Optiflow Le manufacturing solutions

Lean Planning, Operations & Manufacturing Execution - Overviews

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Lean Manufacturing – an Overview

Lean manufacturing is all about adding value by way of reducing waste. It is essentially a pull based system where customers pull goods as and when it is required. This pull results in a chain reaction starting at the delivery point and extends all the way to raw material suppliers.

In practice, it involves creating an orchestrated flow of materials, components and operations in such a way that downstream operations pull materials and WIP from upstream operations & suppliers and customers pull goods from warehouse, as and when required.

It also involves elimination of waste. Several kinds of wastes are cited such as ~ operators and machines waiting for material to arrive, inventory of excess material, Overproduction, improper flow of materials between operations … and so on.

To make sure that only the required quantity is produced in a smooth seamless manner while eliminating wastes, several principles have been devised. These principles come with their own terminology. While there are many principles and terms, we hereunder cite only those which are essential for working with Optiflow-Le. Also included are comments on enforcement.

Takt Time - Available production time divided by the rate of customer demand. Used to set the pace of production to match the rate of demand. Enforced Automatically.

Value Stream - All the actions (including value added and non-value added) needed to bring a product through the production flow (from raw material to the customer) and the design flow (concept to launch). Value stream mapping is provided (in real-time) in terms of Kanban Pull Sequence, Material Replenishment Sequence and Finished Goods Pull Sequence.

Cycle Time - The longest run time required by a single operation. Enforced automatically for internal calculations.

Pacemaker Process - The process which sets the pace of production. Generally the last production process. Typically enforced as Kanban Loop quantity of the last process.

Batch & Queue - Producing more goods in one process than are needed in the next process so that the items collect and wait in a queue for the next processing step. Enforced as Cooling Time (Precedence Constraint). Could also be enforced by manipulating Kanban Loop quantities.

Change Over Time - The time needed to set up or re-fit a work center or an equipment to produce a different item. Enforced as Set-Up Time for initial set up and as a constraint (Precedence Constraint – Change Over Time) for re-fit.

EPEL - Every-Part-Every-Interval. Time required by the equipment to produce the entire batch. A measure to determine batch size. Enforced automatically for internal calculations. Can be enforced manually as kanban loop quantity (Precedence Constraint – Kanban Loops).

Kanban - A signaling system, often a card, containing instruction for production & conveyance of items in a pull system. Presented as Kanban Pull Sequences. Both One-Card and Two-Card Kanban are supported. Printing / Displaying of Kanban Cards needs customization.

Kanban Loop - A pull based workflow methodology that controls inventory between the source and the consuming destination. Enforced as Kanban Loops (Precedence Constraint – Kanban Loops)

Level Schedule - A production schedule that indicates the quantity to be produced by each process per day / shift, to meet the calculated Takt Time. Enforced automatically for

internal calculations. Could be manually specified as a constraint (Production Rate Constraint – Daily Production Rate)

Please note that Optiflow-Le's user interface is free of jargons including lean terms.

In real terms, it boils down to scheduling a smooth flow of operations and synchronizing material supply and inventory buffers with the flow.

Optiflow-Le, by default, provides a lean schedule while taking capacities and constraints into account. You can always optimize, customize, manipulate kanban loop quantities and build a schedule based on your custom criteria.

Kanban, traditionally speaking, is a card with details of the order and materials being pulled. As these cards are specific to your environment, needs customization in most cases, we instead provide you with sequences. These sequences have all the information to construct kanban cards. Sequences provided are :

Kanban Replenishment Sequence : Provides WIP and Material pull sequences in terms of date, time, materials, WIP, quantities ….

Material Replenishment Sequence : Provides pull sequences for replenishing raw material / components / Parts from suppliers in terms of date, time, quantity… Also provides the information like 'Last date for Ordering' and 'Start-to-Date' quantities … and so on.

Finished Goods Pull Sequence : Provides information on when and how much to pull for delivery.

Creating continuous flow is one of the requirements. Optiflow-Le provides a simple technique to flatten and maintain a continuous flow, by way of manipulating Kanban Loop quantities. If there are gaps between operations, just reduce the kanban loop quantity to a minimum. This levels the load and the flow gets smoother. In some cases, the gaps may still persist. In such cases, divide the order into smaller jobs and dock these jobs in a series. This will take care of load leveling and also creates a smooth continuous flow.

Creating level pull - Level Pull is about consistently getting the right parts, components and materials to show-up at the right place and at the right time. Optiflow-Le handles it automatically.

Load leveling is another important aspect. This again is achieved by reducing or increasing kanban loop quantities. Rule of thumb is ~ reduce the kanban loop quantity to move towards unit processing and increase it to more towards batch processing.

There is another easy way out. Just specify the required production rate (<Production Rate Constraint>) and everything else is automatically handled for you.

Process modeling & standardization helps to evolve and improve processes on a continuous basis and control critical procedures at a glance. Processes are stored as templates. A Template could either be a Job Template or a Process Template.

A Job-Template will have all the information such as the Procedures, Operations, Equipment and Tools, Timing and Skills required to manufacture a product or a part, in a readily usable form. Along with Material-Templates, Job Templates provide a stable platform to manage the product life cycle.

A Process-Template will have the same information but defines either a single or a set of procedures.

These templates provide the basis on which future Job & Product definitions are built. Results in faster, more efficient, more effective and standardized processes & procedures. This information is readily available to planners & managers and helps significantly in ensuring quality while expanding the enterprise knowledge base and preventing re-invention of proven processes.

Designing Projects - How to ...

Designing Lean Products & Projects involves Process Planning, defining the job, defining the sequence, defining Kanban Loops, applying constraints and specifying material requirements. Optionally, you may also specify the required skills to complete the job.

To define jobs, go to <Job Definition> and click <New> to create a new job. Click <Open> to open an existing job.

- Select a Division (Optional. Defaults to 'ALL')
- Select an Operation from the list of operations above (click <Menu<Add Resource>> to add a new operation), select
- Select a Resource from the list above (click <Menu<Add Resource>>) to add)
- Key-in the time required to complete 1 unit (please check set up configuration for definition of units)
- Define Quantity-ratio-to-Job Quantity, if any. Quantity ratio is the ratio of quantity to be produced to the job quantity. For ex. If Job qty. is 1000 and this particular operation produces 10,000 units which will be finally assembled into 1000 of finished units, ratio will be 10.
- Key-in number of operators required to complete the job (optional). Leave it blank if you are not sure. Optiflow-Le will determine the number of operators required to complete the job.
- Key-in or select Operator Category (Optional). You may select more than one category and number of operators in each category separated by commas. If you have specified the number of operators, you may have to specify their categories as well. If you are not sure, please leave both 'no of operators' and 'skill classification' blank. Let the system suggest.
- Select the processing method – Unit Processing or Batch Processing from the panel above.
- Save the job.
- Optionally, you may cut and paste the entire job or individual processes from templates by selecting the Template / Process name from the list of available processes above.

Next step is to define Sequences.

Select <Sequencing> from the menu. Sequences are defined in the chronological order by default. Here you can change the sequence in any manner you want. To change the sequence :

Delete the Sequence (click <Delete> button above to delete).

- Place the cursor in the 'Current Operation Column' and select the operation from the drop-down list.
- Place the cursor in the 'Net Operation' column and select from the drop-down list. You may have One-to-Many and Many-to-One relationships between predecessor and successor operations.
- Optionally you may also specify whether the current operation needs setup each time it is run. Select 'Y' or yes and 'N' for No. Leave it blank if it is determined elsewhere?

- Cycle Overlap specifies whether the same operator is allowed to perform more than one operation. This option needs customization. Please contact Support@Optiflow-Le.com for details.

Next Step is to define Kanban Loops

Kanban Loops are basic mechanism used by lean manufacturing practices to synchronize with material supply, load leveling and to maintain inventory buffers (both finished goods and WIP).

If you have selected 'Batch Processing' as the processing methodology, default kanban loop quantity will be the batch quantity. If you have selected 'Unit Processing', kanban loop defaults to 1. You can :

- Level loads across the factory simply by manipulating kanban loop quantity. Going by the rule of thumb, lesser the kanban quantity, more uniform, predictable and controllable will be the output.
- By specifying kanban quantities as required by inventory buffers and scheduling with backward orientation, you can always maintain optimum levels of production and eliminating stock-outs at-the-same-time.
- Supply and Material synchronization is automatic and is governed by kanban loop quantities.

In other words, just specify and amount of output you need per kanban loop.

Next step is to apply constraints

You have Production Rate constraint, Precedence Constraints, Operational Constraint and Inventory Constraints.

- Production Rate Constraint allows you to fix efficiency and daily rate of output per operation. If you need to decrease the efficiency or daily output, just specify it in terms of percentage and quantity.
- Precedence Constraint allows you to specify the change-over time required (apart from the set minutes) and to specify Kanban Loops.
- Operational Constraint allows you to assign an operation to a particular shift and to take it beyond the shift timings (used in cases where the op. can not be complete within a shift).
- Inventory Constraint allows you to specify the minimum start date and time. Used in cases where either the material / component arrives late. Also used as means of synchronizing supply in cases of collaborative manufacturing.

By applying constraints and customizing (explained elsewhere), you can schedule jobs with pin-point accuracy.

Final Step is to specify Material Requirement

You may specify all the materials and components required at various stages by various operations. Select <Materials> from the menu.

Here all the processes are displayed in the specified sequence. To add materials, components etc., right-click on the column below and select <Insert Row> from the floating menu. Specify the material / component and other information as prompted.

Please note that column ‘Rep Lot’ means the replication lot of the process, i.e., the minimum lot transferred from that process to the next process. For smooth sailing, it is generally specified as the Kanban Loop quantity.

You can automate this process by importing data from your existing BOM modules. This option needs customization.

You may save material specifications as templates and copy from templates to fill material requirement.

Scheduling – an Overview

Scheduling & Sequencing module provides you with powerful interactive graphical tools & custom filters to visually optimize work loads and arrange work requirements based on your custom criteria. You can reduce the lead time and get as close to production cycle time as possible.

You have all the **tools, techniques and functions** you need to define the right way orders flow through your factory. You can opt for a **pull-strategy, push-strategy** or **pull v/s push method** (combination of pull & push methods), determine how long it takes orders to go through your factory and where opportunities for improvement exist. Supported features are :

- Finite Capacity Scheduling
- Open Capacity Scheduling

- Forward Scheduling (Push scheduling)
- Backward Scheduling (Pull Scheduling)

- Batch Scheduling (Scheduling for Batches & Lots)
- Unit Scheduling (Scheduling for single units or lots)
- Kanban Scheduling (Scheduling for Kanban Loops – Lean Scheduling ::: Toyota Production System)
- Mixed Model Scheduling (A combination of unit, batch and Kanban scheduling)

- Shift Scheduling (Scheduling for Shifts)
- Collaborated Scheduling (Collaborated Manufacturing)
- Customization (Customizing schedules to attain pin-point accuracy)
- Maintenance Scheduling (Preventive Maintenance)
- Workforce Scheduling (Finite capacity employee scheduling)

Finite Capacity Scheduling enables scheduling for the available capacity as specified by equipment configuration.

Open Capacity Scheduling also schedules for an assumed finite capacity as specified by equipment enumeration (in general configuration). For ex., you may assume enumerated capacity as 400% of installed capacity.

Forward scheduling (Push Scheduling) schedules from start-date to the end-date with forward allocation.

Backward scheduling (Pull Scheduling) schedules from end-date to the start-date with backward allocation.

Batch Scheduling - Schedules for Batches where kanban loop quantity will be same as batch quantity.

Unit scheduling - Schedules for individual units. Here kanban loop quantity could either be '1' or be equal to lot size.

Mixed Model scheduling involves scheduling where some operations are scheduled for batch, some scheduled for unit processing and others for the specified kanban loops / Lots. You may have any combination thereof. Here kanban loop quantities vary from operation to operation.

Kanban Scheduling - Schedules for a specified kanban loop quantity. This quantity could be any number ranging from 1 to job-quantity.

Shift Scheduling - Schedules for a specified shift. You may have as many shifts as you need. Shifts may also overlap. Only restriction is that split-shifts (shifts that carry over to the next day) are not allowed in this edition.

Collaborated scheduling involves collaborated manufacturing where different parts are manufactured at different geographic locations possibly by different organizations. Supply position (delivery dates & time) can be collaborated. Please refer documentation on Integration & Collaboration for a detailed discussion.

Customization is the way to fine-tune your schedules to attain pin-point accuracy. You may customize start-end dates & time, efficiencies, output and other dependencies per operation.

Maintenance scheduling - Scheduling for preventive maintenance of equipments and resources. An asset can be any resource ... Equipments, Fleets of vehicles, Buildings, Estates ...

Lean Scheduling - Pull Scheduling, the basis of Lean Manufacturing, is defined as ~ "Pull scheduling is a concept of dynamic scheduling which is rescheduled in a short planning cycle, for example, daily by backward allocation." Built on well known principles of Lean Manufacturing and Six Sigma, Optiflow-Le is ideally suited for Lean Scheduling.

Sequencing – an Overview

Sequencing is the definition of relationship between the predecessor (supply source) and the successor (consumption destination). It is the basis on which manufacturing slots are assigned to each unit / lot / Kanban Loop. Schedule for each unit is established by applying the build rate while considering capacities, constraints, bottlenecks and other requirements. Specifies when each unit enters and leaves the slot.

By default, Optiflow-Le provides a chronological sequence as specified while defining the job. You can modify it to suit your requirement. Operations may have one-to-one, one-to-many, many-to-one and many-to-many relationships.

In a one-to-one relationship, a supply source will have one consumption destination and a consumption destination will have one supply source.

In one-to-many, a supply source can have more than one destination and destination will have one supply source.

In a many-to-one scenario, a consumption destination may have more than one supply source and the supply source will have one destination.

In case of many-to-many relationships, a consumption destination may have more than one supply source and a supply source may have more than one consumption destination. It is implemented in a round-about manner, by creating a dummy sequence in between (many-to-dummy and dummy-to-many).

Constraints – an Overview

Theory of Constraints is based on the premise that the rate of goal achievement is limited by at least one constraining process. Only by increasing flow at the bottleneck process can overall throughput be increased. So far as manufacturing operations management is concerned, the solution is to pull materials through the system, rather than push them into the system. The primary methodology applied by Optiflow-Le to manage constraints is Drum-Buffer-Rope (DBR). Drum-Buffer-Rope is a manufacturing execution methodology, named for its three components.

The Drum represents finite capacity of the plant including human resources.

The Buffer protects the Drum. Buffers in DBR have time as their unit of measure, rather than quantity of material. Buffers make sure that the successor process has enough material to keep producing when exceptions occur in predecessor process.

The Rope is the work release mechanism for the plant. If jobs are pulled 'before time', it results in high work-in-progress which in turn slows down the entire system. Requires that jobs be scheduled in such a way that each operation starts exactly at the right time.

Initially, plans and schedules will be smooth. While the work is in progress, exceptions occur. From this point onwards, it is driven by exceptions such as delayed supply of raw-materials, equipment break-down, non-availability of human skills, defective material ... and so on. While most of these exceptions can be automatically handled by re-scheduling, Optiflow-Le provides for six constraints handlers.

Production Rate Constraint : Used to fix the daily / shift production rate.

Cooling Time Constraint : Used to enforce gaps between predecessor and successor operations.

Kanban Loop Constraint : Kanban Loop quantity is enforced as a constraint in Optiflow-Le. By manipulating kanban loop quantity, you can exercise control over the entire flow. Please refer overview of Kanban Techniques to learn more.

Operational Constraint : Used to assign a particular operation to a particular shift and to extend time beyond the specified boundary. For ex., if an operation (assigned to a shift) takes 10 hours to produce one unit and shift timings are for 8 hours, you can extend the shift timing for this particular operation by 2 hours.

Inventory Constraint : Used to enforce an operation to start at a given time rather than the scheduled time.

By applying a combination of these constraints, you can handle most exceptions with ease.

Kanban Techniques – an Overview

Traditionally, Kanban is a signaling system, often a card, with instructions for production or conveyance of material & items, in a pull system.

In our system, Kanban replenishment sequence provides the signaling mechanism. Kanban Loops (quantity of items & materials to be pulled) is the basic work-flow mechanism used to enforce lean principles. You can think of kanban loops as inventory buffers between predecessor and successor operations (between a supplying source and a consuming destination).

Kanban loops are expressed in terms of Loop Quantities. In unit processing, typical loop quantity is 1 (or the lot size). In Batch processing, typical loop quantity will be equal to the batch quantity.

Unit processing gives you a continuous flow. Batch processing gives you a staggered flow. You can specify a loop quantity which gives you a continuous flow and at the same time make sure that consumption destinations have enough buffer to keep producing, should an exception occur at the supplying source.

Each process can have its own kanban loop quantity. Loop quantity of the pacemaker process (generally the last process) is used to align your inventory levels with actual consumption.

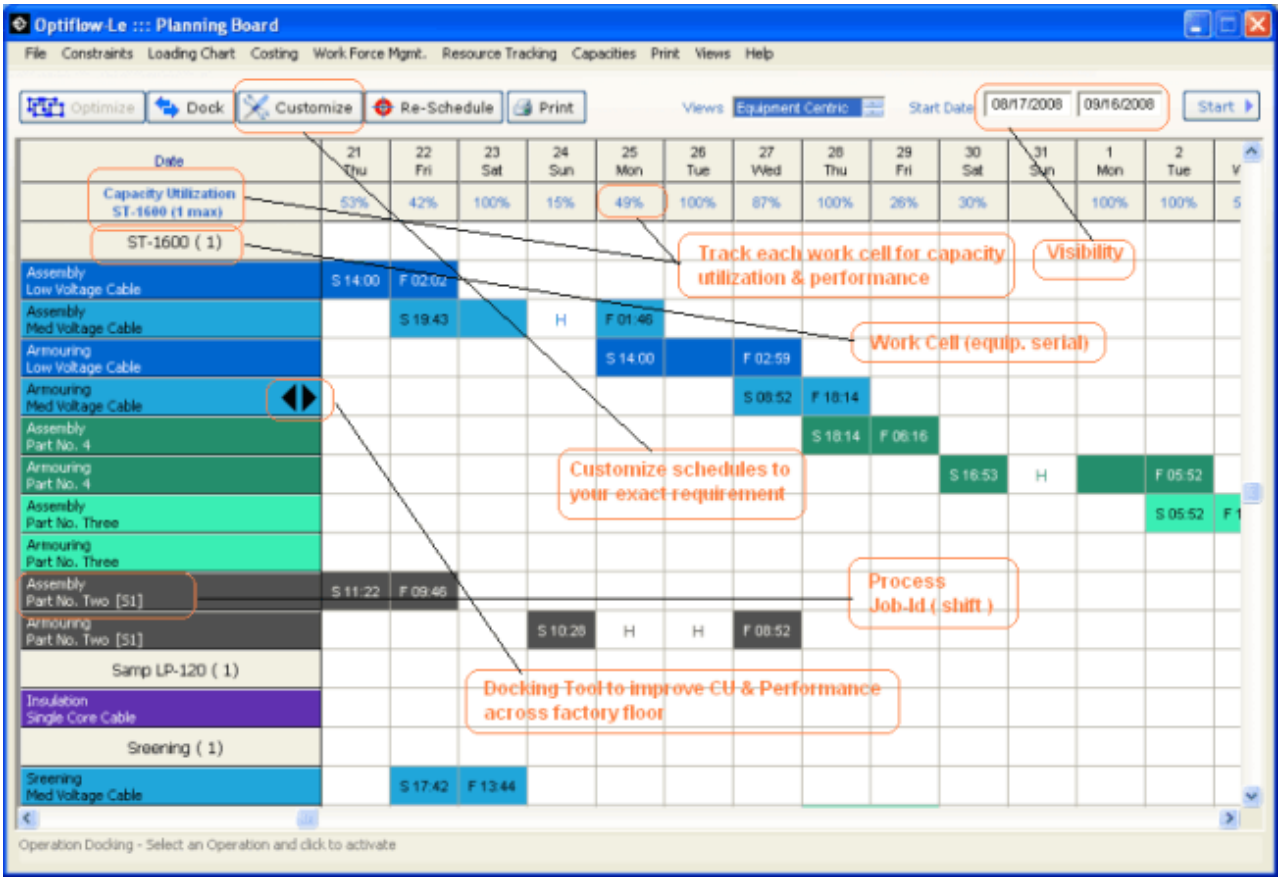
Rule of the thumb is, lower the loop quantity to attain a smooth continuous flow. Increase the loop quantity to increase buffers between processes. Please note that the loop quantity should be equal to or more than the lot size.

In some cases, you may not get a continuous flow even when loop quantities are low because of various other factors. In such cases, split the order into a number of smaller jobs and dock all these jobs in a queue. This should provide you a continuous flow.

Optimization – an Overview

Planning Board (PB) is the place where processes, capacities and employee skills are optimized and customized. PB utilizes simulated floor models to create optimizing opportunities which might not be apparent otherwise.

PB is a 30 day floor model that displays schedules by work cell and tells you whether the cell is constrained or is under-utilized, on a day-to-day basis. You can dynamically move schedules around to meet delivery dates, optimize capacity utilization, synchronize production across the floor and align inventory levels with actual consumption.



Upstream work center schedules are driven by downstream pull signals. You can flatten pacemaker operations and synchronize production across the floor. You can optimize Kanban loops to align your inventory levels with actual consumption and at-the-same-time, eliminate stock-outs.

Views : You have the option of looking at the 30 day floor model in three different views : Operation Centric, Order Centric and Equipment Centric.

Operation Centric View	Displays schedules by processes and operations.
Order Centric View	Display schedules by orders.
Equipment Centric View	Display schedules by equipment / resources.

In each of the above views, you can find optimizing opportunities to increase the flow, reduced the lead time and eliminate waste.

Tracking : You can track constrained resources and flatten pacemaker processes to synchronize workflow across the factory floor.

Capacity Utilization : You can check the capacity requirement and improve capacity utilization by way of dynamic interactive docking.

Customization : You can customize each order to your exact requirement by moving orders around and re-scheduling.

Planning Board is packed with tools and functions for you to simulate 'What-if' scenarios, optimize and customize orders and the entire factory floor to your exact requirement.

Workforce Management – an Overview

Optiflow-Le comes with a sophisticated workforce management solution. Included are ~ Planning, Scheduling (for skill based finite capacity), Tracking, Substitutions and detailed reporting. Most processes are fully automated.

Planning - You may plan for the category and number of operators required while defining jobs and templates or opt for automated planning.

Scheduling - Workforce Scheduling is fully automated. Includes scheduling for a range of days, shifts, specific categories and skill sets.

All you need to do is to select the order, date-range, the shift and the category and click on <Schedule> button.

Tracking - You may search for workforce availability simply by enabling the <Tracking> button. You may also narrow the search to a specific skill, category and shift.

Substitutions - You may substitute an employee for another with ease, either for a specified amount of time or for good. Just takes a few clicks.

Reporting includes detailed employee performance metrics and Overall Labor Effectiveness among others.

Performance Metrics – an Overview

Management Dashboard

Performance Metrics include Process performance, Labor performance and Order performance. Also, Management Dashboard includes various efficiencies, KPI's and variance analysis spread across categories.

Management Dashboard is a separately installable module. You can download it from our web site, if you have not already done so. You may have to provide database access permissions to start with. These permissions persist so long as you don't shift to another database. You may have as many databases as you like.

Overall Equipment Effectiveness (OEE)

Overall equipment effectiveness provides a means to measure the effectiveness of manufacturing operations ~ single pieces of equipments to entire manufacturing plants. It uncovers hidden capability of the factory and provides a complete picture of where time & money is being lost.

OEE measures for three different kinds of waste in the manufacturing process, viz.,

Availability - measures the time the plant was actually available for production
Performance - actual rate at which units were produced compared to planned output
Quality - amount of production that conforms to quality standards).

An improvement of 10% has a huge impact on profitability.

Overall Capacity Utilization (OCU)

Overall Capacity Utilization (OCU) is an extension of OEE. Provides a detailed view of installed capacity and its utilization, in terms of Planned Down-Time, Un-Planned Down-Time, Start-Up Time and the actual Capacity Utilization. Provided as a separate function for clarity.

Overall Labor Effectiveness (OLE)

Overall Labor Effectiveness is a key performance indicator that measures performance, utilization and quality of your workforce. OLE measures :

Availability - amount of time employees spend making effective contributions
Performance - the amount of product delivered
Quality - amount of production that conforms to quality standards

There are many factors that influence workforce availability, performance and quality. It helps manufacturers to make sure that the right person with right skills is available at the right time. Also provides a deep insight into where downtime losses are coming from and impact they have on overall productivity.

OLE uncovers hidden data and help managers to solve problems and improve overall productivity and quality. As with OEE, an improvement of 10% in OLE can have a large overall impact. A tool that every organization should have.

Integrating Optiflow-Le with other SCM and ERP systems

Integration is carried out by way of importing and publishing information.

You may Import :

- BOM from your existing ERP/SCM application
- Inventory of Raw Materials, Components and Finished goods from your Warehousing application
- Schedules from other locations (for collaborative manufacturing)
- Designs, Drawings and Documents
- Job Templates (process designs)

You may publish :

- Material Replenishment Sequence (to SCM partners / SCM applications / others)
- Finished Goods Replenishment Sequence (to Warehousing applications / others)
- Kanban & Material Replenishment Sequence (to warehousing applications / other divisions / others)
- Schedules
- Job Templates (process designs)
- Drawings and Documents

Optiflow-Ic (Integration & Collaboration) provides a seamless way to update both incoming and outgoing data. There are no limitations, as such. Please refer to Optiflow-Ic's help document for a detailed discussion.

A Typical Use Case

Here is a typical use case and the steps required to guarantee delivery.

Assuming that the consumption rate of one of your components is 10,000 per month and you would like to have a buffer of 1 month. Also assuming that the design is readily available.

1. Create a Job Template (list operations in the required order to create)
2. Create a New Job definition by cutting and pasting from the template
3. Modify the sequence if it does not conform to the default sequence
4. Specify the Kanban Loop. Make it as small as possible.
5. Specify Start-Finish dates and time.
6. Specify material requirement. Save it as a template.
7. Schedule workforce (just takes a couple of clicks to schedule)
8. Click on <Schedule> Button

It may take 30-60 mnts. or so to create process definitions. Time is mostly consumed in creating process & material templates. To repeat the same process in the subsequent months, it would just take a few minutes as you can copy details from templates with just one click.

Now you can print :

- The Schedule
- Loading Charts
- Material Replenishment Sequence
- Kanban Replenishment Sequence
- Finished Goods Replenishment Sequence
- Workforce Assignments

While the work is in progress, you can monitor :

- Equipment Performance
- Labor Performance
- Variance in terms of cost and performance
- Quality, Equipment Effectiveness, Labor Effectiveness and Capacity Utilization

and make changes, if required.

That's all it takes to handle hundreds of orders in an efficient & effective manner and make sure that quality and goods are delivered on time.