UNIPLAN/PDS—Synchronous Production Model for Contemporary Flow Manufacturing Production Demand System

The UniPlan/Production Demand System makes a synthetic line out of the whole manufacturing process so that the manufacture of an end-item can be followed as though it is part of a well synchronized production line. To accomplish this, the system requires a complete description of the various actions required from receiving through fabrication and assembly, including check points for quality control, including tolerance checks, tolerance stacks, machine tool degradation, part and subsystem performance tests, as well as the process plan. Of course, the manufacturing system under this method is quite different from traditional MRP systems, and does not require either the work order system or the complex routing systems presently used. This method does require synchronous, or approximately synchronous, production which is achieved by development of work increments at work stations which may contain multiple machine operations, or multiple assembly operations, aimed at equal time step increments in moving the item towards completion and shipping.

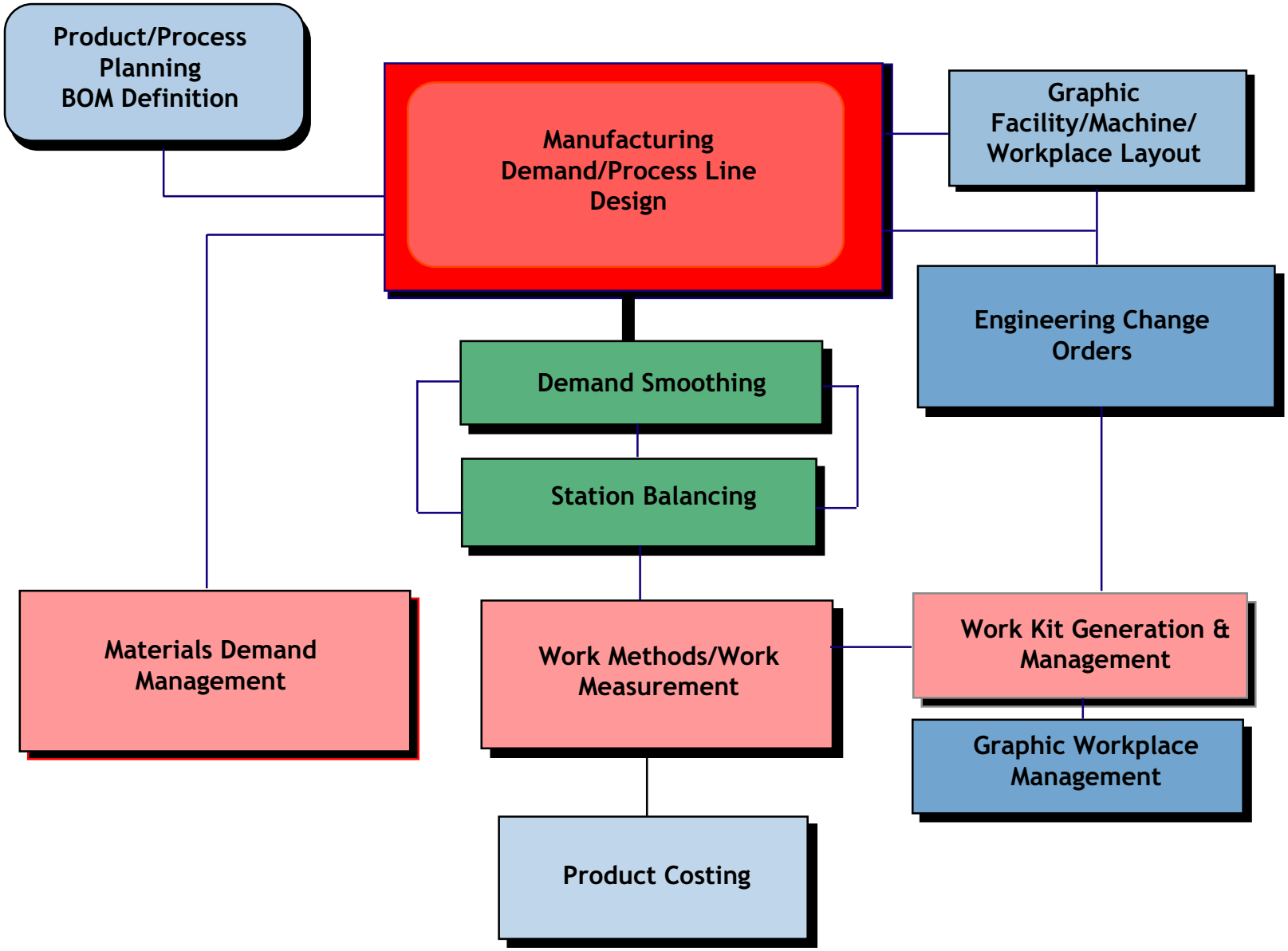
The advantages of this system are: the rapid response to changes in demand; the simplicity of flow patterns across the facility; the simplicity of movement following the process; and the complete separation of manufacturing of the product from support services.

Manufacturing quality checks now become part of the in-line process and therefore do not require special routing, flow directions, temporary movement, or storage.

MI System's MCIE III PLUS with UnivEl, with its UniCAD graphic work station capability, combined with UniPlan, together with special PDS algorithms embedded in the MCIE Series gives you a contemporary alternative to traditional MRP which will save you: production costs; facility space; documentation time; process time; improved quality; and flexibility in the development of your products. Key to all of this is the accuracy of our UnivEl work time generator. It is important to the rapid smoothing of the synthetic lines designed for PDS that one has accurate estimates of work time at each work station. Most PDS systems use standard data which is only good to 20-30%, whereas UnivEl is accurate to 5%. With these other systems, work smoothing, or line balancing is much more difficult and requires more additional test cycles to obtain a smooth flow of production. This single aspect of PDS with UnivEl versus other products gives our users the competitive edge.

Plus, our prices with SmartStart are better than any available on the market.

MCIE-UniPlan/PDS© System



Use of the MCIE Systems for CIM/JIT, PDS Applications

Several important elements are necessary to have a competitive manufacturing environment. Typically, it is thought that MRP II gives the user the capability to respond to sales requirements in a timely manner while maintaining a minimum of inventory and work in process. Unfortunately, MRP II by its nature, does not include the problems of varying capacity. Shop floor problems which may result in temporary loss of capacity or improper simulation of flow of work or process changes can result in MRP II planning which is inaccurate and not responsive to the fluctuations in sales. Plus, work orders and complex routings, along with WIP add to the production complexity.

Basically, MRP II assumes infinite capacity in that capacity fluctuations are not a part of the back scheduling portion of resource planning. In addition, MRP II does not address changes in quality during production due to degradation of machines or the effect of using variable lot sizes to address sales fluctuations as they affect production levels. MRP II is a Batch method of production.

Therefore, in order to meet the needs of production which will fluctuate because of response of sales it is necessary to bring several planning and control tools into the this dynamic environment. These tools include modifications to the production process which are practical only in a CIM/JIT environment. **The MCIE software, in combination with UniPlan production synchronization techniques and KanBan type material management, supplies the necessary computerized environment for these production methods. The following are essential to competitive manufacturing:**

1. **Process Planning** which is computerized and rapidly responds to changes in the manufacture of the product or the flow of work required to produce the product.

2. **Statistical Process Control (SPC)** which prevents large waste through production of unacceptable parts.

3. **Just-In-Time** which, through Simplified Synchronous Production (SSP), uses process planning, statistical Process control and Automated Maintenance together with small lot size to maintain responsive planning for variations in sales order levels and diversity.

4. **Computerized or Automated Maintenance** is an essential part of this upgrade program. It is necessary to use both SPC in combination with a solid maintenance program to maintain both the tools and machines in the best condition.

Simplified Synchronous Production, when used as part of the control over the manufacture of parts at the individual workstation requires that manufacture of the product through the work line be accomplished in equal increments of time. The objective of SSP is to match production rates as closely as possible to the actual rate of sales. SSP can only be accomplished as lot sizes are reduced to minimal levels with frequent changeovers to meet final production schedules. The existing "batch" production approach used by many manufacturers today precludes SSP by its very nature. It takes longer to produce larger batches before the next operation and when mistakes are made in production or machine or tool degradation is not caught in time, big batches mean big mistakes. Also, if work-in-process follows a

batch scheme, versus the process plan, management of WIP, by palletizing systems and AGV hardware builds into the product price unneeded costs of inventory management.

Setup time reduction is essential to good production management. When used in combination with small lot sizes for maximum responsiveness to sales requirements, efficient setup is crucial.

Flow of work must be in such a way as to allow minimal materials or WIP handling. Work cells or work centers must reflect the need for congruency with the process plan and therefore continuous facility layout analysis must be integrated into the production picture.

Uniform Work Loading is an integral part of good production practice in a CIM/JIT environment. Uniform work loading means matching the cycle times for individual operations within the production routing, so that production occurs as though to a drum beat. In each time unit, material moves simultaneously between work centers. In this manner WIP inventory levels are minimized and throughput is improved. To accomplish uniform work loading, one must be able to accurately simulate production at the individual elemental processing level and be able to simulate accurately, changes in flow of work, use of multiple machines, work cells, synthetic work lines and changes in the facility layout to accommodate the need for uniform loading. This means an integration of potential routings, schedule effects, proper use of bottleneck machines and availability of purchased materials and WIP in the production plan.

Assembly Line Uniform Work Loading where applicable and integration of inspection and test stations into the lot size strategy and maintenance programs is another essential part of this program.

This approach is made possible by an integration of our CIM/JIT, graphics driven software, which integrates shop floor management with scheduling in combination with our UniPlan software and real time shop floor reporting. Our approach is accomplished a small piece at a time. We recommend a phased program, starting with a dedicated synthetic line for some part of the manufacturing floor which contains either fabrication or assembly and which could be dedicated to an initiation of the process in the plant without jeopardizing any major portion of the activities and within which operational problems can be removed in preparation for application to the full manufacturing enterprise.

Flow Production Line System

Our software is unique in its CIM/JIT capabilities. Our software integrates engineering function with JIT, shop floor planning and control Materials management and SSP. All information is generated in one consistent data base. Information is generated from the bottom-up, through the engineering system, generating detailed manufacturing information that is realistic and accurate, down to the individual shop floor work element. Every work station has included in it all constraints imposed for fabrication and assembly while producing a balance of time required at each station.

Because our software integrates engineering with the Synchronous Production Planning and Control software, the difficulties of manual inputs requiring manufacturing information that must be manually synthesized in other software systems, is not required by our CIM software. The input to the PDS software is automatically generated by our engineering and manufacturing planning and control software and resides in the integrated CIM data base.

Accurate simulation of What-If plans is included as part of the PDS software system capability. Plans for a new product can easily include modifications to processes, machines and facilities, as well as inventory modifications, financial changes, indirect activities and materials and labor requirements.

Our UniPlan/PDS software allows the engineer to bring to the screen the new parts, new facilities and modifications and the software will automatically generate all the manufacturing requirements, down to the individual work element and compute new product manufacturing cost, facility costs, new tooling, materials and machine process costs, work station production elements, production rates, and more. This type of integrated engineering, planning and control is unexcelled in its ability to reduce planning, costs and lead times, response to sales orders, reduction of non-value adding operations and increase the manufacturers ability to compete.

The software does not require the conventional separate engineering bill-of-material, which must be converted to manufacturing configurations and manufacturing routings in multiple forms. Once the product and process plan are complete, the software automatically generates all manufacturing information required to build the product. There is no need for work orders or complex materials resource planning. It is all done through the development of "synthetic lines" which control the synchronous movement of parts and subassemblies through the plant.

Line Balancing. Our full line balancing system, UNIPLAN, is available on PC's, in NT. This downsized mainframe version includes provisions for utilizing a mixed-model balance, and the system processes a line balance in a few seconds. For example, a mixed model balance with 12 models and 12 different schedules produces a 300 page output report complete with multi-model precedence, and a 100 page Operator Detail report, detailing the work, materials and tools at each station, in a matter of seconds, making analysis of alternatives a snap!

The new MCIE-UniPlan/PDS system lets the user develop new workplace and workstation layouts graphically. Each graphic work station on-screen drawing has embedded in it all of the work methods used at that station. The work station geometry can be changed on-screen by moving objects within the work area and the system automatically produces new methods reports and generates new times and costs of production at that station. This system lets the engineer design synthetic lines for development of JIT production configurations quickly and simply. The development of JIT manufacturing layouts and protocols requires a multi-disciplinary approach, which includes optimizing work methods, synchronizing production stations and

following process plans with production stations which follow the process. The design steps are as follows:

1. Develop the basic process plan for the part. This step requires design of the part and the definition of a set of processes which complete the manufacture of the part. These steps should include indirect as well as direct steps.

2. Develop the workstation geometry for each process step. Each workstation will be designed to complete one or more of the process steps. The workstation may be a machine or multiple machines or a work cell.

3. Combine process steps to make a uniform synchronous flow across the production line. In order to have synchronous production, it may be necessary to combine process steps so that as work is transferred from one station to the next it is done in the same time increments or synchronously with other workstation production rates. Combining process steps may suggest the use of multiple machines at one work station, or multiprocess machines or workcells. This design process will make optimum use of our UniCAD system in that work methods and workstation geometry work together to affect the production process time and cost at the production location under design consideration.

4. Arrange layout to produce streamlined flow of work across the process steps. The plant floor layout needs to be configured to produce minimal extraneous movement of the part through the plant. The processes required to manufacture the end-item must set the plan for the layout of the machines and assembly lines. Manufacturing time and costs for non-flow manufacturing are strongly affected by transport, storage, indirect and queueing times. The best design for the shop floor layout is to have a synthetic line that reflects the process steps and maintains work stations which are in line with the build direction of the process. As much as possible, the plant layout should reflect the general direction of the processes involved for the mix of products produced so as to minimize move times, temporary storage and WIP.

5. Include all performance and quality tests at the appropriate stations along the process path. Include tolerance tests and tolerance stacking requirements as well as machine tool quality tests where appropriate along the line. Testing of any type required to maintain production quality should be done inline, at appropriate station locations, so that flow is not interrupted by temporary storage at special testing sites.

6. Accomplish Line balance for Synthetic Production Lines for a Mixed-Model. UniPlan will give the user a line balance for any specified production rate, including manning requirements and specifics of work associated with each work station along the line. This balance is accomplished for any mix of models to be produced on the production line. Graphic work descriptions together with pictures of the product components worked on at each station before and after work is completed is included for each station.

7. Rework Line balance to assure a smoothing of production through uniform loading. This is accomplished with our UniPlan system and UniCAD, working together to allow movement of individual work elements so as to produce uniform station times.

8. Modify work procedures as needed to produce desired production parameters and repeat steps l through 7 as necessary.

9. Initiate KanBan procedures to maintain sufficient, but not excessive production materials replenishment and control.

Highlights of MCIE-UniPlan/PDS

The flow system contains six major modules, which include:

1. A complete Production Synthetic Line Planning and Control System.

2. A Demand smoothing system.

3. A complete Methods and work generation system, including generation of work times, English language instructions, graphic layout driven work analysis and methods description.

4. An engineering change system which produces new flow requirements based on engineering changes.

5. A complete Product costing system.

6. A KanBan Materials Management system.

All modules exist in one CIM system, fully integrated and maintained. Through one consistent database for all flow production modules. In addition, UniPlan/PDS contains two other databases, a What-If database for ease of analysis of engineering changes without going public to the network until plans are approved and an archival database for maintaining a secure historic database which is read-only for maintaining the integrity of previously generated data. The archival database is especially important during changeover to a flow system with new operating requirements to minimize contamination of the database during startup activities.

Features

- Establishes practical station partitions for production of products.

- Designs production lines for rolling schedules and responds quickly to changes in order quantities.

- Manages families of production events; maintains unique tasks to a specific product while maintaining common tasks to the family SOE.

- Defines production synchronizations quickly and easily.

- Identifies non-value-added work, setups, jigs and fixture operations, moves, queue times, storage activities and quality check procedures. Maintains separation of non-value-added work and direct production activities for ease in planning and control.

- Produces on-screen management of operational work descriptions and modifications of work, including same-as, except type changes.

- Work methods system includes automated work modification capabilities, including graphic work station changes and work coupled production activities tied to methods generation and work kit generation, including process/work station information and methods descriptions for each work station, including work kits which contain tools, materials, a picture of the part or subassembly before and after each work element process.

- Production Synthetic Line analysis includes productions rates for manning levels, or manning levels for specific production rate goals, work station SOE what-if analysis for

use in developing line station activities and machine, tool and material descriptions as well as method descriptions and work constraints for each station.

- Performs sophisticated mixed-model production synthetic line design and "what-it" scenarios.

- Designs mixed-model production synthetic lines with special attention to various production results including scrap and rework, as well as optional product processes.

- Defines manloading on lines and other resource requirements based on production line rates and mix changes.

- Calculates total product cycle times while including ergonomically safe rates and work repetition rates.

- Orders and specific line items can be accepted onto the line for production including locations on feeder lines, changes in production rates, move times, quality checks, changes in model mix, changes in replenishment requirements, inventory impacts, etc.

- Master flow programs track inventory movement, inventory dynamics related to production rates and orders including returns and other transactions.

- Activity histories and highlights are available on-screen, including receipts, moves, adjustments, shipments, returns, recorded by date, time and activity type, including backflushes to order, to scrap, to purchase order, to raw supplies.

- Returns to suppliers are maintained by means of on-screen databases which include order numbers, item numbers, production line areas or feeder areas, accounts involved and the status of the return activity process.

- The system uses on-screen forms for shipment, including direct print backups for shipping records. Shipping forms include the shipment to intermediate stations such as docks, temporary storage, finished goods warehouse and transport facilities.

Materials Management and Replenishment using KanBan

KanBan activity is shown via on-screen reports which include KanBan activities on an hourly basis, tickets issued by the product and subassembly, KanBan replenishment activity demands including pulls to various production sites by stations, feeder lines and main lines, order flags, order requirements, supplier purchase orders and replenishment dates and quantities.

KanBan tickets or flags can be applied to a particular location or a station on a feeder line or main line. Locations may include resupply points on the production line, stores locations or supplier locations. KanBan methods allow a pull of material on demand during production activities while maintaining the flexibility to accommodate mixed-model flow lines or changes in work station activities or SOE component activities at various production stations in fixed locations, feeder lines and main lines, for a product mix.

Highlights

- Integrates material management with mixed-model flow lines and Bills of Materials
- Manages an integrated mixed-model KanBan system which ties replenishment to production of items out of the production facility to storage and shipment.
- Sizes KanBan capacity using order requirements on a daily or component work time.
- Contains resize filters for changes in demand, flow fences, rolling requirements, order fluctuations,
- Handles multi-card and non-replenishable KanBans.
- Uses KanBan pulls from backflush to receiving and supplier location.
- Contains automatic triggers for resizing and non-replenishment KanBans.
- Integrates effect of Engineering Change Orders on Production Lines, station design and materials requirements.
- Supports bar codes, mixed product lines.
- Pull requirements are defined by component, part, subassembly and assembly as well as end-items, Pull requirements can be defined by part family, product groups, group relationships and other sorting criteria.

Inventory Transactions

- Inventory transactions are integrated with the ERP or MRP II system available.
- Inventory applications include inventory history, supplier history, supplier performance, replenishment times, account history.
- Inventory user transactions include use history, credit record,