Many of you know me as one who likes toys and that at each of these meetings I bring a toy. This time I brought a new toy and a new system. The new toy is the large screen video system that you have seen in use during these sessions. This vid o system is used at Boeing as a training aid and as a "show and tell" service for visiting firemen who come to see the system which I will present shortly. We will soon place the large screen system in our management information center as a management display tool.

The large screen display system consists of an adds envoy, a portable 5" CRT that has composite vidio output under the RS170 spec, and a videobeam projector. The videobeam projector is a color TV set that projects onto a 4' x 6' screen and has connections for a TV tape recorder. It is sold to taverne and to the guy who has nothing else to do with $4000 than buy one of these for his living room. We did have one problem with the thing. It is designed to work as a TV and not as a terminal. Therefore, it is setup with overscan rather than under scan as is found on computer terminals. The solution was for us to realign the videobeam. No small task as it is really three TV sets. One for each color, red, green and blue. We also had to go in and remove one circuit card and bypass the card as it buggers up the whole image when data is displayed.

We made one other modification this one to the terminal. Our presentations work off carriage return, so we added a remote carrage return key.

Now to talk about the system we developed at the Electronic Support Division of the Boeing Aerospace Company in Seattle. On screen you see an agenda for this presentation.

Let us look at the corporate structure of the Boeing companies. All of the Boeing are wholly owned by the Boeing Company. As is the company I work for, the Boeing Aerospace Company. Some of the other companies are the Boeing Commercial Airplane Company, Vertol, Boeing Computer Services, and others. The Commercial Airplane Company manufactures 747's, 707's, 737's, and our most popular airplane the 727

which we are currently producing one every other day. The Electronic Support Division, ESD, supplies electronic systems for these airplanes. The Commercial Airplane Company is our largest customer at ESD. Another item of interest is that we are a customer to BCS and BCG is a customer of ours. The Electronic Support Division of the Boeing Aerospace Company is the location we developed and installed our manufacturing system. ESD produces electronics packages for its own products and for other Boeing companies.

Now for a brief description of our hardware configuration. Our HP3000 is a CX which we use very heavily in a multi-user environment. We have a 7905 swapping disc, 3 ISS 47.5 mbyte data discs, two 1600 BPI tape drives, a 200 LPM printer, and two 16 line terminal controllers with 30 lines connected. Seven of those lines are dial-up and the others are hardwired.

We built our system around certain philosophical ideas. The system must be online as much as possible and any data input will be edited online in every way possible. Data entry is not just that, but includes edits for known spelling, usage in the present context, etc. We want to tell the person at the terminal about the error right then, not some time latter, because at the moment of input that person can usually correct the error. If we cannot correct the error we do not want the input until he knows the correct input. Our idea is to check a partnumber for accuracy at the moment of input, and not after a screen is filled. You have wasted the time inputting the balance of information.

In designing the system, we started with detail flow charts and then started programming in fortran. The PMS system is a heavy user of image with some direct access files.

Now to the modules that comprise the production management system. The first module is a master schedule. The schedule that shows when we will deliver those part numbers or assemblies that are known as end items, or they might even be purchased parts in the case of spares. The master schedule lists only the part numbers we are going to ship and the shipment date. No schedule file is maintained on sub-pieces.

This is handled by MRP.

The bill-of-material module contains that information relative to making an assembly. Nothing extra. It is basically what I call a pear tree. A record consists of the assembly part number, the component part number, and how many of that component is used on that assembly. We get into such things as assembly notes; but for the interest here I will not go into those items.

The inventory control module maintains such things as store bin location, quantity on hand, reserved quantitites, lead time, min, max, pansize, and all such buzz words.

Shop order control comes into play at the time a shop order is ready to be released. Shop orders are automically released unless there is a shortage of parts for that order. If there is a shortage then our production control group must decide whether to wait for the parts to arrive or start the order short those parts. The classic example is the knobs on the TV set.

Purchase order control. Here we keep track of the purchase orders we have requested. Their schedule, and the status of the purchase order for expidite action when necessary.

Material requirements planning. We use a regenerative MRP. A little later we will display in detail what happens in MRP. Basically, MRP combines the bills-of-material and the master schedule resulting in recommended schedules for all sub-assemblies and purchased parts on the way to developing schedules MRP will first consider inventory on hand and then combine orders to make economic order quantities.

Applied job routing and standards provides for the job flow and the information required for performance measurement.

Now let's look at MRP and what it really does. I was saying it works with an assembly and here we have assembly A. It consists of Parts C, B, and K, as you see on the screen. We will keep the definition of the assembly up in the corner for reference. Up in the right hand corner you will notice a schedule for one unit of assembly A as marked by the 'V'. So we know we must have an assembly available by

that point in time. And, of course, with reorder lead time we have to look forward and plan to have that order released at that point. Next, we have to plant parts to go on that assembly. Some of the parts are make and some are buy. Again we ask is the supply sufficient to satisfy demand? If not, we have to plan and order for those parts. Some are assemblies, and we go out and plan orders for their subparts, and on down the tree.

Now, that is basically what MRP does. It looks through the bill of material and plans all the orders needed to make the end item for the original demand. Of course, there are usually multiple demands spread through time. MRP must consider all of those demands and apply order rules to combine orders when applicable.

The system is image data base oriented and contains three image data bases and a set of auxilliary files we think of as a fourth data base. The first data base is our primary data base. It contains product structure, the master schedule, open orders, and recommended orders. There are 23 data sets and about 23 megabytes of disc space.

The second data base is information relative to current job charges. Five data sets, two megabytes and designed to work real fast. By using a unique data base for shop charges, locking conflicts are kept to a minimum and response time is maximized.

The third data base is used for performance on completed work. This data is used for performance reports, is not updated too frequently but can be used for management costing games with out impact on the production data bases.

There are ten auxilliary files consuming about seven megabytes. They are direct access files. We use direct access files to minimize the size of the image data bases. The best example is the way we use an internal part number. We had to allow for a twenty-four digit partnumber. Now if we were to use a 24 digit partnumber in image our data base would be 60 percent larger than it is.

(There goes another 47.5 megabyte disc.) So inside the system we work with an integer number that represents the human recognizable partnumber. The integer partnumber is the disc record number corresponding to the real partnumber. To convert an

internal partnumber to a real partnumber takes only on disc read. To get from a real partnumber to an internal partnumber we use an image manual master data set with no related detail data sets. In this case, we take advantage of the fast hashing algorithm provided by image.

That is our system in a nut shell. I will now run a couple of our programs to demonstrate how we believe an interactive program should be written for an online environment. Any one who would like to see more or talk in more depth may contact me for a birds-of-a-feather session.

ESD PRODUCTION MANAGEMENT SYSTEM