i2 Production Scheduler

i2 Production Scheduler™ is a configurable scheduling tool designed to leverage powerful and patented constraint representation and genetic algorithm-based optimization technologies. The tool can generate feasible and optimal manufacturing schedules for execution based on complex shop floor constraints. Production Scheduler is capable of representing both discrete as well as flow manufacturing processes. It can be set up to optimize multi-stage manufacturing processes which have inter-stage work-in-process (WIP) buffers. Production Scheduler is designed for reactive scheduling workflows where the shop floor needs to be re-optimized based on events (such as resource-down or inventory-shorting). Production Scheduler is a component of i2's factory solution offerings for supply chain management.

Current business environment

Industry consolidation in manufacturing sectors is leading to larger demands imposed on manufacturing centers. The state of the economic environment is also forcing enterprises to look closely at their bottom lines. Companies are consolidating manufacturing centers and setting up more configurable factories, so it is becoming more and more important for organizations to have factories that can manage a diverse array of SKUs rather than cater to a specialized production process.

In addition, some industries are experiencing an explosion in demand on their existing factories because of their competition's poor performance. One such example is within the tire and automotive supplier segments where companies are experiencing excessive demands. For example, in the tire industry, the breakdown of supplier relationship between an OEM and its supplier can drive larger demands for other manufacturers. For automotive battery manufacturers, industry consolidation is leading to demand explosion on some suppliers.

In the process (flow) manufacturing segment, SKU diversity and demand explosion often mean that resources must be further optimized to manage unwanted setups and changeovers due to multiple process and SKU-related conditions.

These business drivers are forcing management at the factory level to examine how to cost effectively increase throughput at their facilities. For this to occur, factories must optimize manufacturing based on a constantly changing and increasing set of complex shop floor and process constraints.

i2 Production Scheduler is designed to increase throughput of a constrained manufacturing facility.

Business drivers

As the marketplace becomes more dynamic, manufacturers are providing more options and requiring increasingly flexible shop floors. Because of tighter supply chains and limited resources, manufacturers must be more productive. Manufacturers are adapting to technological and market changes by constantly upgrading processes, resources, and factories. Factories require a schedule optimization technology that can scale with their needs and can be easily incorporated into the existing shop floor model.

i2 Production Scheduler is designed from the ground-up with configurability, scalability, and real-time workflows in mind. It was designed to cater to manufacturers who are aiming to increase service levels, reduce inventories, and cut manufacturing costs. The primary business drivers that led to the development of i2 Production Scheduler include:

–Current solutions were largely heuristic-based and could not be easily extended
–Production processes and technologies were changing in many industries
–Companies were forced to manufacture many more SKUs to stay competitive
–The shift from build-to-stock to build-to-order manufacturing led to variability in manufacturing, which was more granular than planning systems could model and optimize (reactive scheduling)
–Manufacturers had an increased need to capture and optimize both soft and hard constraints
–End users required a domain-relevant, easy-to-use interface to support daily scheduling decision making
–Black-box solvers were not useful and manual scheduling workflows were critical

i2 Production Scheduler can directly impact ROA

ROA can be measured as (revenue – expenses) / assets. At the factory level, i2 Production Scheduler can help reduce manufacturing costs while increasing utilization of resource capacity. The combined effect of these influences can cause a steep increase in ROA for factory operations. In some cases customers have seen a 100% ROI within one year of implementing Production Scheduler.

i2 Production Scheduler is designed to be flexible

i2 Production Scheduler is built on strong constraint programming fundamentals. Relying on constraints rather than heuristics for representing manufacturing rules, the product is highly robust, scalable, and extendable. Further, the constraint programming

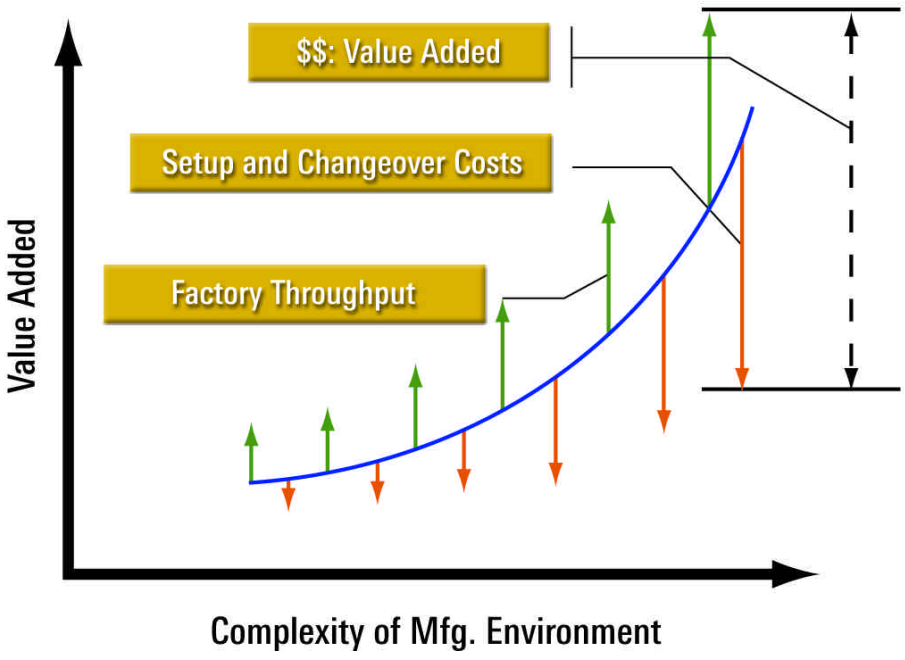

Figure 1
i2 Production Scheduler can directly influence ROA

technology is supplemented by a genetic algorithm-based schedule builder for quick, in-memory optimized schedule generation. i2 Production Scheduler can expose a rich object-oriented programming interface for interacting with the constraint network and optimization engine. This can enable third-party optimization strategies and solvers (e.g. CPLEX) on demand when required. The product design can facilitate a highly extendable, flexible, and powerful environment in which a manufacturing scheduling problem can be modeled and solved, irrespective of the optimization strategy or problem domain.

i2 Production Scheduler can enable companies to:

–Rapidly create, revise, and manage manufacturing schedules
–Model a wide range of manufacturing constraints
–Increase throughput and reduce overhead from unplanned overtime
–Minimize inventory while increasing customer service levels
–Provide real-time scheduling decision support via look-ahead and "what-if" scenarios
–Increase velocity with industry-specific templates
–Configure display of data to suit user needs

Rapidly create, revise, and manage manufacturing schedules

Creating a feasible, detailed manufacturing schedule can require a delicate balance among many production constraints. The scheduling process can be manually intensive and time-consuming. i2 Production Scheduler can automate that process, enabling rapid schedule generation that can free personnel resources for other productive uses. The tool also can enable schedulers to efficiently react to common manufacturing floor problems, such as the failure of critical parts to arrive

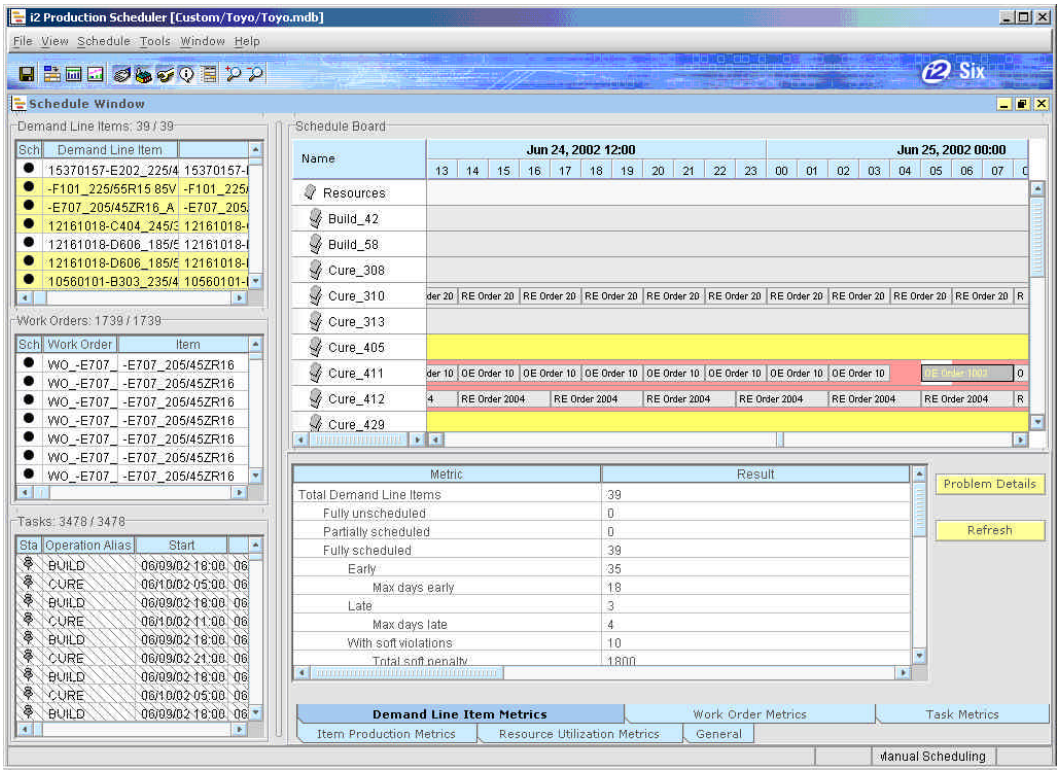

Figure 2
i2 Production Scheduler user interface

on time, or machine breakdowns. i2 Production Scheduler can allow schedulers to see the work that can no longer be accomplished. The tool's powerful visual capabilities can empower the scheduler to re-optimize the schedule quickly, given new production constraints.

Easily model a wide range of manufacturing constraints

i2 Production Scheduler can offer an extensible modeling framework that can allow users to easily configure scheduling models using their own business rules and to accommodate unique scheduling requirements. This configurability is in addition to a library of common production constraints, such as due-date enforcement, setup minimization, tank storage handling, and inventory tracking provided by i2 Production Scheduler.

Increase throughput and reduce overhead from unplanned overtime

Building a detailed schedule that can efficiently utilize resource capacity requires careful consideration of many interacting constraints. Typical production scheduling tools can generate a schedule in one pass, based on a predetermined heuristic. These simple strategies will not consider and compare alternates to determine the best schedule and best use of resources. i2 Production Scheduler provides patented genetic algorithm technology that can examine far more schedule possibilities than can be searched with a manual approach or a single-pass automated scheduler.

While building and evaluating a schedule, i2 Production Scheduler can consider production constraints and can strive to find the schedule that can maximize capacity utilization while minimizing the number of changeovers

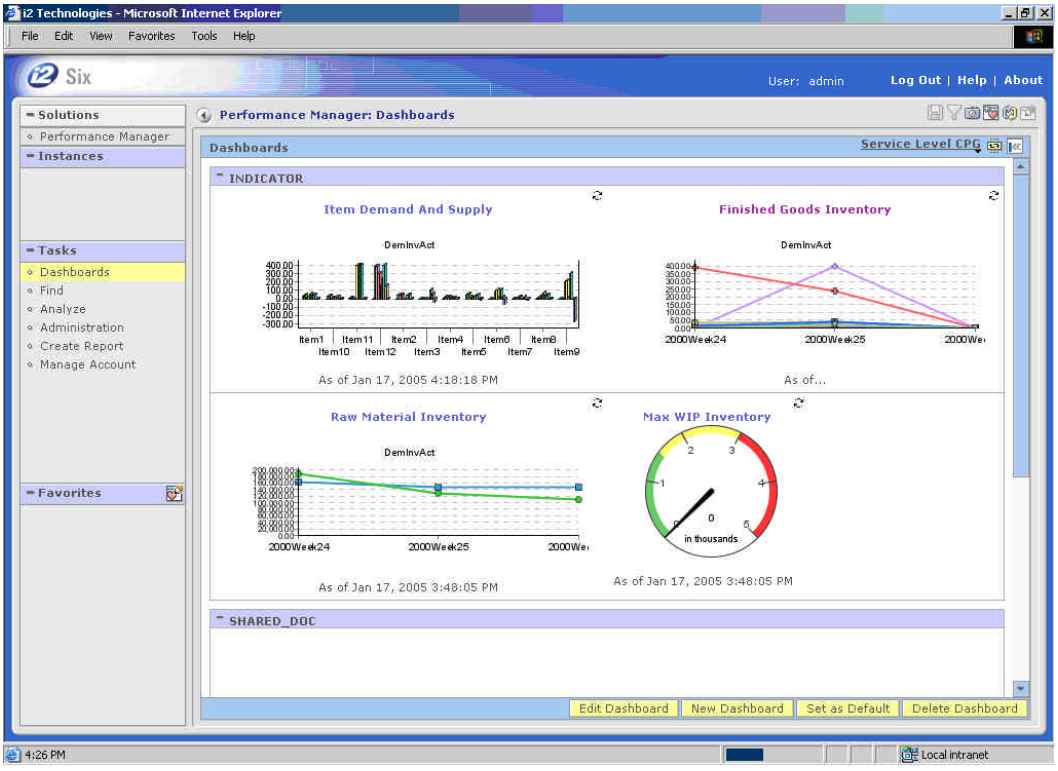

Figure 3
Performance Manager—Service analysis dashboard

or machine setups required. The end result can be increased throughput and an efficient use of production capacity, minimizing the need for overtime.

Minimize inventory while increasing customer service levels

Through tight integration to upstream production planning systems, i2 Production Scheduler can take inventory constraints into account. The result is a more realistic version of the production schedule and visibility into raw material shortages. The user interface can allow the scheduler to adjust inventory levels if required and re-generate the schedule.

Furthermore, i2 Production Scheduler has the flexibility to enforce production rules as hard or soft constraints. As an example, if a customer due-date is configured as a hard constraint, the optimizer will strive to schedule an order on or before its due date. If it can not meet the due date because of capacity restrictions, an order will remain unscheduled. If due-date enforcement is a soft constraint, the optimizer will still strive to schedule the order on or before its due date, but if this is not possible, it will schedule the order late and incur a penalty. i2 Production Scheduler can alert the scheduler to the late or unscheduled orders and can give detailed feedback on why the orders can not be scheduled. This can allow the scheduler to take appropriate corrective action, such as increasing capacity, changing order priority, or scheduling overtime shifts if necessary.

Provide real-time scheduling decision support via look-ahead and "what if"

i2 Production Scheduler is equipped with an in-memory optimization engine. This means, when users open the manufacturing model, their constraints and optimization rules can be loaded into memory. This can allow real-time constraint checking to be performed for user actions. For example, if a user selects a task and attempts to schedule it on, for example, packing line 1, the system will recognize the users' drag/drop action and provide the information needed to support their decision. In this case, the system can provide information as to changeovers, operation durations, labor requirements, or any other constraints as the user moves his or her mouse over various available time slots on packing line 1.

This type of look-ahead and "what-if" support is very powerful for manual schedulers. Often, the visibility required to make good scheduling decisions is half the battle. i2 Production Scheduler's in-memory architecture and constraint technology can provide this rich real-time information.

Increase velocity with industry-specific templates

i2's optimal scheduling technology has been licensed for nearly 75 implementations, providing experience across industry verticals—including automotive, consumer packaged goods, pharmaceuticals, industrial, telecommunications, soft goods, and chemicals. Leveraging i2's implementation experience and solid expertise in production scheduling processes, i2 continues to develop and enhance a set of best-practice solution templates for supply chain management, which include scheduling workflows tailored for specific industries.

These solution templates can significantly reduce implementation time by eliminating confusion and providing well-defined processes for implementation. Enterprises can begin to see an improvement in scheduling—and the associated financial benefit—in as little as three months.

Configure data display to user needs

Many individuals within a plant require access to schedule-related information. The plant manager needs an overview of scheduled activities in order to effectively understand his or her plant shift and labor requirements. The master scheduler and/or production planner need to assess the effectiveness of their procurement plans and react, if necessary. The production floor

needs access to the scheduled jobs for each shift. Sales may want to view the current schedule to assess whether or not a rushed order can be accommodated.

These end users occupy different areas of the plant and some, such as sales, are highly mobile. These users require an easily accessible view of schedule details. For this purpose, i2 Production Scheduler provides a web-based analytics workflow, which can allow the end user to view and analyze production schedules.

In contrast, schedulers can require a detailed and interactive representation of demand data, resources, production constraints, and item inventory to effectively build and analyze each schedule. For this purpose, i2 Production Scheduler can provide a very configurable user interface that can display detailed information in formats which can be easily manipulated (filter, sort, search, drag and drop), with standard and configurable metrics to allow the scheduler to rapidly view and assess schedule quality. This schedule data accessibility can ensure i2 Production Scheduler offers unsurpassed value in building schedules that respect shop floor status.

Product positioning

i2 Production Scheduler is a component of i2's factory solution offerings for supply chain management.

Production Scheduler can also integrate with the operational data store and, as a result, can be easily deployed for customers using i2 Supply Chain Planner™ and i2 Factory Planner.™

i2 Production Scheduler can interact with i2 planning tools, such as i2 Supply Chain Planner and i2 Factory Planner, as follows:

- The planning tool can determine bucketed demands, which are usually daily or weekly, for each plant in the supply chain based on approximate production constraints (decides what to make and when to make).
- Next, an implementation of Production Scheduler at each plant receives the demands for that plant and schedules production on a detailed level to satisfy as many demands as possible. Because Production Scheduler is implemented at each plant, each plant's model can be built and customized for that particular production environment (decides how to make).
- The resulting schedule can be sent back to the planning tool as well as the execution system to close the factory optimization loop (closed-loop workflows).
- A schematic of the factory-level business workflow is shown in Figure 4. Production Scheduler is designed to bring factory plans to realization by coupling planning to execution via optimal scheduling.

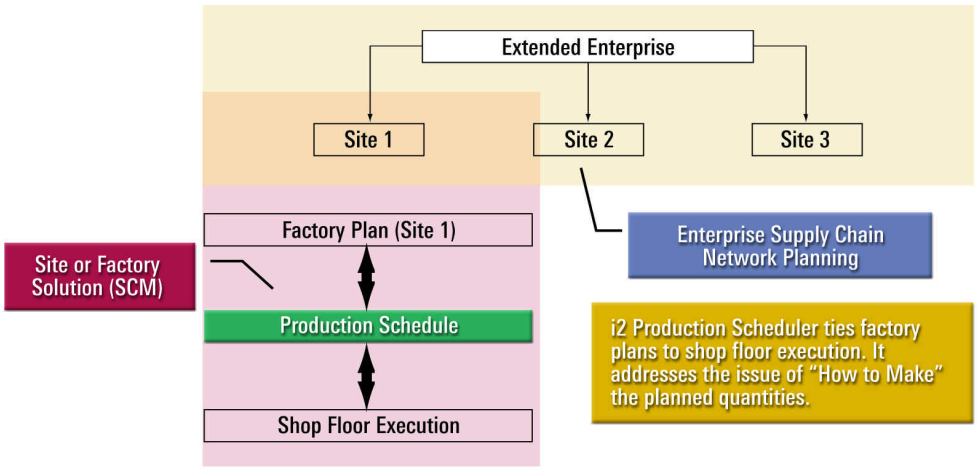

Figure 4
i2 Production Scheduler business workflow

In addition to integration with other i2 products, Production Scheduler may be integrated with external ERP and legacy systems through industry-standard technologies including Java, CIS, and ODS.

Key features

Optimization-based scheduling

i2 Production Scheduler can offer a comprehensive set of standard scheduling rules and analysis tools that can provide the scheduler with maximum power to understand and react to manufacturing signals.

– Create template models utilizing business logic
– Optimize production resource utilization with patented genetic algorithm technology, based on prioritized business objectives
– Represent and respect a rich set of common production rules, such as setups and due-date enforcement
– Build schedules using either as-soon-as-possible (ASAP) or just-in-time (JIT) strategies
– Batch together orders based on similar attributes and due dates
– Determine optimal and varying batch sizes based on resource capacity
– Prioritize orders by customer or due date

Shop floor synchronization

By allowing the user multiple means of sharing data with the shop floor, Production Scheduler can provide value in building schedules that respect the status of the shop floor.

– Configurable Gantt report in HTML—can be easily shared with shop floor
– Web-based analytics reporting using i2 Performance Manager™ that can enable schedule collaboration
– Schedules that respect the current state of the shop floor
– Graphical and tabular data display

Reactive re-scheduling

i2 Production Scheduler's powerful visualization capabilities guide the scheduler to re-schedule subject to new production constraints.

– "What-if" analysis optimizes production after problems, such as machine breakdowns or material shortage, arise
– Inventory and resource capacity can be modified through charts

Usability

i2 Production Scheduler can offer a highly configurable user interface.

– Easy-to-configure workspace and data display
– Advanced data filtering and sorting
– Search procedures for finding specific data
– Predefined schedule metrics provide useful feedback on production levels and capacity utilization

Reporting and analytics

i2 Production Scheduler's reporting capabilities can allow users to extract, mine, and analyze data to drive the continual improvement of schedules.

– Full real-time reporting capability directly from i2 Performance Manager for available data measures and models
– Production Scheduler ships with Service Analysis and Schedule Analysis dashboard, which offer multiple drill-down paths
– Users can easily create custom views and additional reports if needed

Hardware/software requirements

Client infrastructure

– Windows 2000 SP4
– Windows XP SP2

Server

– Windows Server 2003
– Solaris 9/10
– AIX 5.3

Databases

– Oracle 10G Release1 (10.1.0.4) supported on all platforms
– DB2 8.2 on AIX

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