leading the reader from disease-carrying mosquitoes, via cycles in commodity prices and on to the growing strategy of a start-up company, one might expect this to be a somewhat dizzying read. Instead, Mike Goodman's book takes its time in slowly laying out and exploring some of the basic ideas of System Dynamics. Clearly building on the seminal ideas of Forrester, and also acknowledging the contribution of subsequent system dynamicists, he is offering a narrower but less dense account than the founding work[1] whilst also introducing readers to some of the most interesting applications that have arisen to date. That date, it must be said, is 1974, for this is another of Productivity Press's re-issues of books in the System Dynamics field (though, once more, no new publication date is to be found). It therefore suffers for being written in an old version of DYNAMO which has an unforgiving equation structure and lacks a graphical user interface (GUI). However, rejecting the book on these grounds would be to allow form to triumph over content and this would be unfortunate since the content is very good. When it was written, this material had been used with students at three universities and had been put together very carefully. At every point in its pages the reader is aware of the educational purpose of the section being worked on. The exercises present building blocks of understanding, laying them squarely and firmly before progressing. The CLDs are developed slowly and presented well. The stock and flow diagrams use the same conventions developed by Forrester,[1] ones that are still used, with slight variations, by modern software packages which do have GUIs. Finally, the range of applications accumulates to demonstrates the generality of the approach and to validate the power of the abstract ideas being employed. Of course, many ideas are not covered and this book by no means conveys all that is System Dynamics today or even in 1974 (readers must look elsewhere for work on validation approaches and techniques for using System Dynamics in a GDS mode). But Goodman offers an excellent set of examples for introducing the fundamentals of the structure-behaviour perspective at the heart of System Dynamics. A final observation: the stock and flow diagram on page 371 has a causal link missing. Finding this printing error is left as an exercise to the interested *JORS* reader...

To conclude, this book is old but not too dated. Its presentation and examination of the basic loop structures and associated behaviours of System Dynamics and its layout using multiple exercises makes it an excellent source book for teachers.

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## References

1 Forrester JW. (1961). *Industrial Dynamics*. MIT Press: Cambridge, MA (re-issued by Productivity Press, Portland, OR).

## Book Reviews

### Lean Thinking—Banish Waste and Create Wealth in your Corporation

JP Womack and DT Jones

*Simon and Schuster, London, 1996. 350 pp. £16.99. ISBN 0 684 81035 2*

In *The machine that changed the world*,[1] Womack and Jones with their co-author, presented the results of a major benchmarking study on the automobile industry. The results of the study showed that Japanese plants in Japan were far ahead of other plants on all major measures of performance. The book had a profound effect on manufacturing executives in general, and not just those in the automobile industry. It will have also caused a good deal of frustration because no cure was provided along with the diagnosis. In this book they seek to remedy that situation.

The lean thinking prescription for the elimination of waste, *muda* in Japanese, is a five stage process. First, there is the need to specify *value*. Value, it is argued, should be defined by the customer, in terms of specific products with specific capabilities at specific prices. Second, the *value stream* should be identified. The value stream incorporates all the actions required to bring the product to the customer: including detailed design, engineering, production, order-taking, production scheduling and delivery. This stage should identify activities that add value, that do not add value but are unavoidable in current circumstances and those that do not add value and are avoidable. Those activities in the third category should be eliminated. The third stage is to create *flow*. Here the authors argue that a radical change from traditional batch processes is required. They expect such a change to reduce product development time by a half, order processing time by 75% and physical production time by 90%. Then the fourth stage is to let the customer *pull* the product as needed. The fifth stage is called *perfection*.

No doubt such a description of lean thinking will create a good deal of scepticism. However, many detailed recent

examples are given, from North America, Japan and Germany and involving both small firms and large corporations, which show that these ideas do work. Here you can read about the dramatic changes at Pratt and Whitney, what the authors call the acid test for lean thinking, in which a £1m swing in operating results from 1991–1992 was the catalyst for a complete overhaul of their production process, involving *inter alia* the movement of all 7000 machines at least once, so that throughput time fell from 18 months to 6 months, inventories fell by 70%, the massive central warehouse was closed, and unit costs fell by 20% during a period when production volume declined by 50%.

Or consider the revolutionary changes at Porsche, which in 1994 resulted in the first defect-free car ever rolling off the production line. In 1991 the concept to launch time for a new car was 7 y. In 1997 it is expected to be 3 y. In 1991 the time from welding to the finished car was 6 weeks. In 1997 it is down to 3 d. Over the same period the inventories have fallen from 17 d supply to 3 d, and the effort to build a 911 model and its successor has fallen from 120–45 h. It is difficult to gainsay these achievements.

The classic example is, of course, Toyota. Here you can read a blow by blow account of the experiences of Taiichi Ohno as he pushed what became known as the Toyota Production System through Toyota itself in the 50s and 60s, and then through Toyota's supply base, and after his retirement from Toyota, through Showa Manufacturing, a traditional manufacturer of radiators and boilers.

In my view, this is a book that should be read by everyone in OR who is interested in Operations Management. The principles delineated, and the examples given, cover manufacturing, the supply chain and logistics. The stories told are fascinating in the historical detail and description of the actions of individual managers. It certainly is not a textbook, but I was interested to read a review in a Sunday newspaper, which said that 'much of the text, not to mention the charts, comes over like a manual for production and operations engineers.'[2] If that is the view of a management journalist then I suspect there is enough in the book to keep the typical OR person interested.

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## References

1 Womack JP, Jones DT and Roos D. (1990). *The Machine that Changed the World*. Rawson: New York.
2 Trapp R. (1996). How to be a lean machine. *The Independent on Sunday*. 20 October.

## Self-Producing Systems—Implications and Applications of Autopoiesis

J Mingers

*Plenum Press, London, 1995. xvii + 246 pp. $59.40.*
*ISBN 0 306 44797 5*

The intention of this book is to bring together in one volume an introduction to Maturana and Varela's concept of autopoieses and related ideas, and to illustrate their applications across a spectrum of subjects. A primary aim is to re-present the ideas of autopoiesis in a more transparent language than the original. The book also attempts to examine the connections of these ideas to other bodies of work, and in particular to explore the philosophical stance of the work.

After a short introductory chapter, the book divides into four parts. The first, 'Autopoiesis in the Physical Domain' develops the essential idea of autopoiesis as an explanation of living systems, then explores the implications of this on biology in particular, but also more generally. The first part finishes with a chapter dealing with various aspects of the mathematics of autopoieses and a computer model of autopoiesis. Part two then deals with theories of cognition, exploring first the organization of the nervous system, then the evolution of such systems to yield language, description and the observer. The last chapter in this section explores the philosophical implications of autopoiesis, both the original work, and Maturana's more recent development of radical constructivism.[1,2] Here Mingers argues that this later work is compatible with a critical realist position, along the lines expounded by Bhaskar.[3,4]

The third part is concerned with the application of autopoieses in various disciplines; there are four different chapters. The first covers sociology and organisation theory and includes discussion of Maturana's own social theory,[1,5] Luhmann's analysis of society as autopoietic communication,[6] and finishes by considering Morgan's work[7] as an example of using autopoiesis as a metaphor for viewing social systems. The second chapter looks at law as an autopoietic system, starting from Luhmann's work[8,9] and then moving on to the debates this has stimulated. The third chapter looks at the impact on family therapy of Maturana's later theories, focusing on the constructivist family therapy[10] that is based on Maturana's general cognitive theories, epistemology, and theory of social systems. Here the argument is that although constructivist family therapy brings some benefits to family therapy, it has major weaknesses, arising out of its epistemological assumptions, and leading to the criticism that social and political contexts are ignored. The fourth chapter deals with Varela's later work on cognition[11] and its relationship to information systems, cognitive science and artificial intelligence. Here Mingers argues that Varela's work on 'enactive cognition'[12] may well provide a framework for future research, something that he argues is needed in view of the perceived failure of the representational paradigm to produce results.

The fourth and final section in the book includes a single chapter which provides a review of the major ideas of autopoiesis and the debates it has stimulated, followed by a short section which explores two potentially new debates, the political implications of Maturana's position, and possible 'resonances' between autopoiesis and postmodernism.