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The L-mobile APS Fact Sheet

Important functional areas of the APS system

Summary

APS stands for Advanced Planning and Scheduling. In simplified terms, planning refers to the "what" and "where", and scheduling describes the "who" and "when". Planning and scheduling are necessary for the detail planning of production where, as a rule, the "who" and "when" require detailed expert knowledge.

The L-mobile APS application is able to store this expert know-how and make it available in a structured way, as it works with input data from ERP systems on the one hand and a multitude of planning-related parameters and variables on the other hand. It uses them to create a tested, i.e. workable and optimized production plan using a probability-based approach. The core element of the software is a generic algorithm, a form of artificial intelligence (AI), that tries to create a cost-optimized production plan based on optimization parameters, which takes into account the resources involved together with any restrictions and dependencies.

Orders from the ERP system
- Sales orders
- Production orders

L-mobile APS
Optimization algorithm → Gantt chart → Dynamic, manual adjustment of the optimized program → Gantt chart

Machine   Employee   Tool   Warehouse stock   Restrictions

Production plan
- Resource allocation
- Scheduling
- Can be adjusted during the actual process
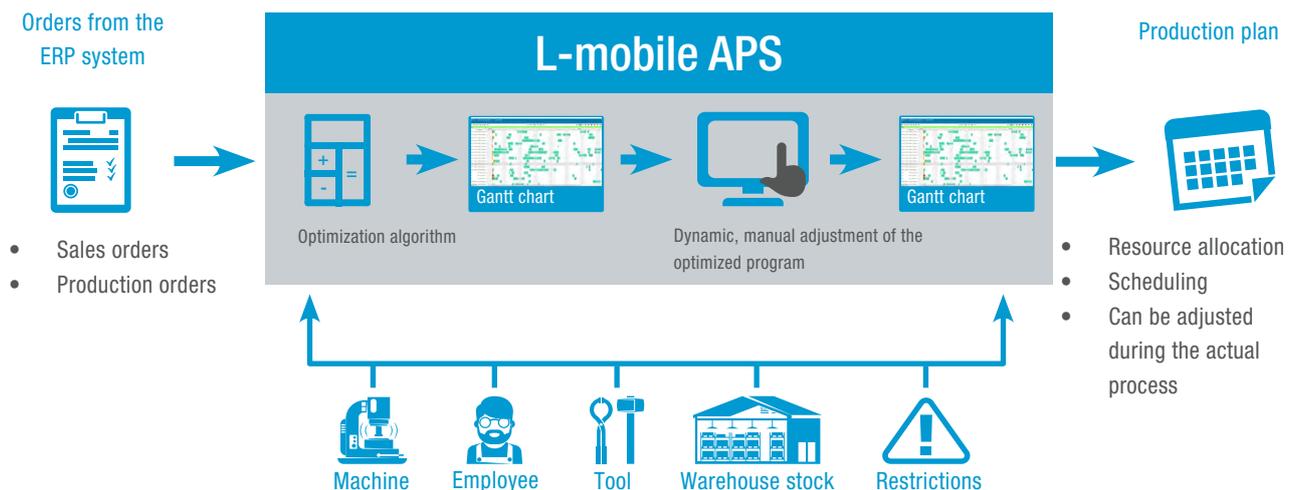
Figure 1: L-mobile APS production planning process

In this fact sheet, we introduce you to the different functional areas of L-mobile APS. The availability of the individual functions depends on the ERP system in question, as it must be possible to transfer certain data generated in APS back to the ERP system and this must be checked on an individual basis (e.g. master bills of material, orders split into separate orders).

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General functions

There are numerous standard functions and configuration options available in L-mobile APS. By restricting user rights, areas can either be blocked (to prevent changes or entries) or they can be enabled. The planning board (GANTT) provides the planner or manufacturing department with a quick overview of the current manufacturing situation and capacity utilization. In addition, order tracking provides greater transparency over progress at project, order, or operation level. For visualization for employees in the production areas, we recommend using the L-mobile cockpit with Microsoft Power BI. Views in table form provide further detailed information about orders and operations along with the status of completion, plus filter and sorting options.

Function overview

Multilingual
English, German, and Hungarian can be selected as the language for the client user interface.

Support for simulations
The data structure is similar to ERP in that the user can change the properties or create new objects for simulations (e.g. machines, sales orders).

Near real-time connection to the ERP host system
Prompt synchronization of data between the ERP system and L-mobile APS.

Reference plans
Reference plans make it easier to monitor the progress of work at specific time points. Various scenarios and production plans can be saved individually and compared against each another.

Always valid production plan
The production plan is always validated by simultaneous and logical testing based on the available data, unless resource constraints are deliberately disabled.

Comparison of production planning and execution
Using data obtained by means of production data collection, it is possible to compare the planned start and end dates with the actual dates.

Productivity analysis
Display of pool of orders, utilization situation, and shift output for resources/resource groups.

Creation and maintenance of operations calendar and time model
For machines and personnel, if this is not possible in the ERP system. Configuration of capacities and shift model assignment by resource.

Concurrent users, operational units
Multiple users can plan different machine groups at the same time. Separate production areas can be planned independently of each other.

Create reports, print, and export to Excel
Support for Jasper and Crystal Reports, plus the ability to quickly export data to Excel. A range of list reports are available, including utilization, sales orders, and manufacturing plans.

Resources

Machines, work stations, collaboration partners (e.g. contract manufacturing and outsourcing), personnel, tools, and materials can all be managed as resources in planning.

Function overview

Machines/work stations
Recipes can include various alternative machine combinations, enabling multiple machines to be used concurrently in manufacturing.

Machine groups/work station groups
Creating machine groups by grouping machines and work stations makes it easier to filter machines in the planning board and visualize utilization.

Suppliers/collaboration partners
Partners are added to the planning board for users to assign collaboration orders. These alternative manufacturing methods can also be optimized.

Tools
Recipes can include various alternative tool combinations, enabling multiple tools to be used concurrently in manufacturing.

Tool groups
Creating tool groups by grouping tools makes it easier to filter tools in the planning board and visualize utilization.

Personnel qualification matrix
Different qualification levels can be defined to describe the required expertise for a specific work step.

Personnel
Employees can be added and then scheduled and assigned to various jobs or machines based on their qualifications.

Resources with multiple capacities
The configuration of resources makes it possible to work with multiple capacities (e.g. multiple personnel at assembly work stations). This also enables short-term capacity adjustment in the event of unplanned incidents, such as malfunctions.

Limited resources
This type of resource can be used for anything that has a finite capacity (e.g. space, energy usage, simple unnamed tools, etc.).

Resources with infinite capacity
Work stations that can be used in parallel or, for example, test work stations can be visualized with infinite capacity.

Time models, shift calendar
Setting time models (shifts) for machines and personnel and specifying the time periods when the resources are available or not.

Detail capacity planning

Detail capacity planning is the domain of L-mobile APS. This production-related detail planning supplements the rough planning carried out on the ERP side and can take into account correspondingly extensive resources, equipment, materials, and other planning elements and parameters. Users have a multitude of functions at their disposal for detailed planning.

Function overview

Determining delivery dates with alternatives through simulation
Automatic or manual splitting of operations, including parallel and overlapped processing, or grouping of operations.

Short-, medium-, and long-term planning
In L-mobile APS, the planning horizon controls short-term planning, where all planning constraints in terms of scheduling and optimization are taken into account, medium-term planning, which takes into account the most important framework conditions for planning and optimization, and long-term planning via backward scheduling of sales orders.

Short-term capacity adjustments
Simple adjustment of the available capacity by resource, for example, in the event of failures, processing urgent orders with additional shifts, machine speed, etc.

Rescheduling via drag and drop
In the planning board, individual operations or sequences of operations can be postponed or rescheduled to alternative means via drag and drop, while also ensuring that capacity is verified. Permanently assigned personnel, materials, tools, and collaborations are also taken into account.

Planned machine maintenance
During the set maintenance operation, the machine in question is unavailable.

Overlapping operations and materials
The overlap between the successive operations of a production order can be set in terms of quantity, time, or percentage. It is also possible to overlap unrelated operations if one operation produces (a proportion of) the material for the other operation.

Resource requirements for work stations
Resource constraints, such as machines, tools, limited resources, qualifications, and materials can be managed.

Transportation times between machines/work stations
Transportation times facilitate the control of physically separate production areas (e.g. locations or even preferred machines). Rules can also be defined for transportation times.

Setup activities—calculation and rules
Based on fixed times, the setup time can be calculated prior to operations. Using detailed setup rules, targeted optimizations can also be achieved by saving time.

Setup time and transportation time optimizations
Order tracking with full visualization of throughput.

Resources required for setup activities
Planning takes into account the resources required for setup and teardown as well as tool fitting and dismantling times.

Preparation time and (subsequent) wait time
Specifying these times makes it possible to control the transition times between operations. The wait time can be assigned to the material or a machine.

Dynamic calculation of start times
Performed for the earliest and latest start dates, unless strict production and sales order assignment has been defined.

Dynamic recalculation of sales order delivery times
Performed if there is no fixed assignment of production and sales orders.

Detail capacity planning

Function overview

Split orders/operations for parallel manufacturing
Splitting makes it possible to shorten throughput times, as production is divided between different machines.

Operation blocks
By defining order blocks, the planner can group orders and plan them together, which is useful when using certain technologies (e.g. laser cutting).

Functions for the status of orders/operations

Visualization of the progress/status of work.
Feedback from production data collection is used in L-mobile APS to indicate the status and progress of processing. The numeric values can be output via a tool tip and the operation can be visualized accordingly in the planning board.

Planned and released orders
This status is used to determine whether and how orders are taken into account during optimization.

Started operations
L-mobile APS calculates the percentage progress of operations that have been started.

Paused and interrupted operations
Interrupted operations are optimized; paused operations are not optimized until they are resumed.

Non-interruptible operations
Operations can be marked as non-interruptible, so that they must be planned after a period of unavailability rather than before.

Functions for personnel planning

Strategic personnel planning
Various personnel planning strategies are used to control the automatic assignment of personnel.

Assignment of personnel
The plan for the assignment of personnel to operations can be created automatically and modified manually.

Personnel qualification
Display of existing and required personnel qualifications for the respective operation or resource—can be carried out as part of comprehensive personnel planning. Personnel can be assigned to fixed work stations, or the personnel structure can be deactivated. Qualification requirements also support the scenario where a person can perform two or more operations simultaneously (e.g. multi-machine operation) by specifying partial qualification requirements for operations.

Employee qualification matrix
Used to provide a quick overview and for the automatic or manual assignment of personnel and qualifications. The data used for this is taken from the ERP system.

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Manual planning

Manual planning allows the planner to define their own interventions at any time that can be optimized in advance or subsequently using the integrated heuristics or artificial intelligence. Manual planning offers clearly structured and easily accessible functions for this.

Function overview

Real-time behavior
Any changes that are made in the planning board are checked and displayed in real time.

Capacity-verified scheduling of orders and project orders

Rescheduling via drag and drop
Operations can be postponed and/or rescheduled to alternative machines. The same applies to operation sequences and blocks of similar operations as well as entire production orders and projects.

Quick rearrangement of operations on machines
The user can create operation sequences based on similar activities, which are automatically arranged on the respective machine.

Release of orders, project orders, and operations
Via a movable time reference line, the planner can mark orders as planned and released in the planning board (the start time is relevant here). This defined work queue is omitted during optimization. Optimization can be enabled again by revoking a release.

Change machine via pop-up menu
Operations can be switched to an alternative machine (based on the work plan) via a pop-up menu.

Tool assignment via drag and drop
Individual tools can be assigned and changed manually by visualizing the tool in the planning board and moving it with the mouse.

Operations can be assigned to individual machines and employees.

Fixed resource assignment
Once orders or operations have been fixed for a machine, postponement is permitted for optimization purposes, but rescheduling with a change of resources is not permitted.

Manually planned operations and sequencing
Using specific labeling, the planner can specify to the automatic scheduling function that these operations are to be given preferential treatment when planning, i.e. they are to be left as they are with the other operations planned before and after them.

Prioritization of sales orders and production orders
Orders can be prioritized to prevent missed deadlines. Optimization takes these priorities into account during planning.

Postponement buffer
In the planning board, the postponement buffer shows the time period in which an operation must be started so that the subsequent operations can still be carried out in time.
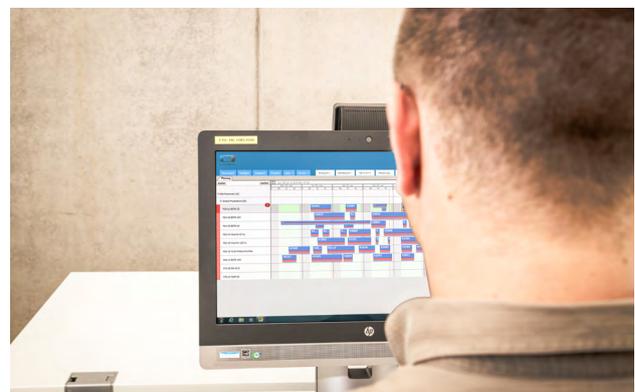
Manual planning

Function overview

Tool filter
Filtering by the tool used for each operation and detailed overview of the operations in which the tool is used both before and after.

Quick heuristic planning
Quick heuristic planning supports the user. Using heuristic calculations as a basis, the planner can select the following strategies for automated planning: based on end date, orders, or earliest and certain start time.

Bottleneck scheduling
Bottleneck resources are given preferential treatment during optimization. The planner can also place an order with operations on critical machines and then rearrange the other orders in the pool via optimization.

Short-term capacity changes
Capacity increases/constraints can be set and also simulated to ensure a prompt response in the event of failure, illness, and unplanned disruptions.

Manual assignment of personnel
The user can manually assign personnel to machines and work stations. They are shown the relevant time model for this.

Project planning

Project planning is a standard function of planning. It enables the planning of upstream areas such as design, development, prototyping, etc. Manual documentation of the different planning stages, by simply saving the plan as a pdb file in a database, is one of the many helpful functions that can be used in projects. The logged planning stages of a project can be analyzed in graphical and table form at any time. For project tracking in table form, filters can be used to provide a better overview and to select and deselect assembly levels.

Furthermore, the planning board can be used to provide a representation of the project progress with predecessor and successor relationships at operation level, existing time buffers for dependent operations, as well as the critical path and end date, with any missed deadlines. It is also possible to display cross-project dependencies.

Function overview

Structured view
Shows the structured view of the project order including all dependencies.

Splitting of projects
Projects can be split into linked individual orders (not possible for the following ERP systems: Infor:COM and Sage).

Analyses in tables
Analysis can be performed using the sorting and filter function. There is also an Excel export function.

Overview of project order levels
Overview can be expanded based on orders, modules, and assemblies.

Other functions:

• Structured display in Gantt chart with filter function

• Prioritization of project orders

• Simulation option

• Project tracking

• Storage and retrieval of project states

• Display of deadline violations due to delayed activities

Material requirement and availability calculation

During capacity planning, L-mobile APS is able to take into account the required raw materials and stocked assemblies, provided this information corresponds to the ERP system. The availability check that is performed also includes warehouse stock as well as scheduled receipts and issues to cover the existing known requirements according to the current valid plan.

Function overview

Material availability
Via configuration, it is possible to specify whether material availability is taken into account or disregarded during scheduling. Stock can be tracked visually and in figures.

Consideration of scheduled goods receipts
With the modeling of the goods receipt process, the planning logic can estimate when material will be available in production.

Stock levels
The material stock managed in L-mobile APS is reduced by the planned required quantity at the start of the operation and added to the finished item at the end of the operation. Negative quantities may be permitted or prohibited.

Overview of procurement
L-mobile APS provides a comprehensive overview of all pending orders in the ERP system.

Production technologies

L-mobile APS supports various technologies, which have specific characteristics and require appropriate planning methods. The following overview provides more detailed information.

Function overview

Injection molding
Supports the use of multiple nested tools when the machine is producing two different products at the same time.

Twin- and triple-pallet rotary machines In this case,
the cycle time depends on the orders that are scheduled in parallel on the pallets.

CDC/powder coating systems
In this application, the cycle time is mainly determined by the throughput time of the machine.

Heat treatment
Characterized by fixed job times, with interruptions not being permitted.

Freely selected workflow
During manufacturing, the sequence of operations can be freely selected.

Co-production
Supports the planning and manufacture of co-products.

Manufacturing/machine lines
Line production can be configured.

Joint planning of subsequent operations
With some technologies, the subsequent operations must follow directly and be scheduled on the same machine.

Visualization

In addition to the planning board, L-mobile APS uses overviews in table form and lists in the form of grids. There are editable and non-editable grids. The user can move, nest, sort, and filter columns, and store these settings in their user profile.

The main options for visualization are:

• Machine (group)/resource utilization
• Personnel deployment planning and utilization
• Processing sequence of every machine/work station
• Tool assignment and utilization
• Material requirement and procurement
• Collaboration partners and assignment
• Missed deadlines and time buffers

Function overview

Configurable views
For time intervals and zoom factor of the planning board, horizon, shift-oriented or time-oriented display, etc.

Corresponding table overviews
In the table overviews, it is possible to select individual rows and display the corresponding orders filtered in the planning board.

Highlight order type, customer, item, person, etc.
It is possible to highlight activities within the same order, including with the predecessor, to highlight the same tools, to highlight operations/orders which produce material for the selected item, and so on.

Freely configurable color options
It is possible to individually configure various color options for the display of objects (e.g. customer, item, etc.) in the planning board.

Attendance and availability times
For personnel and machines, including maintenance times during which no operations can be scheduled, for example.

Earliest start date and end date
With the display of the calculated earliest start and end times, it is easier to see what kind of leeway there is in planning.

Production orders and projects
Individual orders and groupings of higher-level projects can be displayed.

Filtered view for orders
The filtered view reduces the planning board to the selected order showing all operations.

Operations
Like orders, operations can be displayed in the planning board, rearranged if necessary, and a new production plan created.

Setup activities
This display differentiates between tool fitting and dismantling.

Preparation and wait times
Preparation times between operations can be displayed as well as subsequent wait times, which can also be assigned to the machines according to the work plans.

Visualization

Function overview

Machines/work stations, outsourced manufacturers, tools, and limited resources
The display in the planning board can be used to change the type of manufacturing, for example.

Personnel and employee qualifications
Employees and the respective qualification requirements can additionally be shown in the planning board.

Resource utilization
For each type of resource there is a utilization chart, a table overview, and a usage report, which shows the average usage of a resource or resource group for different time intervals.

Material stock
Current and future stock levels can be visualized.

Dependencies
In the planning board, it is possible to open the dependencies view for various objects (orders, operations, etc.), which also shows all the orders, withdrawal of material, additional purchases, and collaborations that are mutually dependent on each other.

Order status/order progress
Color coding according to the current status, i.e. planned, released, started, paused, interrupted, or completed. For orders that have been started, it is possible to use production data collection to display current quantities and a progress bar showing the percentage and/or time.

Delays and end date
Delayed operations and end date limits can be highlighted in the planning board.

Priorities of operations and orders
The components can be highlighted according to priorities.

Procurement/additional purchases
This view shows when the additional purchases recommended by L-mobile APS's own MRP or those accepted by the planner will be available in production.

Object link to Infor:COM
When L-mobile APS is integrated with Infor:COM, the objects in Infor:COM can be opened via the Infor object link.

Optimization

L-mobile APS offers two methods of optimization designed to support manual planning. The first is one-click optimization based on heuristics and the other is AI optimization, which uses artificial intelligence. Either way, the end result is a valid production plan, i.e. one that has been determined taking all known dependencies and constraints into consideration.

The user is able to obtain a valid plan due to the option of limiting the run time for AI optimization and of canceling the process at any time. The optimizer has an evaluation function and a range of optimization strategies, which are aimed at reducing manufactur-

ing costs. There are various predefined optimization procedures and there is also the option to save your own.

Current planning goals can be specified in the optimization dialog using sliders and can be reproduced. A detailed cost analysis is performed during optimization, and this is shown.

Multidimensional AI optimization also makes it possible to shorten the run time by using all available CPU cores.

Function overview

Heuristic one-click optimization for:
- The scheduling of sales orders or production orders
- The prioritization of sales orders or production orders
- Machine utilization
- Manually created planning

Definition of similar operations
This makes it possible to group similar operations during optimization according to predefined aspects in order to avoid setup activities.

Optimization based on end dates for warehouse goods
Optimization can be performed based on end dates for warehouse goods, i.e. differentiating between sales orders and warehouse orders.

Generic algorithm
Algorithm for optimization of the lead time, lowest production costs, and highest capacity load.

Reduction of setup costs and throughput times for production orders.

Intelligent splitting of orders/operations to reduce throughput times:
- Parallelization
- Parallelization and expediting partial quantities for

earlier completion (e.g. for partial delivery, when material availability is limited, etc.)

Other functions:
- Increased machine utilization

- Reduction of transition times and gaps or free buffers between operations

- Prevention of missed deadlines

- Reduction of missed deadlines

- Reduction of warehouse stock and costs

- Reduction of stock

- Optimal assignment of personnel

- Prioritized machine assignment
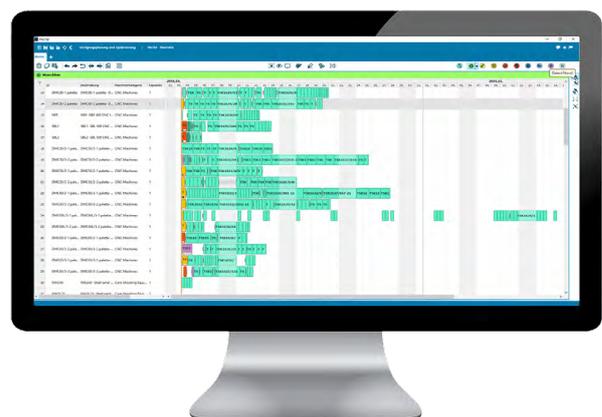
ERP interface

The calculated data can be adjusted manually and transferred back to the ERP system. L-mobile APS runs in the memory, utilizes all available CPU cores on the respective work station (PC), and uses pdb files for database storage.

The data generated in both systems is processed via the interface to the ERP system, and this is also used to control exchange. The use of a general input data format makes it possible to communicate with almost any ERP system.

Data export/import in pdb files used as a temporary storage medium also makes it easy to run simulations during planning. So it is also possible to work in several different pdb files (databases) in parallel and then save the differences back to the base PDB file as the valid plan.

System architecture

L-mobile APS can be operated in stand-alone mode, where there is just one user. In this case, the server and the client can run on the same PC. This is recommended in the test phase and for demos. Stand-alone mode must be set up in the ini files.

For production, the use of a client-server architecture is recommended. In this mode, L-mobile APS must be run on a computer. The server communicates with the message broker and writes data to or reads

data from the pdb file. The L-mobile APS server uses Apache and Qpid broker. The broker creates the interface between clients, the L-mobile APS server, and the interface to the ERP system. The data is uploaded from the ERP database via the interface, synchronized with L-mobile APS, and stored back to the leading ERP system.

L-mobile APS

ERP

Data retrieval →

← Posting

L-mobile APS
server & connector
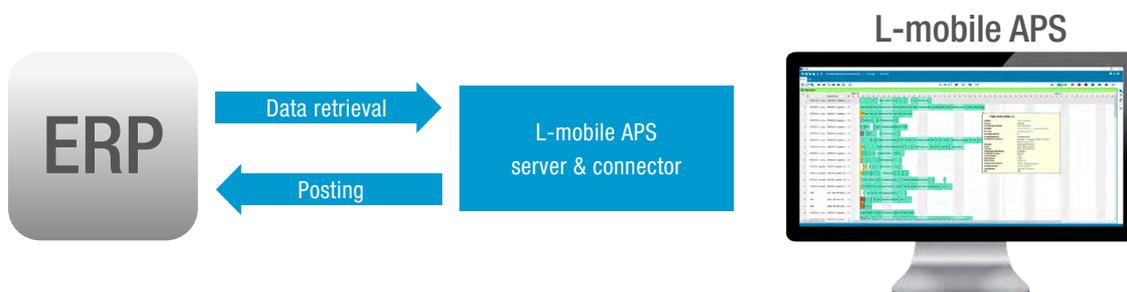
Figure 2: L-mobile APS system structure

www.l-mobile.com/aps