Autonomous or "Lights Out" Supply-Chain Planning: What New Technology Is Required

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PREVIEW *Analogous to the emergence of autonomous vehicles is the momentum toward autonomous supply-chain planning, given names such as "lights out" planning. Niels van Hove describes this development as the third wave of supply-chain planning, following the functionality in ERPs (first wave) and advanced planning software (second wave). But he argues that before the lights can be turned out—i.e., before human input can be eliminated—many technological hurdles must be overcome.*

INTRODUCTION

If you operate in the supply-chain or the planning world, it's hard to not come across terminology like "supply-chain planning 4.0," "light touch planning," or "lights out planning." They all rate high in the hype cycle, and for good reason.

Considerable progress has been made in technology in recent years, and this continues at dizzying speed. Autonomous car development is happening in most of the major car companies with the promise of self-driving cars everywhere within a few years. Since such vehicles already exist in the supply chain (Gray, 2019), why should we not strive to achieve autonomous supply-chain planning?

THE THREE WAVES OF SUPPLY-CHAIN PLANNING

If we look back over the history of supply-chain planning, we can properly say we are in the third wave of *integrated supply-chain planning software*.

Wave 1—Enterprise Resource Planning

Building on developments that date from the 1960s, the first wave really started in the 1980s with Enterprise Resource Planning (ERP) software. Initially, ERP was facilitating and automating transactional business processes like inventory control and planning functionality, such as Materials Requirements Planning (MRP).

On a transactional level, ERP has been a great advance for business; in fact, hardly any large commercial organization can properly function without it. However, planning was never the main focus of ERP; rather, its functionality incorporated accounting, human resources, sales and distribution, quality management, and asset management, to name just a few. However, planning entered center stage with the next wave: integrated supply-chain planning software.

Wave 2—Advanced Planning Systems

Advanced Planning Systems (APS) gained momentum about 20 years ago to facilitate a forward view of the business, integrate plans with other functions, and automate and optimize supply-chain measures of forecast accuracy, inventory holdings, and customer service. Now, two decades later, APS are in the maturity stage of their product life cycle. This makes them a commodity in a crowded and competitive marketplace, just like the databases and ERP systems that support them.

The common principles of demand, supply, inventory, and replenishment planning that APS must address have hardly changed over the years. Neither have the master data and planning parameter requirements that drive them. And although APS systems have become visually more appealing and have added functionality and optimisers, they are still dependent on accurate data input. This remains a challenge, as most global businesses run

Key Points

- If we look back over the history of supply-chain planning, we can properly say we have entered a third wave of *integrated supply-chain planning software*: Enterprise Resource Planning was followed by Advance Planning Systems, and now we have begun to see the emergence of *Autonomous Planning Systems*.
- But autonomous planning requires a new wave of technology. Third-wave software must support further digitisation, automation, and ever-increasing intelligence to make, communicate, and implement business decisions. It must relieve planners from the cumbersome, limited value-added tasks like gathering, cleansing, formatting, and segmenting data from multiple-source systems and enable them to focus on actual planning decisions, collaboration, and the bigger picture.
- In this article I elaborate on the critical systems requirements for achievement of autonomous planning. To truly achieve "lights out" planning, which will eliminate the human planning role, the problem-solving and decision-making capabilities of the system must improve upon human reasoning, judgment, and creativity so as to resolve impediments to execution of solutions.

more than four ERP instances (a single-instance ERP solution is one that uses the ERP system for all business operations) and four to five supply-chain planning technologies (Cecere, 2018). They still operate without a "one source of truth" to support the best possible decision making.

Wave 2 Shortcomings

APS often misses advanced end-to-end decision intelligence, and many APS vendors don't cover the full end-to-end supply chain with their technology. Most of them fail to provide the option to design a full digital copy of the underlying supply-chain planning processes. Furthermore, APS systems are not able to extract value out of the large amount of data that today's supply chain creates.

The reality is that enterprise reporting and decision making are still tied together by spreadsheets, with over 90% of companies being dependent on them (Cecere, 2018). Planners still spend significantly more time on gathering and generating information than on decision making for their schedule (Larco and colleagues, 2018). In short, APS is a far cry from supporting "lights out" planning.

These shortcomings won't be solved by including marginal improvements to existing APS products. It is more likely that a third wave of supply-chain planning software is required to solve these issues. This third wave must support further digitisation, automation, and ever-increasing intelligence to make, communicate, and implement business decisions. It will relieve planners from the cumbersome, limited value-added tasks like gathering, cleansing, formatting, and segmenting data from multiple-source systems and enable them to focus on actual planning decisions, collaboration, and the bigger picture. In doing so, third-wave planning technology might indeed turn the lights out in the planning department, and perhaps beyond.

WAVE 3—AUTONOMOUS PLANNING SYSTEM REQUIREMENTS

What follows are what I believe to be some of the key requirements of third-wave supply-chain planning software, including some of the challenges still to overcome.

1. A digital twin to model the supply-chain planning process as well as the demand and supply plans

To fully automate any process, digitization is required. The planning technology must know the steps, decision points, and communication channels for sharing decisions and outcomes. This is the definition of a "digital twin" for supply-chain planning.

The scope of the digital twin depends upon the scope of the value chain being planned. In a small company, the digital twin may cover only a single plant and associated distribution points, while in

a larger company it may cover multiple plants, warehouses, and both customers and suppliers across multiple tiers of demand and supply.

2. A common planning and analytic data layer

This data layer must solve the information shortcomings typically present in large global enterprises that are running many disparate systems while lacking a common database.

The common data layer should only use relevant planning data from appropriate sources—with minimum latency, maximum detail, and maximum security and responsiveness. It must have the ability to read from multiple data sources and dynamically update those sources if required.

3. Advanced analytics

Descriptive, predictive, and prescriptive analytics must support every decision in the digital supply-chain planning process. Descriptive (what happened?) is useful to send automated reports to stakeholders and to allow technology to learn about the past. Predictive (what will happen?) automates scenario planning across every digital process step, relevant planning parameter, and decision point. Prescriptive analysis (how can I make it happen?) will select the best course of action out of the predictive analysis based on a defined business goal and some clever probability analysis.

4. Automated and dynamic problem solving and decision making

To truly achieve "lights out" planning, eliminating the human planning role, the problem-solving and decision-making capabilities of the system must improve upon human reasoning, judgment, and creativity so as to resolve impediments to execution of solutions.

However, even reasonably straightforward production problems can be computationally complex. If we try to automate and optimise the value chain, we must make millions, billions, or trillions of choices to decide the best course of action. Moreover, the reason for any given decision may be far too complex for humans to even understand.

5. Flexible goal setting

As smart as "lights out" problem-solving algorithms may become, they still need a goal. What do we optimise in a decision: function, business, or value chain? Do you maximise customer service or profit, minimise costs or something else? Goals can change during economic and product life cycles and don't always have to be logical. A business logically wants to optimise EBIT but might decide to incur losses to gain market share.

Technologies to support "lights-out planning" must provide flexible ways to update business goals into the digital supply-chain planning process, in order to guide advanced analytics and automated decision making. Human interaction will likely be needed for a long while to provide the goals for wave-three artificial intelligence.

Artificial intelligence without a goal is like an autonomous vehicle without a destination.

6. Automated execution

Planning decisions will need to be automatically executed: planned orders need to become production orders, or stock-transfer orders, or purchase orders; rescheduling decisions are needed to update due dates on the factory floor or at the supplier. The automatic conversion from orders planned to orders executed sounds plausible and straightforward. It needs to be properly controlled, however. Real-time information updates in both planning and execution systems, in combination with the objective of automated algorithms to react and optimize, can trigger continuous replanning and readjusting, which can become counterproductive and undermine stability in the supply chain.

Once planned orders are converted to execution orders, the "lights out" planning software needs to be able to write back these transactions across the value chain, in real time, and to any of the underlying systems from which it got its information.

Finally, the technology needs to automatically communicate key decisions with expected impacts to stakeholders in any department where the lights are still on.

7. Continuous self-learning
Wave-three systems will have to document decisions, expected outcomes, and actual outcomes, and they must create a feedback loop to learn about what works best so as to improve decision making in the future.

To be fully "lights out" and continuously self-learning, wave-three technology needs to be able to train itself.

8. Self-maintaining
Once the automated planning decision has been taken and executed, self-maintenance will be required. Changes to master data, planning parameters, or algorithm settings will need to be updated based on the latest available status, predictions, or learning. Doing this requires technology to automatically update settings, in itself and in any of the older source systems.

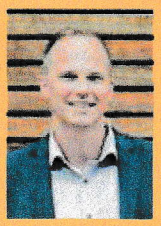
"LIGHTS OUT" PLANNING IS COMING...OVER TIME

To cover all of the functionality described in an integrated platform, on a global scale, the "lights out" planning technology needs to 1) have a flexible architecture, 2) be scalable, 3) be able to two-way interface with hundreds of entities and sources, and 4) have the ability to absorb and dissect significant amounts of data. The average supply-chain professional will understand that the wave-one and wave-two systems they are working with can't provide the requirements for "lights out" planning.

The good news is that we seem to be on the cusp of the breakthrough of wave-three supply-chain planning software. Many of the requirements discussed are already available or will be soon. In the coming years we'll see acceleration in the availability of these types of functionalities. We'll see wave-three vendors appear on the scene and watch them grow and converge into end-to-end offerings that will support a road map towards autonomous supply-chain planning.

We are starting to hear about the first examples of autonomous planning from early adapters (Castellanos, 2018). These are specific cases, with a clear scope, and in specific segments of the supply chain. Once again, the analogy with the autonomous car is apt, as the self-driving vehicle is available in specific business and social segments and situations. However, full, hands-off automation on a mass scale in a busy city center is still some years away. From the current early adapters phase, "lights out" planning will have to go through a similar journey to reach the highest levels of automation at mass scale.

These are exciting times in the supply-chain planning world. Autonomous supply-chain planning is coming, but some patience will be required before we can turn all the lights out!



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