

PREFACE

Hello Innovators of Intelligent Manufacturing Operations,

If you have followed the work of the ISA-chartered ISA-95 Best Practices Working Group, you may have noticed that as chairman and founder of this working group I have derived the book title for each collection of Manufacturing Operations Management (MOM) methodology white papers from a classic science fiction book title. The title aligned with the general theme of the paper collection. The first two books were:

1. *The Hitchhiker's Guide to Manufacturing Operations Management: ISA-95 Best Practices Book 1.0*, which was derived from *The Hitchhiker's Guide to Galaxy*
2. *When Worlds Collide in Manufacturing Operations: ISA-95 Best Practices Book 2.0*, which was derived from *When Worlds Collide*

The paper collection in Book 3.0 is titled *The MOM Chronicles*, which is derived from the legendary work of *The Martian Chronicles* by Ray Bradbury. Our working group has dedicated the Book 3.0 collection to Ray Bradbury, who passed away on June 5, 2012. Ray Bradbury was one major influence in my life as a teenager looking for a positive direction and way to influence the world. Mr. Bradbury was the author of more than three dozen books, including the celebrated literary works of *Fahrenheit 451*, *The Martian Chronicles*, *The Illustrated Man*, *Dandelion Wine*, and *Something Wicked This Way Comes*, as well as hundreds of short stories. He has written for the theater, cinema, and TV, including the screenplay for John Huston's *Moby Dick* and the Emmy Award-winning teleplay *The Halloween Tree*. Sixty-five of his stories were adapted for The Ray Bradbury Theater on television. He received the 2000 National Book Foundation's Medal for Distinguished Contribution to American Letters, the 2007 Pulitzer Prize Special Citation, and numerous other honors.

In *The Martian Chronicles*, written during the 1940s, Bradbury as one of America's preeminent storyteller tells how humans conquered the planet of Mars in 1999 while fleeing from a troubled and eventually atomically devastated Earth. Then the humans themselves are conquered on Mars. In this classic work of fiction, Bradbury exposes our human ambitions, weaknesses, and ignorance in a strange and breathtaking world where humans do not belong. *The Martian Chronicles* follows a "future history" structure similar to the paper collection structure of Book 3.0. The short stories, complete in themselves, come together as episodes in a larger sequential narrative framework as do the Book 3.0 papers as chapters of the book. The overall structure of *The Martian Chronicles* is presented in three parts that are punctuated by

two major catastrophes: (1) the near-extinction of the Martians and (2) the parallel near-extinction of the human race on Mars after their extinction on Earth. Starting in the far-flung future of 1999, humans colonize Mars for a new beginning but take their shortsighted behavior with them. Below I draw the parallel to Book 3.0 explanations of how corporate IT colonized the plant operations with their shortsighted methods.

In a crucial story, “—And the Moon be Still as Bright”, the fourth exploratory expedition reveals the Martians have all but perished in a plague caused by germs brought by the previous human expeditions. This unexpected development sets the stage for the second act and set of stories (December 2001—November 2005), in which humans from Earth colonize the deserted planet with the few surviving Martians to make Mars a second Earth. However, as war on Earth occurs, most of the human settlers pack up and return to Earth. A global nuclear war ensues, cutting off contact between Mars and Earth. The third act and set of stories (December 2005–October 2026) deals with the aftermath of the war, and concludes with the prospect of the few surviving humans becoming the new Martians.

A 1997 edition of the book advances all the dates by 31 years (thus running from 2030 to 2057). This change counteracts a problem common to near-future stories where the passage of time overtakes the period in which the story is set. The 1997 edition includes “The Fire Balloons”, and replaces “Way in the Middle of the Air” (a story less topical in 1997 than in 1950) with the 1952 short story “The Wilderness”, dated May 2034 (equivalent to May 2003 in the earlier chronology).

The “future history” structure of short stories in *The Martian Chronicles* is similar to the structure used in the ISA-95 Best Practices Books where common-theme white paper collections from Book 1.0 to 3.0 frame the evolution and history of applying computer applications to the work processes of manufacturing operations. From the 1980s with “computer integrated manufacturing” to Manufacturing Execution Systems (MES) in the 1990s to MOM in 2005, computer applications have repeatedly only achieved marginal success toward intelligent process. However, in 2013 and 120 years into the industrial age, mankind still has not effectively colonized the manufacturing plant with real-time work process systems to execute self-thinking artificial intelligence. According to *Control Magazine* and my general observations, 80% of manufacturing operations globally are still paper-based processes. Across my 30 year career (with some notable exceptions in electronics and semiconductors), manufacturers, software vendors, and system integrators are all failing to recognize that the manufacturing operations problem is 80% cultural. It is a work process problem of poor planning with slow response processes to adverse events. From my experience, 80% of the operations system solution is the cultural engineering of merging people, processes, machines, and the supply chain

(only a 20% technical solution). This is not widely recognized as a starting point.

The Martian Chronicles' first act (in its "future history" structure) of human shortsighted colonization of Mars has a direct parallel with the marginal success rate of manufacturing operations applications over the last 15 years. Since 1999, corporate IT and plant engineering attempted to solve real-time operations process issues with purely technical solutions based on material resource planning methods or equipment automation methods, respectively, as opposed to developing real-time work process applications based on a continuous improvement approach required for each plant's cultural environment.

The Book 3.0 collection addresses the need for true system engineering to organize the complexities of the manufacturing plant and not trivialize the complex as an equipment optimization or material quality or consumption problem. The following are the white papers as book chapters:

Chapter 1: Applying Global MOM Systems in a Manufacturing 2.0 Approach

Chapter 2: The Role of Semantic Models in Smarter Industrial Operations

Chapter 3: Applying Manufacturing Operations Models in a Discrete Hybrid Manufacturing Environment

Chapter 4: Defining an Operations Systems Architecture

Chapter 5: A Workflow-driven Approach to MOM

Chapter 6: Scheduling Integration Using an ISA-95 Application in a Steel Plant

Chapter 7: Intelligent Integration Interface: I3, A Real-world Application of ISA-95

The manufacturing operations paradox of the 80% cultural/20% technical solution is explained in each chapter. Bill Gates, founder of Microsoft, states it simply:

"The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency. The second is that automation applied to an inefficient operation will magnify the inefficiency."

In the first 20 years of computerized MES/MOM solutions, I discovered that most manufacturers primarily applied and still apply point solutions to department issues without developing an overall operations process definition and without understanding operational dependencies for the entire plant. This operations process definition is typically in the MOM Master User Requirement Specification and maps out the As-Is inefficient and To-Be reengineered efficient operations. Over 30 years, I have come to realize that the leaders and managers of most manufacturers have a very limited vision and sometimes short-sighted vision of how their plants must operate in the global market in five or ten years (2020–2025). Today's manufacturing managers generally do not have a vision, plan, or concept of the total cost for engineering and transforming their paper-based operations into real-time manufacturing artificial intelligence for their work processes. Ironically, these manufacturers talk and talk about innovation but want it without risk at predictable fixed cost and return on investment. The proven reality of manufacturing operations is that manufacturing innovation requires trial and error. It requires an iterative continuous improvement process through systems engineering. This requires the acceptance of innovation with managed risk to move manufacturing operations technologies forward. Operations intelligence is high-risk innovation. Period.

But by 2025, those manufacturers who have not adopted paperless processes for intelligent operations will simply not be able to compete globally and will fail in business.

Of the 20% of advanced manufacturers that are applying MOM systems to their plants for paperless processes, all are still going through the 10-15 year MOM transformation life cycle using a trial-and-error approach to innovate operations to intelligent manufacturing. In the last 20 years, the unforgiving MOM life cycle has generally required at least three MOM (design/deploy) attempts to get their MOM applications and governance to a high maturity level. At this level, the system intelligently adapts their real-time operations to the continual changes of the marketplace and resources toward the best available optimized operations state (in less than a single work shift). As brought out in many of the chapters/papers of Book 3.0, the first and second MOM attempts typically deploy stand-alone disparate systems within each of six to ten operations departments and then integrate them for reporting and metrics with point-to-point interfaces. As I have witnessed in my 30 years doing MOM systems, this disparate MOM architecture leads to 75% of the system life cycle cost occurring after deployment. This occurs because each of the 15-to-20 MOM systems of record required in a plant to process a production order have a different master data / metadata definition set. Consequently, all interfaces, reports, and metrics must be custom mappings of multiple names of the same or similar resources.

The 20% of advanced manufacturers discovered that the first two MOM attempts lead to: (1) high-cost MOM systems with very poor data integrity and (2) high-cost change during new production introduction, production scaling time to market, and continuous improvement. Their first two MOM attempts occurring in the 1990s and early 2000s actually were also found as a primary hindrance to continuous improvement efforts because the MOM system owners were typically understaffed, under skilled, uncoordinated, and ungoverned to support real innovation. These most advanced manufacturers who have applied MOM systems for 20 years are now moving to the semantic model-based approach to MOM architecture and systems. This best practice approach is a main theme of *The MOM Chronicles'* chapters/papers. As explained throughout Book 3.0, the 80% MOM cultural solution is partially solved by properly addressing MOM paperless operations as a common language and metadata solution across all the MOM systems in a single manufacturing information model at the system integration level of the architecture.

Another third MOM attempt lesson learned by the advanced manufacturers is the absolute requirement for a single MOM System Group or Center of Excellence within their company to own and manage all MOM systems. By the third MOM attempt, these advanced manufacturers simply learned the hard trial-and-error way that it is physically impossible to protect MOM data integrity when the plant's 15+ systems of records are supported across six to ten departments. Governance of MOM systems of record, their master data, and instance data is literally impossible to manage and so is not managed—thereby producing corrupt data for inaccurate decisions. As well, with most of the department-level systems being supported by a part-time super user who changes jobs every 18–24 months, the critical plant MOM systems are always in a state of disrepair due to a lack of documentation and overlapping support skills. By the third MOM attempt at a MOM architecture after 10+ years, the advanced manufacturers are figuring out in 2013 that they must consolidate and ordinate their MOM super users to significantly lower the cost of MOM systems. Unfortunately, many manufacturers still do not understand that IT approaches such as cloud technologies without semantic computing and governance only lead to an expensive failure when applied to MOM applications for real-time work processes.

I believe the Book 3.0 papers/chapters have taken another significant step forward from the foundations of Books 1.0 and 2.0 in explaining the necessary methods for building the 21st Century MOM architecture for real-time work process systems based on continuous improvement and supply chain requirements. These papers are just the beginning of the discussion on the best practices for developing self-thinking intelligent manufacturing plants within the next 20 years.