

An On-Line Interactive Shop Floor Control and Capacity Planning System

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Production Management/3000, the newest HP Manufacturer's Productivity Network Application Product, was announced in the summer of 1981 with first installations in the fall of 1981. Production Management/3000 is an interactive application system for managing the production planning and control functions of a manufacturing operation.

This paper describes the major functions of the product, the contributions of the product, and the actual experiences at several test sites as the users integrated interactive shop floor control into their daily operations. The paper explains the uniqueness of the product, and the potential productivity gains which are inherent in the effective utilization of the product.

The challenges of managing production are very familiar to production managers (Slide 1). The efficient use of available resources to meet production requirements at the lowest total cost is a key to successful production management. HP's goal was to produce an interactive application system to manage production planning and control.

The process of improving manufacturing productivity through the effective management of production resources can be viewed as a cycle of causes and effects as illustrated (Slide 2). In the past, one of the major obstacles to successful management was getting timely information on inventories, work-in-process, and capacity requirements.

The six functional modules of Production Management/3000 are routings and workcenters, work order scheduling, work order tracking, shop floor dispatching, work-in-process, and capacity requirements planning. The environment best suited for Production Management/3000 is a manufacturer with workorders for fixed quantities of specific products with individual start or completion dates (Slide 3).

Data collection on the shop floor is available via the standard terminals, or through the factory data capture terminals (Slide 4). These special terminals are suited to users who are unfamiliar with computers or typing; they utilize a set of pre-defined functions keys and prompting lights to assist users with each transaction. The factory data capture terminals can be equipped with bar-code reading wands, badges, punched cards, or magnetic

card readers in order to streamline certain types of data entry on the shop floor.

Production Management/3000 also features a customizable user interface, with features similar to those offered in Materials Management/3000. (Slide 5). The user is able to customize data, screens, reports, security, system values, "help messages," and processing specifications, without programming. Customization offers the user increased flexibility, shorter implementation time, and a lower maintenance burden.

These features highlight a brief summary of the functional capability of Production Management/3000. Let us now examine the ways in which this application tool can be used on the shop floor.

The physical appearances and layouts of discrete manufacturing shop floors varies widely, but the functional requirements are similar. The discrete environment is characterized by the workcenter; a typical example is shown in this picture (Slide 6). In this environment, the work is dispatched to a workcenter, the specified tasks are performed, and the work moves to the next assigned workcenter. Production Management/3000 has sophisticated scheduling capabilities, but they are not discussed in this paper. The point to be noted here is that the workcenter manager can review the work-in-process, priorities, status, etc. The workcenter manager can also track the work completed, rework, scrap, exceptions, labor data, and routing lists. In other words, the manager has an on-line system which eliminates the need for most written reports, although printed reports are available, if desired. Our test sites have now learned to check the terminal in order to resolve all questions regarding work-in-process, as well as scheduled work. They have also learned to quickly scan status information to look for potential trouble spots.

In a typical installation, every workcenter could have a CRT, plus one or more factory data collection units. It should be noted that the system can be run entirely with CRTs, but the factory data collection units offer specialized features which make them attractive in many situations. Work order tracking would typically involve one or more data collection stations at each workcenter (Slide 7); a workcenter is composed of one or more workstations. The idea here is to allow the

employees to record work completion, labor, and status information. Our experience has been that one data collection station typically can support 15-25 employees, although there are exceptions where factors such as distance must be considered. The key point is to place the data collection stations where they are easy to reach. In those instances where employees have expressed discontent, it has almost always been resolved by moving a station closer to the employee, or adding another station.

Employee training is the key to acceptance of the system and the data collection concept. The best technique for training the shop floor employees is to conduct the training in small groups of 3 or 4. This gives each person a chance to ask questions, to try the terminal or data collection unit, and to understand what is really happening. Large training labs usually result in one or two self appointed leaders doing all of the terminal operation, while the others stand back and watch. Our original estimates of training were not enough; we have worked with our test sites in developing training to a point where it is most effective.

The workcenter managers pose a slightly different training problem. Many of them have been doing very good work for years, and they are somewhat resistant to change. Why fix it if it works? The managers are often quick to change their position as they come to realize that this on-line tool can really improve their productivity. In many cases they become ardent converts who then sing the praises of the system.

Here is where the realization of the uniqueness of this application becomes apparent. The manager can now see exactly what happened during the shift that just ended. If action is required, it can be taken in time to be effective. If a problem is developing today which will affect final assembly areas next week, the managers know about it now. The manager can also use capacity planning to determine potential trouble spots ahead of time. He can know that his workcenter faces a demand that is 150% of capacity four weeks from now. In the past the manager was not able to see this potential over-capacity problem. The first time the capacity report is available, the capacity problem may come as a shock. The manager's initial reaction is not to know what to do; however, the manager soon learns to modify his managerial skills to react to situations now, rather than being forced to wait until the problem has reached epidemic proportions. When the system is first installed, the managers have mixed reactions. As the system has had six to twelve weeks of operation, they become highly favorable. At the end of this period, they begin to wonder how they managed to operate the old way (Slide 8). The ability to know what is going on at all times and modify the course of events before things go wrong allows a degree of fine tuning which appeals to the skilled manager.

This degree of success requires that everyone uses the system. Our test sites have reported up to 98% ac-

curacy in all shop floor transactions. This very high degree of accuracy allows management to use the system with the highest degree of confidence. The system is currently running in environments ranging from single shift to three shifts in production around the clock.

One of the best ways to improve productivity on the shop floor is through the use of capacity requirements planning. (Slide 9) The bottom line of the manufacturing productivity equation is the full utilization of assets without the need for idle equipment and inventory. Capacity planning permits the evaluation of the production plan before material and other resources are committed to production. In this way capacity planning allows you to smooth the production plan. The ability to track production on the shop floor allows management to ensure that day to day operations are following the capacity plan.

Prior to this time one of the ways in which to ensure a constant flow of product seemed to be to "flood" workorders into the front end of the system, in hopes that sufficient production would result. The excess of workorders could result in complications which were worse than the cure which was intended. (Slide 10) Production Management/3000 uses both open work orders and suggested work orders (from Materials Management/3000, or some other system) in the capacity plan. This results in a projection of workload over time for each workstation. An analysis of this load profile allows management to focus attention on potential trouble spots.

As we mentioned earlier, our experience with test sites has been that capacity planning has opened a whole new vista of planning. The first reaction is to assume that perhaps the application is simply furnishing data which outlines some potential trouble that might never occur. But the users quickly come to believe that the predicted will indeed become reality, if they do not take action. They have also come to understand that monitoring of day to day operations, and comparing them to the plan, is essential in order to keep production flowing smoothly.

Production Management/3000 can be run with Materials Management/3000, or it can be run standalone with orders entered from an external system. (Slide 11) Our test sites are running the product in both modes. The only difference that we have noted here is that those users who already have Materials Management find it quite easy to implement Production Management as they are used to the screen formats, customization, monitor, and the other features of the system. In any event, the training requirements for the shop floor personnel remain the same, as Materials Management does not use factory data collection units on the shop floor.

We have briefly discussed customization earlier in this paper. Customization is a major technological contribution which cannot be given the recognition it deserves in this paper. However, it should be noted that our approach in Production Management/3000 was to

put all of the product features in, and let the users remove those features which they did not require (Slide 12). This is evident in the screens as all of the features of the product are addressed. Out test sites have been pleased with this approach, and they find it easier to tailor existing screens to their needs, than to try and put in numerous additional functions. The editing has been done by the users running the customizer, and the process does not require computer specialists.

The same situation has been experienced in operations, where persons with a minimum of computer experience have been able to operate the system. In fact, one of the test site operators has become skilled in using Query to generate additional reports as needed.

In general, the test sites were pleased to discover that their own non-EDP type manufacturing personnel could learn to use the system quite easily.

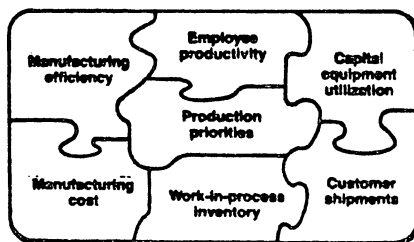
When Production Management/3000 was in the design stages, we knew that we were developing a major new product which should make a significant contribution. What we did not realize was the discrepancy between the environment of many shop floors and the solution which we were inventing. Many of the existing systems are batch oriented with reports appearing long after there is any time to do anything about it. In fact, workcenter managers have developed their own survival techniques for this environment which include banking some of the punched cards during good weeks for submission at a later date during a bad week. The concept of having all production information on-line, and updated at all times, comes as a bit of a shock. (Slide 13) The managers quickly discover that the new environment works to their advantage, but this conversion is

complete only after the system has been in place for a month or two.

Another area of surprise comes when the routings and workcenters are being entered into the system. At this point the managers take a look at their operation and discover that in some cases it is far from efficient. One example is where the transit time between two workcenters greatly exceeds the actual time in the workcenter. The managers are tempted to change their shop floor based upon these initial insights into potential inefficiencies. Our advice to the users as been to go ahead and implement the application based upon the present shop floor, rather than try to correct things now. After all, production as been working, and too many changes all at once could complicate matters beyond repair. Better to get the application up and running, make a detailed study of all of operation based upon data gathered by the system, and then make improvements.

Production Management/3000 can be used to solve a variety of problems. The potential offered by customization gives great flexibility to the product. The localization of the product into many foreign languages expands the potential even further. Our initial experiences with test sites have indicated great satisfaction with the functionality of the product, and a wide variety of benefits which have resulted from its implementation. As the number of installations grows, the users will develop the expertise which will enable them to gain the greatest benefits. (Slide 14) We have seen the awareness of the potential of this new application begin to emerge, and we are anxious to work with the users to bring the product to its full potential.

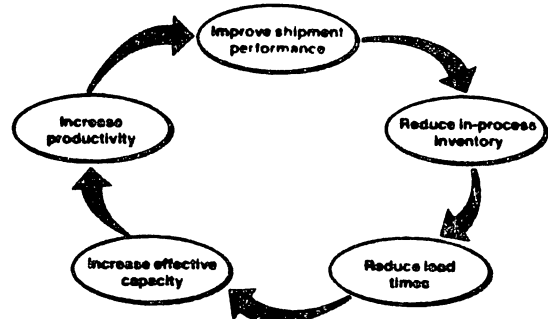
The Challenges of Managing Production



Balance Production Issues to Increase Manufacturing Productivity

Slide 1

Production Planning and Control Helps



Slide 2

Production Management/3000

Schedules, tracks, and plans capacity using

workorders
for
fixed quantities
of
specific products
with
individual start or completion dates

Slide 3

Factory Data Capture Terminals

- Easy to use
- Desktop or wall mounted
- Multi-media Input
- Alphabetic keyboard layout
- Prompting lights
- Function keys



Integrated Factory Data Collection

Slide 4

Customizable User Interface

Modify HP Manufacturing Systems

- Customize data base
- Customize data entry and retrieval screens
- Customize reports
- Customize data and device security
- Customize system values
- Customize "Help" messages
- Customize processing specifications

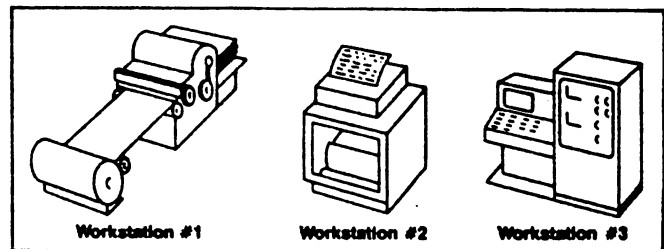
... without programming

Slide 5

Routings and Workcenters

Flexible two level facility definition

WORKCENTER

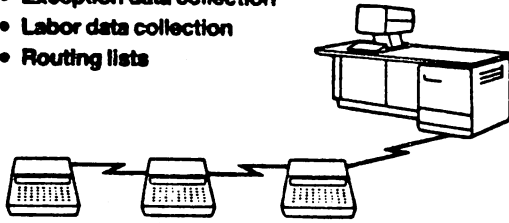


Match your equipment layout AND your organization

Slide 6

Work Order Tracking

- On-line sequence completion reporting
- Rework and scrap data collection
- Exception data collection
- Labor data collection
- Routing lists



Accurate shop status is available at all times

Slide 7

Work-In-Process Control

- Evaluate manufacturing performance
- Analyze shop status
- Fine tune the production plan

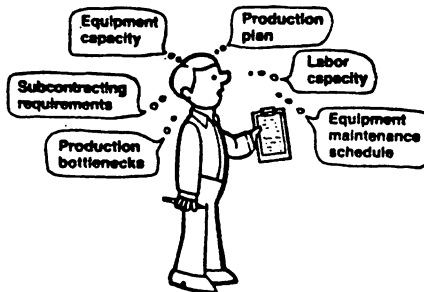


Balance Production Issues
to Increase Manufacturing Productivity

Slide 8

Capacity Requirements Planning

Helps you evaluate the production plan

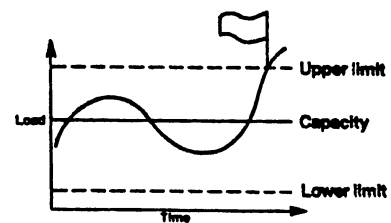


Realistic Production Schedules

Slide 9

Capacity Requirements Planning

- Workstation load profiles
- Alternate load measures
- Exception reporting
- Workcenter labor summary

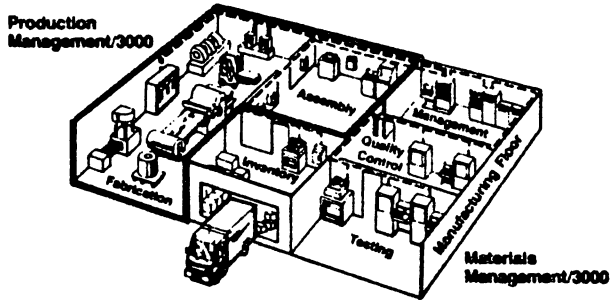


Predict Labor and Equipment Requirements

Slide 10

Production Management/3000

Completes the Manufacturing Planning & Control Cycle

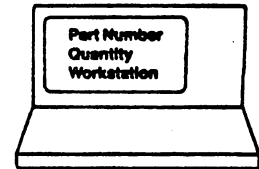


Slide 11

Customize Screens

Users can ...

- Change existing screens
- Design new screens
- Change sequence of screens

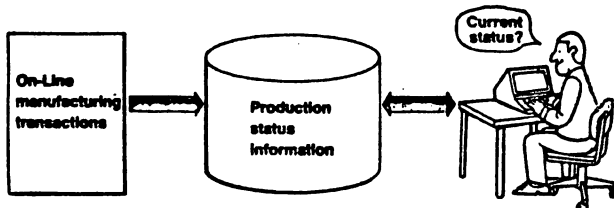


...with HP Manufacturing Systems

Slide 12

Manufacturing Information is Timely and Accessible

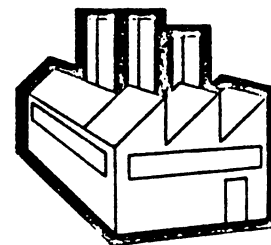
- On-line entry
- On-line data base update
- On-line information retrieval



Make Decisions with Most Current Information

Slide 13

HP Manufacturing Systems



Interactive Application Products to
Increase the Productivity of Manufacturers

Slide 14