Coordinated Operation of Multiple Manufacturing Plants

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Abstract

This white paper explores the transformation of U.S. manufacturing from self-contained, make-to-stock plants into globally distributed networks of semi-custom, make-to-order operations, driven by shifting labor economics, geopolitical pressures, and the obsolescence of traditional ERP systems. As companies seek to coordinate manufacturing across company-owned and third-party facilities worldwide, they face growing complexity and labor costs in front-office operations.

The paper argues that legacy ERP systems—originally designed for long-run production forecasting—are ill-suited for today's real-time, demand-driven environment and are increasingly being displaced by Smart Operations Management (SOM) platforms like SmartOps24x7. These AI-based systems centralize planning, automate "intelligent grunt work," and coordinate execution across multiple plants and warehouses through intelligent agents, enabling faster, more efficient, and lower-cost operations while minimizing the need for redundant local management and manual data entry

Introduction

Back at the turn of this century (Y2K) manufacturing plants acted as self-contained entities, each making a limited number of products to stock, with all the front-office operations contained within each plant. This was true, even for conglomerates of multiple manufacturing plants.

Over the past quarter century, all of this has changed:

1. Many more plants are now part of a group of related manufacturing businesses as a result of being sold. Some of this was due to retirement of owners. But far more was due to competitive pressures from China, with its much lower labor rates, forcing many smaller privately held manufacturers to sell out to conglomerates and private equity backed groups, with greater financial resources.

2. As supply chains within China evolved, it became more economical to make complete products in China, rather than in the USA, and simply to distribute products when they arrived in LA or other US west coast ports.

3. Along the way, especially during the Covid pandemic, US manufacturing organizations came to realize that China's labor rates had risen from under $1/day to over $5/hour, with much more generous and costly fringe benefits than elsewhere. This is compared to $2/hour in Mexico and under $1/hour in Thailand and Bangladesh.

4. Then along came tariffs along with China's "Wolf Warrior" approach to global domination. As a result, many manufacturers in the USA, got scared and pulled out of China as a way of reducing supply-chain risks.

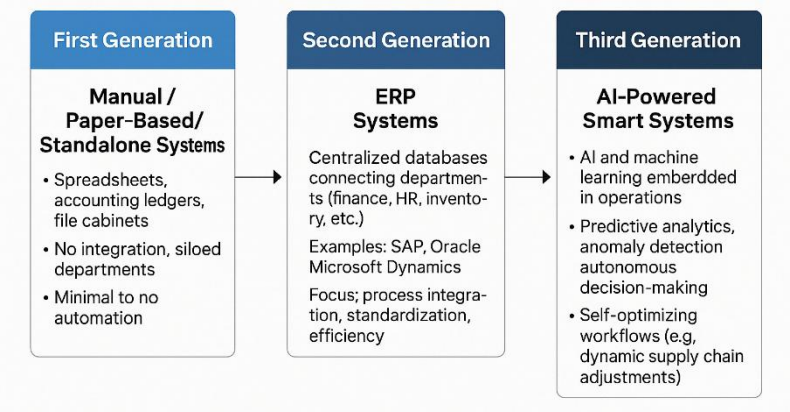
5. But, with average shop-floor labor rates of over $24/hour in the USA and with over 400,000 unfilled job openings, with another estimated 1.3 million to come, if ICE rounds up all the undocumented immigrants working in US manufacturing plants, there is no way many of the manufacturing jobs now fleeing China are returning to the USA.

6. As a result, the only economical approach for US manufacturing plants is to do final assembly of semi-custom products in the USA, possibly supplemented by components, such as semiconductor chips, made on highly automated machinery, with complex supply-chains spread over multiple continents.

For reasons of control and lower cost, it is often much more beneficial if feeder plants in Mexico, Brazil, and Thailand, for example, are company owned, rather than relying on the vagrancies of third-party suppliers. But sometimes companies have no choice but to deal with third-party suppliers.

Then, the question remains, how do you maintain control over this far-flung supply chain so as to ensure that finished products get shipped to the end customers quickly and efficiently. This white-paper seeks to address this question.

ERP Obsolescence



About 40 years ago accounting systems “grew up” to include materials requirements planning (MRP), for long-run make-to-stock manufacturing plants. These then evolved into Enterprise Requitements Planning (ERP) systems enabling sales predictions, for several months into the future, to be converted into scheduled purchase orders to buy raw materials and manufacturing or work orders to make products in multiple plants.

Then along came the “China” effect with most long-run make-to-order production outsourced to China, and ERP systems added warehouse management system (WMS) capability along with customer relation management (CRM) capability as US “manufacturing” companies became primarily distribution companies.

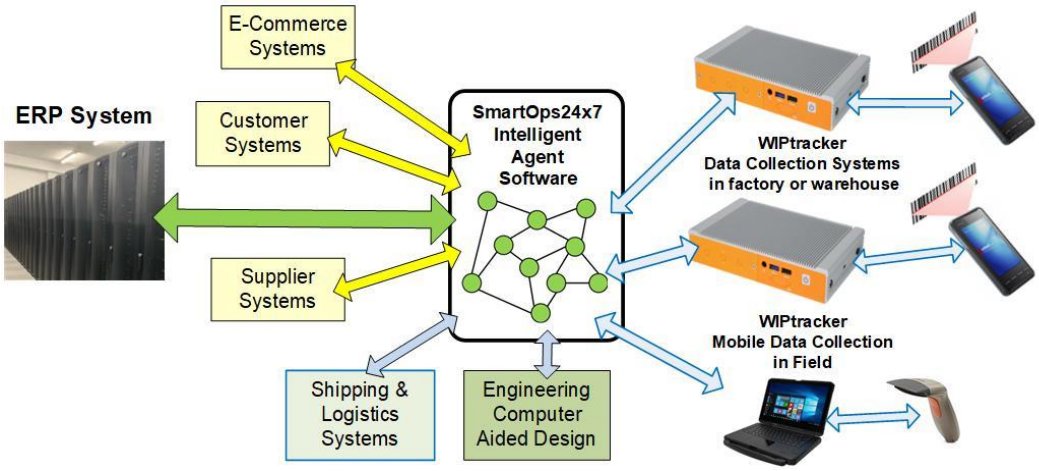
Then long came the “Amazon” effect with customers demanding a wide-range of make-to-order semi-custom products delivered quickly, on-demand, which made the MRP algorithms used by ERP systems, for materials planning and production scheduling, obsolete as monthly or quarterly sales forecasts were replaced by real-time daily demand from customer order flow.

Many manufacturing plants in the USA benefited from the Amazon effect as they could quickly deliver semi-custom made-to-order products far faster than they could be delivered from China by boat, even if the prices were higher.

But these plants were forced to revert to the use of first generation tracking and planning mechanisms, such as spread-sheets, paper forms, and daily planning meetings, to overcome the short-comings in their ERP systems, which were designed for long-run make-to-stock manufacturing.

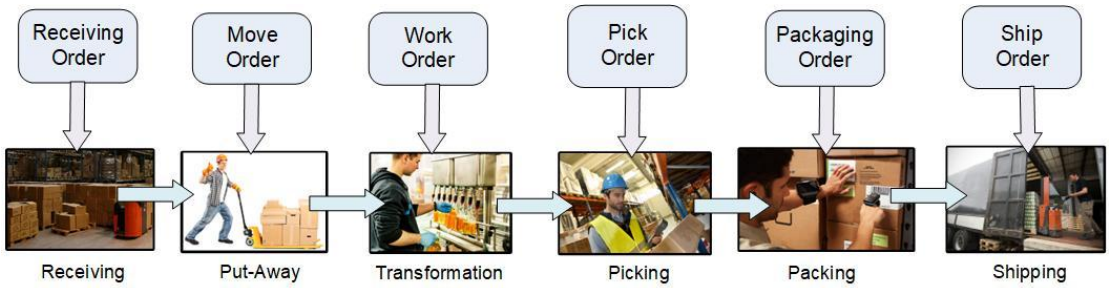
While the number of people required on the factory floor in the USA has reduced significantly, due to automation, this issue, along with increasing Government regulations, has caused the number of people managing operations in manufacturing plants to grow by about 30% over the past decade, to handle all the “intelligent grunt work”. In fact, these people have become the major labor cost in manufacturing plants.

As a result, all the operations tracking and management capabilities of ERP systems are now being replaced by real-time Artificial Intelligence systems such as SmartOps24x7, which integrates operations tracking management over multiple plants and warehouses.

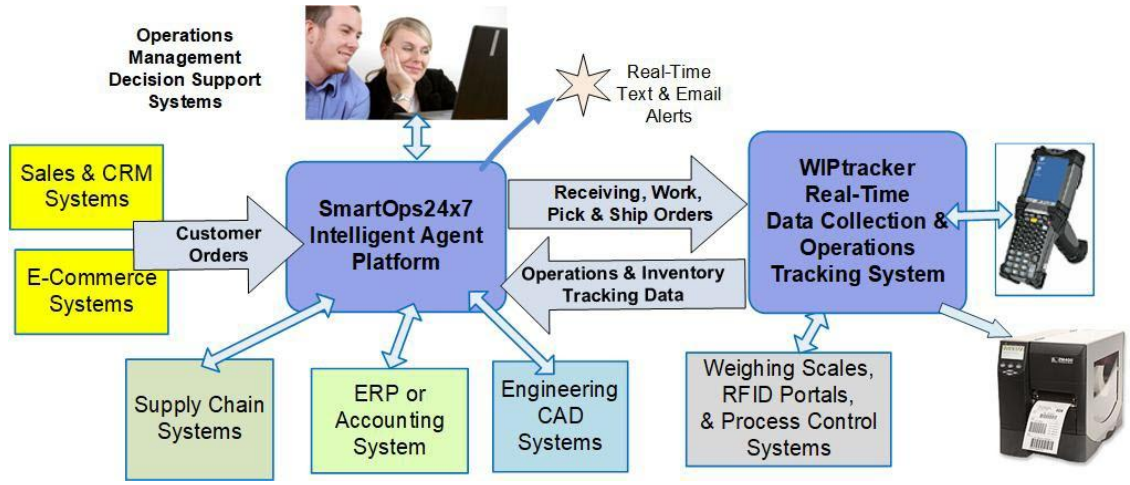


Smart Operations Management Systems

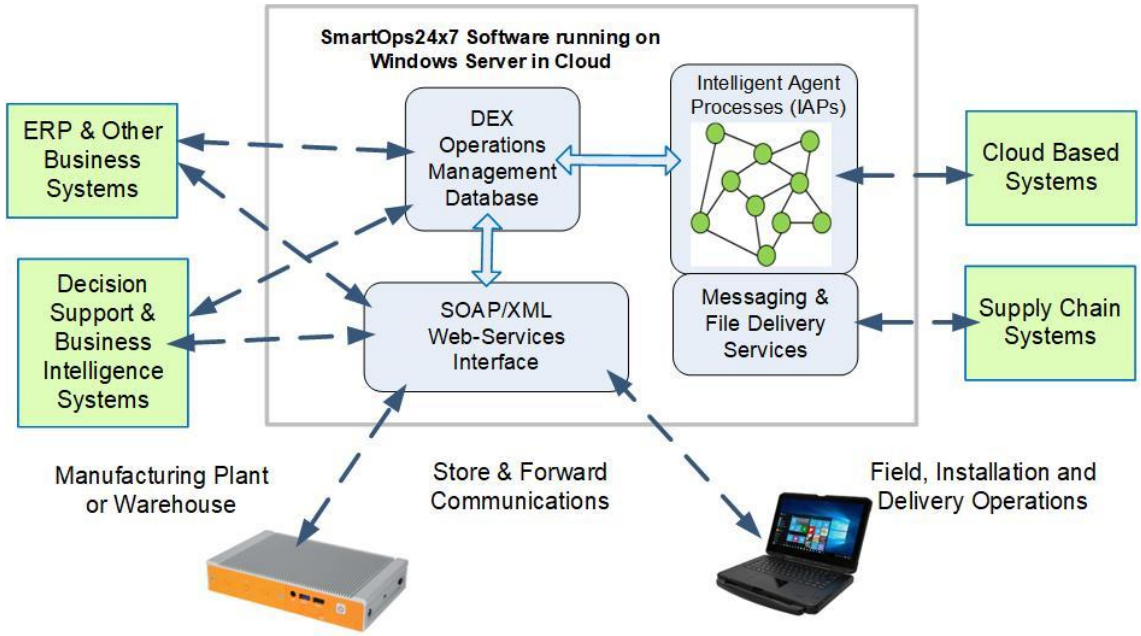
A Smart Operations Management (SOM) system, such as SmartOPs24x7 consists of a real-time data collections system in each plant and warehouse plus a centralized real-time intelligent-agent based platform, which converts the incoming flow of customer orders into actional operations management orders and automatically routes these to the appropriate plant or warehouse in near real-time.



The WIPtracker integrated work-in-process, warehouse management, materials track &trace material execution systems then automatically send back the resultant operations tracking and inventory tracking data to the intelligent agents for action.



At the core of a system, such as SmartOps24x7 is a smart operations management database, which contains the current status and history of all the orders and resultant operations tracking data. The contents of this database are used by intelligent agents to convert incoming customer orders into orders, such as purchase requisitions, work orders and shipping orders. Alternately, where appropriate, these orders may come from an external ERP system.



Yet other agents route these orders to external systems or to the WIPtracker data collection systems, which run in industrial IOT computers in the plants and warehouses or to mobile computers controlling field, installation and delivery operations.

Note that, in such a configuration, orders flow out from the central intelligent-agent server to the data collection system in the plants.

This offers the potential for:

1. Automating much of the “intelligent grunt work” done by operations managers and their staff in each plant
2. Centralizing much of the planning and scheduling in one headquarters staff, which makes extensive use of AI based intelligent agents to automate much of their “intelligent grunt work”

Operations in each plant or warehouse are driven by orders issued from a centralized headquarters and acted upon under the control of supervisors and lead people. As a result, the number of management staff needed in each plant or warehouse is minimized, with shop-floor and warehouse data collection being largely automated through the use of barcode and RFID technologies.

A major advantage of this is that neither the shop-floor personnel and materials handlers, nor their supervisors, have to learn how to enter data into ERP systems (which were designed for use by office staff) or other administrative systems. These people simply have to be trained to follow orders and to capture the resultant data, which only requires a minimal level of computer usage competence.

This is because most of the decision making is based on rules in the data collection systems, which also warn users in real-time when they make mistakes and alert supervisors by Email when situations they need to pay attention to arise.

The need for senior managers at headquarters is also minimized by intelligent agents that monitor the flow of operational orders and resultant data. These agents then alert managers and their staff when there are situations which they need to pay attention to, along with actionable situations reports, to eliminate the intelligent grunt work of reading reports about what went wrong yesterday or spending countless hours in coordination meetings.

Another benefit, for US based manufacturing plants, is that all the centralized operations can be performed in English with plants in far-away places using data collection capture systems that enable their people to communicate in their local language.

Also, as more intelligent agents are implemented and functions of the ERP system displaced, there is no need to change shop-floor and warehouse operations, even if the ERP system is replaced or eliminated in its entirety to save money.

Commentary

While experienced managers and supervisors are essential for running manufacturing plants and warehouses, they are also a large overhead expense. This expense can be minimized by using intelligent agents to minimize much of the “intelligent grunt work” involved in doing their jobs and by centralizing many of the management functions so they are shared over multiple plants and warehouses.

Initially AI based smart operations management systems will be used to supplement ERP systems but, the author believes that all of their operations management functions will be

displaced over the next decade by Smart Operations Management systems, such as SmartOps24x7, leaving ERP systems to become expensive accounting systems.

For more information about the SmartOps24x7 system, please see www.SmartOps24x7.com.

Author

This white paper was written by Dr. Peter Green, who serves as the Technical Director of a number of software companies. Dr. Green also consults to manufacturing companies on the application of real-time intelligent systems to improve their manufacturing and supply chain operations.

Dr. Green obtained his BSC (Hons) in Electrical Engineering and his Ph.D. Degrees in Electronics and Computer Science from Leeds University in England. Subsequently Dr. Green was a senior member of technical staff at Massachusetts Institute of Technology and a Professor of Computer Engineering at Worcester Polytechnic Institute.

Dr Green is a Systems Architect who is an expert in using real-time artificial intelligence methods to implementing real-time operations tracking and management systems for industrial organizations. He has led the implementation of over 100 such systems over the past decade. Dr Green also led the team which developed the SmartOps24x7 real-time artificial intelligence software platform and the BellHawk operations tracking software.

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