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The evolution of a management philosophy: The theory of constraints

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Abstract

In 2004, the Theory of Constraints celebrated its Silver Anniversary. In twenty-five years, what started out as a scheduling software has evolved into a management philosophy with practices and principles spanning a multitude of operations management subdisciplines. As the Theory of Constraints has grown, so has its acceptance by both practitioners and academicians. At this point in its development, as it transitions from niche to mainstream, it is important to review what has been accomplished and what deficiencies remain so that both the promise and problems impeding greater acceptance can be examined. To that end, we review the evolution of principal TOC concepts and practices in an objective fashion.

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1. Introduction

In 1979, development of the Theory of Constraints (TOC) management philosophy began with the introduction of Optimized Production Timetables scheduling software (Goldratt and Cox, 1984). TOC has evolved from this simple production scheduling software program into a suite of integrated management tools encompassing three interrelated areas: logistics/ production, performance measurement, and problem solving/thinking tools (Spencer and Cox, 1995). Due to its simple yet robust methodology, application of TOC

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techniques have been discussed in the academic literature and popular press across a variety of operations management subdisciplines, including: project management (Goldratt, 1997; Leach, 1999; Umble and Umble, 2000; Steyn, 2001; Cohen et al., 2004), retailing (Gardiner, 1993; Goldratt, 1994), supply chain management (Rahman, 2002; Watson and Polito, 2003; Simatupang et al., 2004), process improvement (Schragenheim and Ronen, 1991; Atwater and Chakravorty, 1995; Gattiker and Boyd, 1999), and in a variety of production environments (Jacobs, 1983; Koziol, 1988; Lambrecht and Segaert, 1990; Raban and Nagel, 1991).

Studies reporting anecdotal evidence from early adopters suggested that TOC techniques could result in increased output while decreasing both inventory and cycle time (Aggarwal, 1985; Johnson, 1986; Koziol, 1988). Rigorous academic testing has validated those early findings revealing that manufacturing systems employing TOC techniques exceed the performance of

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those using Manufacturing Resource Planning (MRP), Lean Manufacturing, Agile Manufacturing, and Just-in-Time (JIT) (Ramsay et al., 1990; Fogarty et al., 1991; Cook, 1994; Holt, 1999; Mabin and Balderstone, 2000). The results of these studies indicate that TOC systems produce greater levels of output while reducing inventory, manufacturing lead time, and the standard deviation of cycle time.

TOC techniques have been applied at a number of Fortune 500 companies; 3M, Amazon, Boeing, Delta Airlines, Ford Motor Company, General Electric, General Motors, and Lucent Technologies have publicly disclosed significant improvements achieved through deployment of TOC solutions. Additionally, a number of adopting companies state an unwillingness to disclose improvements for competitive reasons. Application of TOC is not limited to for-profit companies; not-for-profit organizations and government agencies such as Habitat for Humanity, Pretoria Academic Hospital, British National Health Service, United Nations, NASA, United States Department of Defense (Air Force, Marine Corps, and Navy), and the Israeli Air Force all have successfully employed TOC solutions.

However, despite mounting evidence in both the academic literature and popular press of the potential benefits of TOC implementation, mainstream acceptance has proven elusive. According to the 2003 Census of Manufacturers less than 5% of U.S. manufacturing facilities drive process improvement efforts with TOC (IW/MPI, 2003). Additionally, TOC implementations appear to be the least mature of the various methodologies employed with only one of the 42 facilities employing TOC reporting completion of the transformation process.

We have undertaken this research project to better understand both the promise of TOC and the problems that impede its widespread acceptance. We do not intend this to be a literature review, although we will reference a plethora of academic articles. Rather we intend to discuss the evolution of principal TOC concepts and practices in an objective fashion. To clearly focus on the development of principal TOC concepts, we have segmented the evolution of TOC into five eras, Fig. 1:

- 1. The *Optimized Production Technology* Era the secret algorithm.
- 2. *The Goal* Era articulating drum-buffer-rope scheduling;
- 3. *The Haystack Syndrome* Era articulating the TOC measures.
- 4. The *It's Not Luck* Era thinking processes applied to various topics.
- 5. The Critical Chain Era TOC project management.

Defining the eras in terms of the titles of Dr. Goldratt's books does not imply that he has been the sole contributor to the evolution of TOC. Indeed, we identified 400+ books, articles, dissertations, conference proceedings, reports, etc. that contribute to the body of knowledge. Additionally, it is understood that practitioners have made numerous undocumented advances within the many companies that have adopted TOC. However, Dr. Goldratt's books serve as useful demarcations in time, allowing us to analyze the principal events and developments during each era. Discussion of the five eras is followed by an examination of deficiencies in the TOC literature. This examination is intended to point to areas that, once addressed, will facilitate acceptance of TOC by a wider audience. We conclude with a discussion of what appears to be the emergence of a sixth TOC era; this includes a review of emerging applications and suggestions for future research.

2. Era 1: optimized production technology

The Theory of Constraints has an unspectacular beginning, resulting not from some grand vision of production management's future but from a simple request for help. Late in the 1970s, a neighbor of Dr.



Fig. 1. Timeline of major eras in the development of TOC.

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