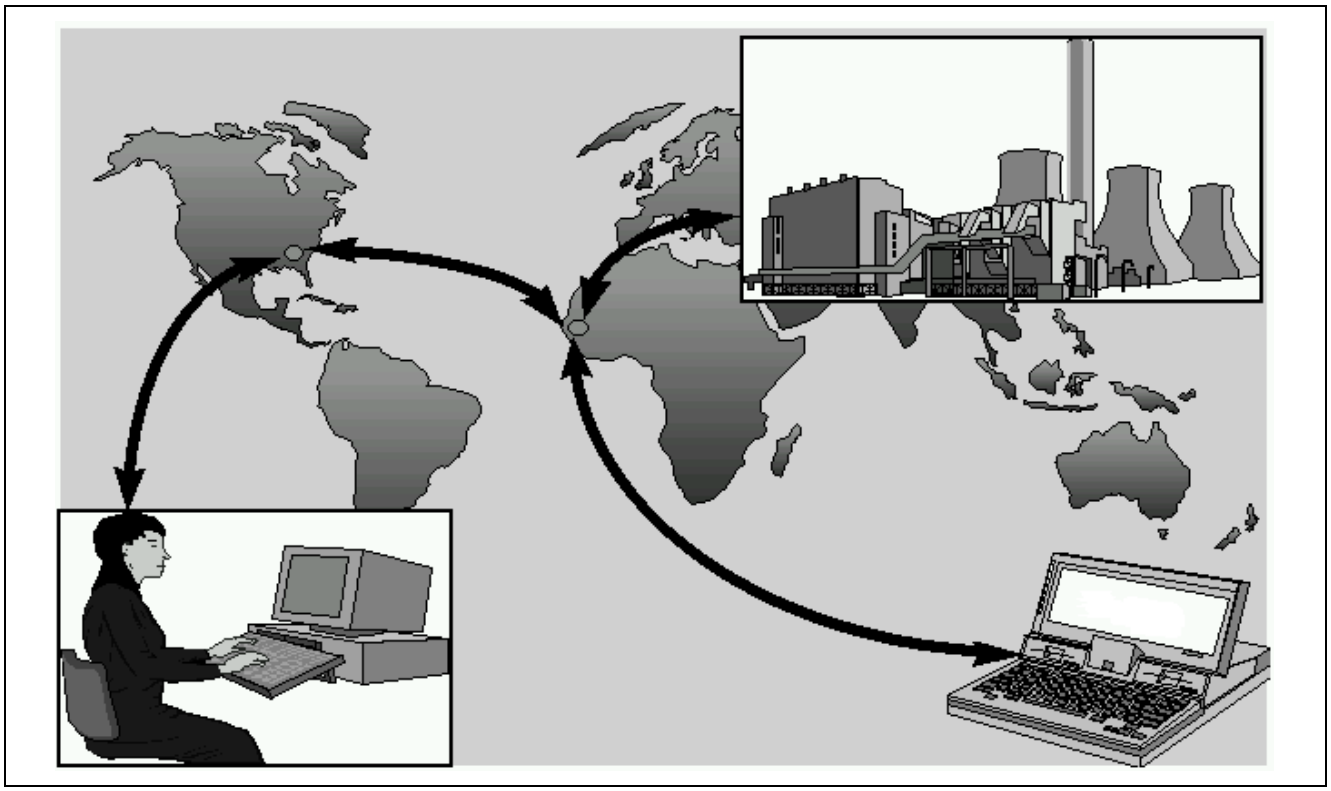
FOXBORO®

PSS 21S-4X2 B3

I/A Series® Software
FoxDPM.com – Dynamic Performance Monitor.com



Foxboro's Dynamic Performance Monitor.com (FoxDPM.com) is an advanced decision support tool which combines process data from the I/A Series system, cost information from the customer's business system, the I/A Series Statistical Process Control (SPC) Package, and optional process models. Together, these elements monitor real-time and target values for cost, quality and production variables.

OVERVIEW

FoxDPM.com has been engineered to improve product quality and maximize production while decreasing product cost. FoxDPM.com includes an optional dynamic model of the process that is used to calculate target values or "goals" for cost, quality and production variables.

Microsoft Excel is utilized to organize, manipulate and store cost information and target values from the process model and other data from the PC operator. Real-time data and target values from Excel are transferred to the I/A Series Historian as collection points. This method of integration with the I/A Series system allows easy access of both real-time data and target values.

The analysis tool for FoxDPM.com is FoxSPC.com, the I/A Series Statistical Process Control package. The SPC package analyzes Real Time and target values by way of statistical process control charts to enhance process control. By monitoring the 11 Western Electric Rules, the SPC package informs the user when a process is out of statistical process control. The SPC charts and tools provide on-line dynamic updating for all configured process parameters.

To organize plant areas and to trace alarming conditions, FoxDPM.com includes Cause and Effect or “fishbone” diagrams. By incorporating Cause and Effect Diagrams (CEDs), plant personnel are given the tools to trace and address alarm conditions in real-time. From the overview display, (Figure 1), an alarm condition can be detected and traced to any area in the plant.

A valuable feature of the underlying FoxSPC.com is data filtering. Configurable for a batch or continuous process, data filtering enables the elimination of “bad” or unwanted data from statistical processing. For a batch process, FoxDPM.com can evaluate statistical data according to batch, lot or product ID. This feature not only improves the accuracy of statistical calculations and relationships, it also organizes data logically.

FoxDPM.com is a “solution” package which utilizes information technology and application engineering to provide enhanced process performance. By having PC and Web client capabilities, FoxDPM.com provides secured performance monitoring from anywhere in the world.

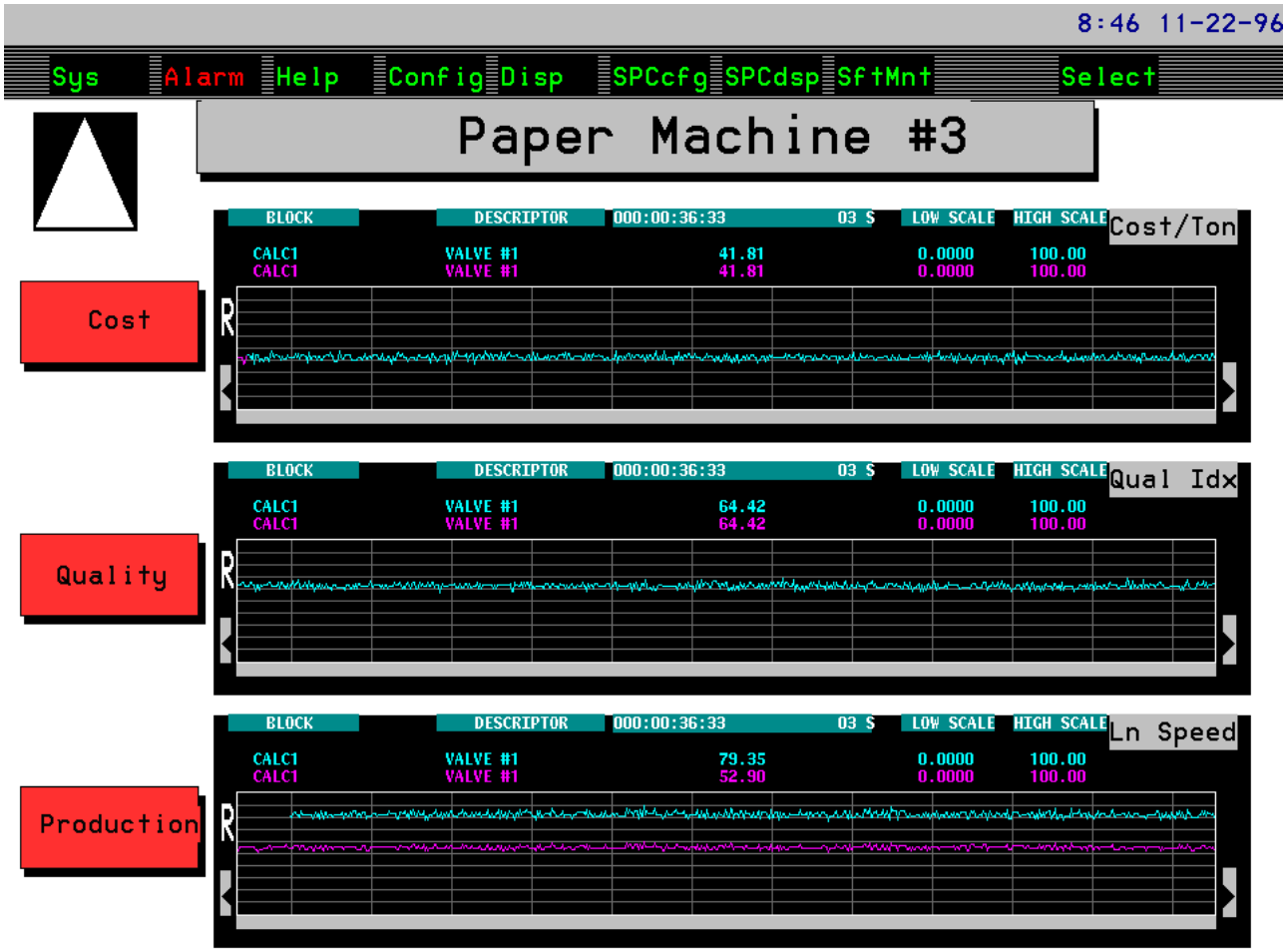


Figure 1. Overview Display

SYSTEM ARCHITECTURE

FoxDPM.com is fully integrated with the Foxboro I/A Series system or other systems via the I/A Series Historian. The server software runs on a 50 Series Application Workstation or Application Processor. Process model target calculations are calculated on a networked PC and stored on the I/A Series Historian as is the real-time data monitored by the I/A Series system. I/A Series 50 Series Workstation Processor and Application Workstation clients are connected to the server over the Nodebus.

Users can view individual SPC charts, overview graphical trend relationships, alarms and other performance information on the I/A Series clients. As an option, users can have access to FoxDPM.com information from desktop PCs connected to a TCP/IP Information network. Also, an optional Web server is available to provide secured access to FoxDPM.com functionality over the Internet or intranet.

A diagram of the basic system architecture is shown below.

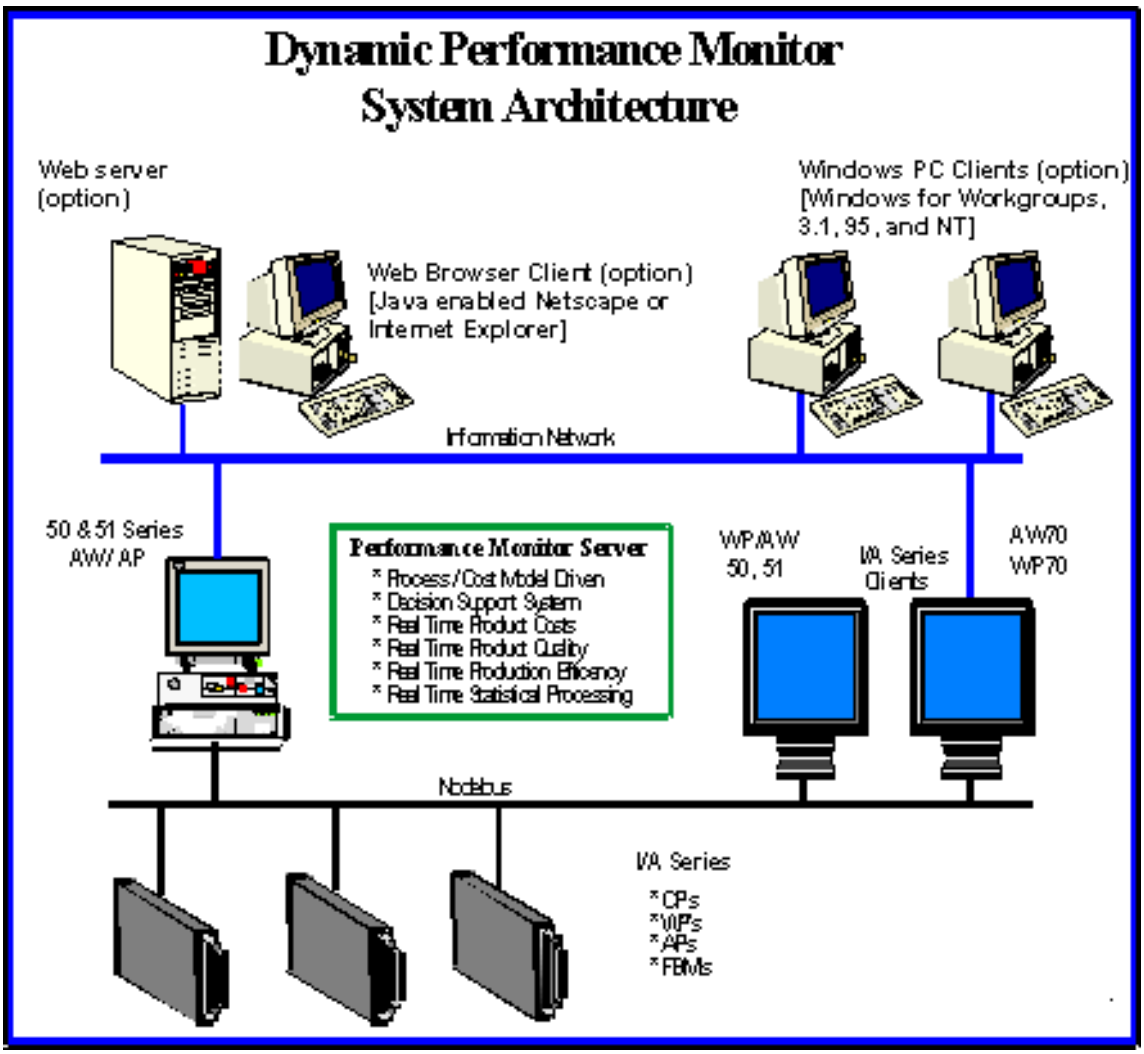


Figure 2. System Architecture

PROCESS MODELS

The value of FoxDPM.com is best realized when integrated with a process model developed for a specific plant or mill. The design can accommodate complex process models or simple cost calculations provided by the user. The integration and design supports either method. In each case, FoxDPM.com requires real time process inputs to determine actual product costs based on measured consumption.

The process model will calculate the optimum target values for the variables being monitored by SPC charts or overview displays (Figure 1). These target values will be exported from the process model into an Excel spreadsheet running on a networked PC.

The process model will calculate ideal operating conditions. In the appropriate Excel spreadsheet, these conditions will be manipulated and sent to the I/A Series Historian as cost and production targets. An example of a cost spreadsheet is shown as Figure 3. The format of the spreadsheets allows a user to enter targets manually by choice or in the absence of a process model.

With the purchase of FoxDPM.com, the customer may optionally acquire a license for the modeling software. This allows the model to be updated for any changing conditions in the plant. A process model also can be utilized to test a change in the process before the change occurs.

TAG NAME	VARIABLE VALUE	VARIABLE DESCRIPTION	PRODUCT COST	COST UNITS	VARIABLE TRANSFORMATION	FINAL COST	COST UNITS	MODEL TARGET	MANUAL TARGET
COMP:BLK.PAR	2.5	ClO2 flow rate - gal/min	50	$/gal	1.304347826	$ 1.30	$/ton	$ 1.10	$ 1.10
COMP:BLK.PAR	5	Caustic flow rate - gal/min	20	$/gal	4.301075269	$ 4.30	$/ton	$ 4.10	$ 4.10
COMP:BLK.PAR	50	Fresh cold water - gal/min	0.05	$/1000gal	2.608695652	$ 2.61	$/ton	$ 2.41	$ 2.41
COMP:BLK.PAR	21	Energy Supply - kW/min	0.2	$/100KW	0.281685575	$ 0.28	$/ton	$ 0.08	$ 0.08
COMP:BLK.PAR	1	Hot Water - gal/min	0.0005	$/100gal	0.212	$ 0.21	$/ton	$ 0.01	$ 0.01
COMP:BLK.PAR	0.25	Talc supply - lbs/ton	4	$/10lbs	24	$ 24.00	$/ton	$ 23.80	$ 23.80
COMP:BLK.PAR	26	Clay supply - lbs/ton	56	$/ton	5.146391753	$ 5.15	$/ton	$ 4.95	$ 4.95
COMP:BLK.PAR	95	Caustic flow - lbs/ton of pulp	0.06	$/lbs	1.368	$ 1.37	$/ton	$ 1.17	$ 1.17
COMP:BLK.PAR	10	Coal Consumption - tons/day	100	$/ton	15.38461538	$ 15.38	$/ton	$ 15.18	$ 15.18
COMP:BLK.PAR	75	Oil Consumption - tons/day	125	$/ton	12.48197049	$ 12.48	$/ton	$ 12.28	$ 12.28
COMP:BLK.PAR	120	H2O2 flow - lbs/ton of pulp	2.33	$/100lbs	11.83492063	$ 11.83	$/ton	$ 11.63	$ 11.63
COMP:BLK.PAR	14	Lime flowrate - lbs/day	0.85	$/100lbs	0.2856	$ 0.29	$/ton	$ 0.09	$ 0.09
COMP:BLK.PAR	10	Steam usage - 1000lbs/day	150	$/1000lbs	36	$ 36.00	$/ton	$ 25.39	$ 29.39
COMP:BLK.PAR	3	Defoamer flowrate - gal/day	45	$/100gal	5.491525424	$ 5.49	$/ton	$ 5.29	$ 5.29
COMP:BLK.PAR	160	Wood chip usage - tons/day	180	$/ton	69.12	$ 69.12	$/ton	$ 68.92	$ 68.92
COMP:BLK.PAR	25	Demineralizers - lbs/month	67	$/100lbs	16.37474542	$ 16.37	$/ton	$ 16.17	$ 16.17
COMP:BLK.PAR	23	Hydrochloric acid - gal/day	0.008	$/10gal	4.416	$ 4.42	$/ton	$ 4.22	$ 4.22
COMP:BLK.PAR		Operating Cost per Day				$ 210.61	$/ton	$ 196.80	$ 200.80

Figure 3. Excel Spreadsheet for Cost

CAUSE AND EFFECT DIAGRAMS

Cause and Effect Diagrams are the tools that make FoxDPM.com an easy to use decision support system. Each block in the CED can be linked to SPC charts, text blocks or other CEDs. When an SPC chart or overview display detects a controlled metric that is not within expected range or has violated one of the configured rules, that violation will be linked to the corresponding block in the CED. Each CED can have up to 24 causes.

Figure 4 is an example Cause and Effect Diagram. A cause box can have four different links. In Figure 4, the chart indicated by the arrow is causing an alarming condition.

The up arrow in the left corner allows you to “drill up” through the hierarchy of CEDs. The CED hierarchy is accomplished by modifying the “cause” block connection types to include a new type, a link to a CED. This allows CEDs to inherently support multiple levels of Cause and Effect Diagrams. These multiple levels are valuable tools for tracing alarming conditions and organizing plant areas.

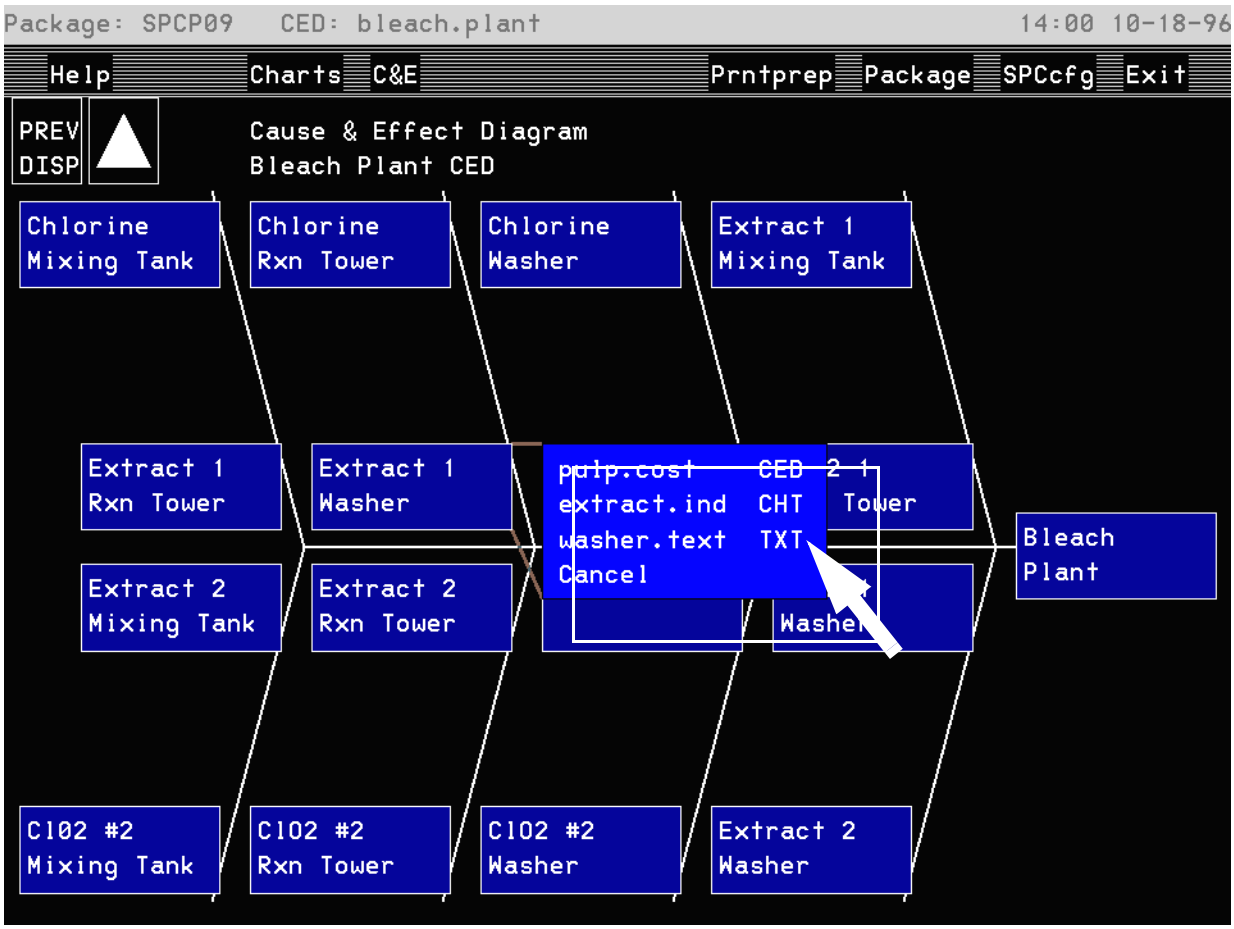


Figure 4. Cause and Effect Hierarchy - UNIX Client

Embedded FoxSPC.com in FoxDPM.com

FoxSPC.com provides on-line displays of charts for process variables and targets. When requested for displays and analysis, the SPC charts access variables from the current time to as far back as required by the subgroup size, type and number. Once a chart is displayed, you can move both forward and backward in time, by one subgroup or half of the chart, and then, redisplay the chart. You can also change the starting time of data access, either temporarily of permanently, via on-line reconfiguration. Thus, you can readily move on-line through the whole history of a charted variable.

The SPC package uses the following four types of variables:

- Quality Variables – Examples are viscosity, composition, density, melt index, brightness and others. They are used in Xbar and Range, Xbar and Sigma, Individuals, CUSUM, and Cumulative Sum charts to monitor product quality.
- Causal Variables – Examples are flow, temperature, pressure, feed composition, and others. They are used in Xbar and Range, Xbar and Sigma, Individuals, CUSUM and Cumulative Sum charts to monitor and determine the cause of poor product quality.
- Attributes – Examples are sample size and fraction and number of defective items, and unit size and number of defects and defects per unit. They are used in P, NP, C, and U charts to monitor end (final) product and overall process performance.
- Causal Relationships – These consist of text information. They are organized and displayed in Cause and Effect Diagrams.

SPC TOOLS

The SPC charts and other analysis tools access data from real-time databases that consist of real-time data and target collection points. SPC tools can be classified according to variable and analysis types as follows.

SPC Tools for Quality and Causal Variables

Tools to analyze and monitor individual samples are:

- Individuals Histogram
- Individuals Chart
- Scatter Diagram for Auto-Correlation.

Tools to analyze and monitor subgrouped samples are:

- Xbar Histogram
- Xbar and Range Chart
- Xbar and Sigma Chart
- CUSUM Chart
- Cumulative Sum Chart.

SPC Tools for Attribute Variables

Tools to monitor fraction and number defects are:

- P Chart
- NP Chart.

Tools to monitor defects and defects per unit are:

- C Chart
- U Chart.

SPC Tools for Cause and Effect Analysis

These tools are:

- Scatter Diagrams for Cross-Correlation
- Pareto Diagram
- Cause and Effect Diagrams.

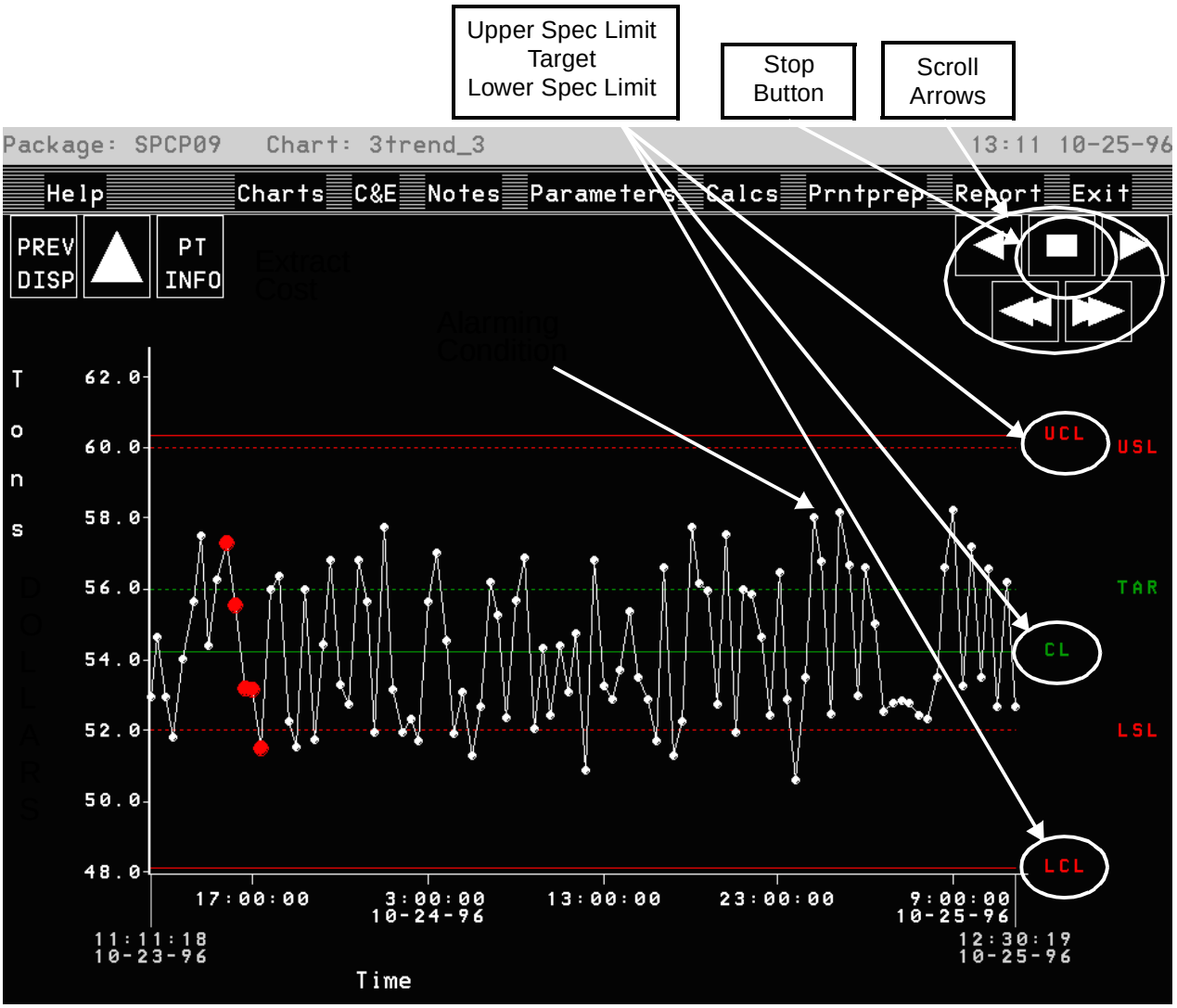


Figure 5. Example SPC Chart – UNIX Client

DATA FILTERING

Data filtering is a component which filters out data that is bad or unwanted, and should not be included in SPC calculations. This unwanted data will be shown on the charts with a yellow triangular marker, a different marker style and color than the normal data points, and will be ignored in SPC calculations. It is also possible to remove the unwanted data from the SPC chart completely, and concatenate the remaining data points.

Many processes operate on a batch basis, and make a variety of products. Several batches of one product could be made during a production run, and several production runs could be made in a year. The number of batches per production run and the length of each production run may vary. With batch and product ID data filtering, it is possible to view only data associated with a batch, or all the batch data for a product. Batch, lot or product ID information must be added to the Historian to allow batch data filtering.

An example of batch data filtering can be found in Figure 6. The first chart shows all of the sample data with the calculated mean and control limits. Charts 2 and 3 show the same data separated by batch type.

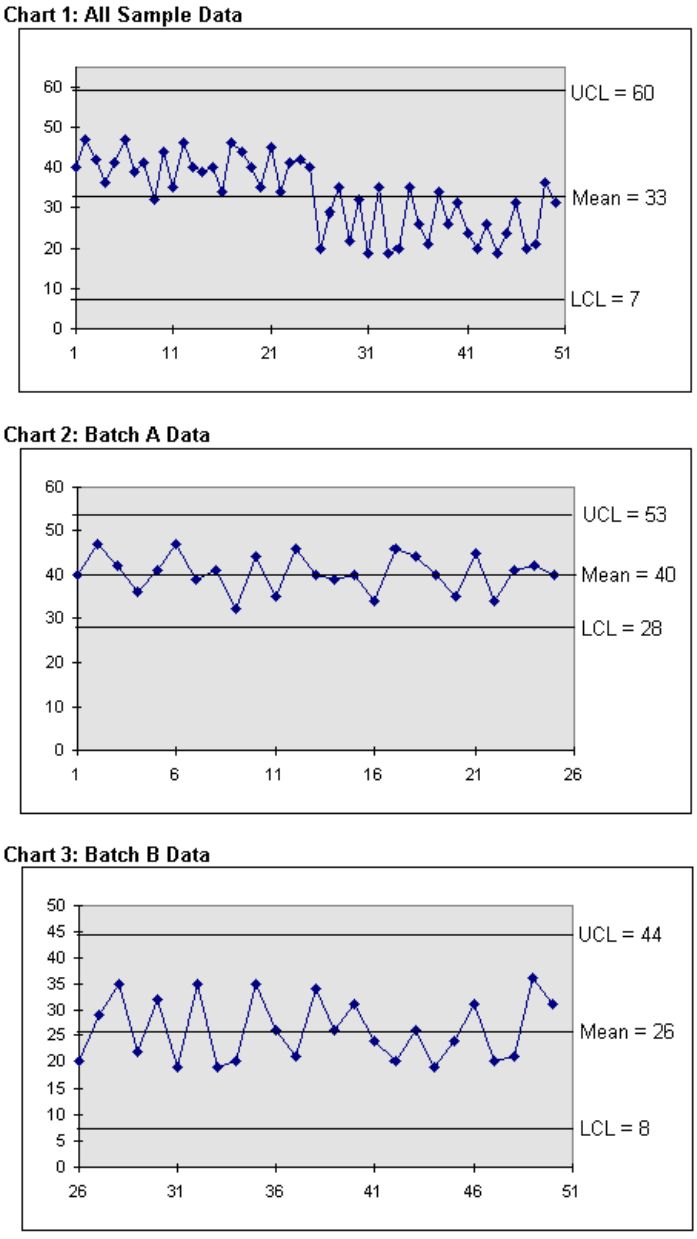


Figure 6. Data Filtering by Batch ID

SYSTEM CONFIGURATION

FoxDPM.com software executes on the following Solaris-based 50 Series stations:

- Application Processor in conjunction with a Workstation Processor
- Application Workstation (AW) which can host WPs.

FoxDPM.com residing on an AP can service all WPs hosted by the AP. FoxDPM.com configurations and displays are performed locally within the AP/WP cluster. Process data is accessed from any Historian database in the I/A Series network.

The FoxDPM.com software package can access data from the local Historian (database) and all remote Historians in the I/A Series network.

PC AND WEB CLIENTS

PC client stations can access FoxDPM.com displays over an Ethernet TCP/IP local area network. PC clients can run under Microsoft Windows 95/98, or Windows NT 4.0 operating systems.

An optional Web server can be added to the network to allow secured remote access to FoxDPM.com displays using Netscape Navigator or Microsoft Internet Explorer over the Internet of a corporate intranet.

SERVER SOFTWARE

The FoxDPM.com server provides all the software needed to configure charts, Cause and Effect Diagrams, and other tools. It also includes software needed to support all of the connected I/A Series UNIX clients that are connected to the Nodebus. No additional software is needed for I/A Series UNIX clients. Software is also included to provide client license validation to support other software client types. At least one server is needed to support a FoxDPM.com system.

WINDOWS CLIENTS SOFTWARE

FoxDPM.com Windows clients will run on Windows 95/98, or Windows NT 4.0. From a Windows client, users have access to the full range of charts, CEDs, and other FoxDPM.com tools. The Windows client look and feel is similar to the UNIX client with small changes in color, menus and fonts. Placement and behavior of buttons, however, are more consistent with the Windows environment.

When using the Windows client, data can be exported to spreadsheets, word processors and other Windows DDE applications. Data that is transferable includes all plotted data values, and SPC calculation results (target, sigma, cpk, etc.) for any displayed chart or trend.

FoxDPM.com Windows clients are sold as *named user* licenses. A *named user* can log onto the system from any PC that is connected to the TCP/IP information network as long as the correct user name and password are entered.

The Windows clients does not support permanent configuration changes. On allowable chart types, users have access to the parameters, calculations and other functions. Items can be changed by a user on an *ad hoc* basis but the changes can not be permanently saved. The alarm state of a trend, chart or CED is shown when a display is called on a Windows client but new alarms that occur will not update the display. The Windows client does not directly support printing except for PC print screen functions.

WEB SERVER SOFTWARE

FoxDPM.com can also be accessed over the Internet or a company intranet in a secured fashion. The software allows the same functionality as the Windows clients. The Internet/intranet server software can be loaded on the FoxDPM.com server or another dedicated server.

FoxDPM.com Web licenses are sold as *named user* licenses. A *named user* can log onto the Web server but is allowed access only if a correct user name and password are entered.

SYSTEM REQUIREMENTS

FoxDPM.com is offered on the following platforms:

Servers

- Solaris operating system
- I/A Series AP/AW51 B, C, D or E with an information network connection using a second Ethernet port if supporting PC or Web clients
- I/A Series AW70
- Servers with a minimum of 32 MB of RAM memory – more for additional clients
- 30 MB of hard drive space

Clients - Personal Computers

- A 486 PC or Pentium
- Windows 95/ 98 or Windows NT 4.0
- At least 16 MB of RAM
- A network interface card for Windows clients and a Win-Socket-compliant TCP/IP software

Clients - Web

- Java Enabled Web browser - (Netscape Navigator or Microsoft Internet Explorer)

Clients - I/A Series

- I/A Series software V4.1 (or greater) running on AW51 or WP51 Models A, B, C, D or E running Solaris with a direct information network connection using a second Ethernet port
- 12 MB RAM memory minimum
- WP30s are not supported but can be upgraded to the I/A Series 50 Series through The Foxboro Company Advantage Program.
- All AW/WP51s must communicate to the FoxDPM.com server via the Nodebus.

PRODUCT CONFIGURATION

Basic FoxDPM.com Solution

- FoxDPM.com software licenses for two plant areas for cost, quality, and production monitoring
- One PC client and all Nodebus connected UNIX clients
- Configuration of 60 SPC charts, 30 per area
- Configuration of historian points needed for DPM
- Implementation of customer cost model from PC based spreadsheet
- Configuration of real-time Cause and Effect Diagrams for “drill down”
- Two engineering work sessions with customer, two days each
- On-site startup services – two weeks, two engineers. Includes on-site operator and engineering training
- User documentation
- Project engineering – design, plan, and administration

PACKAGE SOLUTIONS

INTRANET & INTERNET

- Pentium Processor, 64 MB RAM, 2 GB hard drive, CD-ROM, Ethernet I/F
- Web enabler software loaded and tested
- Windows NT4.0, Web site software
- FoxDPM.com Web server software and installation

PC CLIENT

- 133 MHz Pentium processor, 15-inch color monitor, Ethernet I/F
- Windows 95/ 98, MS Office Pro
- FoxDPM.com MS Windows PC Client software – one user license

PROCESS MODELS

Process models are available for various industries. Services typically include:

- Two weeks of on-site services to study the processes and develop flowsheets
- Development of model and costing relationships
- Integration of the model with FoxDPM.com
- On-site model startup with FoxDPM.com.

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