

MachineWorX

Specification Guide *for the Machine Builder OEM*

October, 2002 VERSION 7.0



Web Automation at Your Fingertips

Table of Contents

1. PREFACE.....	4
2. REQUIREMENT NUMBERS	4
3. SOFTWARE ARCHITECTURE.....	5
3.1. GENERAL DESIGN FEATURES	5
3.2. NETWORKING	6
3.3. MISCELLANEOUS	6
4. SYSTEM HARDWARE	7
4.1. SYSTEM UNIT	7
4.2. COLOR MONITOR	7
4.3. KEYBOARD AND MOUSE	7
4.4. PRINTER.....	7
5. GRAPHIC DISPLAY SOFTWARE MODULE	8
5.1. OBJECT CREATION TOOLS	8
5.1.1. Common Requirements	8
5.1.2. Line, Polygon.....	9
5.1.3. Rectangle, Square	9
5.1.4. Ellipse, Circle.....	9
5.1.5. Arc, Pie, Chord	10
5.1.6. Text	10
5.1.7. Images	10
5.1.8. Metafile	11
5.1.9. OLE Object.....	11
5.2. DRAWING UTILITY TOOLS	12
5.3. ANIMATION TOOLS.....	13
5.3.1. Dynamic Connections.....	13
5.3.2. Size Dynamic	14
5.3.3. Flash Dynamic	14
5.3.4. Digital Color Dynamic	14
5.3.5. Analog Color Dynamic.....	15
5.3.6. Hide Dynamic.....	15
5.3.7. Disable Dynamic	15
5.3.8. Rotation Dynamic.....	15
5.3.9. Dial Dynamic	16
5.3.10. Location Dynamic	16
5.3.11. Slider Dynamic	16
5.3.12. Animator Dynamic.....	17
5.3.13. Digital Selector Dynamic	17
5.3.14. Analog Selector Dynamic	18
5.3.15. Value Dynamic	18
5.3.16. Data Entry Dynamic.....	19
5.3.17. State Field Dynamic.....	19
5.3.18. State Field Data Entry Dynamic.....	19
5.3.19. Time/Date Dynamic	20
5.3.20. Display Switch Dynamic	20
5.3.21. Button Dynamic.....	20

5.3.22. Pick Dynamic.....	21
5.4. ALARM/TREND TIE-IN	21
5.5. SYMBOL STORAGE LIBRARY	22
5.6. EXPRESSIONS	22
5.7. SCRIPTING.....	23
5.7.1. JScript.....	23
5.7.2. VBScript.....	23
5.8. MISCELLANEOUS	24
6. ALARM MONITORING MODULE.....	25
6.1. ALARM SERVER.....	25
6.1.1. Digital Alarms	26
6.1.2. Analog Limit Alarms	26
6.1.3. Deviation Alarms	26
6.1.4. Rate of Change Alarms	26
6.2. LIVE/ACTIVE ALARM VIEWING.....	27
6.2.1. Configuration	27
6.2.2. Runtime	29
7. SECURITY.....	30
8. PROJECT MANAGEMENT	32
9. LANGUAGE CAPABILITIES.....	33
10. OPC DATA.....	35
11. ALIASING.....	35
12. TRAINING.....	36
13. TECHNICAL SUPPORT	36
14. SOFTWARE UPGRADES	36

1. Preface

The purpose of this document is to provide users with a detailed specification to include in various proposal and bid documents. This is a GENERAL HMI & SCADA SPECIFICATION for defining most functions that are typically used on industrial automation systems.

Although many projects may not require all the features described in this document or may require additional special features, this document should still be included as a whole in any proposal or bid without modification.

This document has been carefully compiled to ensure that the specifications will provide a system that has all the features herein. Modifying the document may provide loopholes for vendors that are unable to provide full functionality or create a specification that no vendor can meet, nullifying the specification and again opening up the possibility for vendors to bypass the specifications.

2. Requirement Numbers

Requirements in this document are individually identified with numbers to the left of the paragraph in the form: *RX.Y*, where *X* matches the section number, and *Y* is a unique number identifying a specific requirement.

It uses the automatic list numbering feature used in Microsoft Word. Note that changing the order of the paragraphs, or adding/deleting requirements will change the numbers assigned to the rest of requirements below the change (later on in the document). So, once a document goes out for bid, care must be taken to keep changes from affecting these numbers. If new requirements must be added, it is suggested that they be placed at the end of the section, such that the *Y* numbers preceding the change are not affected.

These requirement numbers should be referenced by the bidders, identifying any non-compliance with this requirement specification.

3. Software Architecture

3.1. General Design Features

The HMI/SCADA package will:

- R3.1 Be 32-bit software capable of running Windows 98, and Windows NT, and Windows 2000 and Windows XP. MachineWorX must provide options for the additional operating systems of Windows CE and Embedded systems.
- R3.2 Support and take advantage of multiple processors on the same machine (symmetric multiprocessor design). For example, adding another Pentium chip to the computer should distribute the load of the HMI/SCADA software across both chips, thereby increasing performance, etc.
- R3.3 Support and take advantage of multiple threads within the CPU. This multi-threading, among other benefits, aids in multi-tasking for CPU optimization, dependencies, and the like.
- R3.4 Have a Modular architecture based on Microsoft's Distributed Internet Applications (DNA) architecture and plug & play features. It must not be one large monolithic software product.
- R3.5 Permit the user the flexibility to purchase only the modules and components necessary for the application. For example, if only alarming is required on one station, then only the alarming module should have to be purchased (and not the graphics, trending, etc. for that node).
- R3.6 Offer separate stand-alone modules for:
 - Dynamic Graphic Displays
 - Real-Time Trending and Historical Data Logging
 - Alarm Management
 - Project Level Scripting
 - Security
 - Real-time OPC Servers
 - OPC Redundancy
 - OPC Data Bridging
 - Screen Management
 - Process Control
 - Project Management
- R3.7 Have a scalable architecture such that the user can start with a small application and later grow the application and database to any size by upgrading the license.
- R3.8 Embrace and integrate Microsoft Standards including:
 - Microsoft Access
 - Microsoft SQL Server
 - Microsoft Data Engine (MSDE)
 - Open Database Connectivity (ODBC)
 - ADO, OLE-DB for Database Interface
 - Object Linking and Embedding (OLE)
 - ActiveX Technologies
 - OLE for Process Control (OPC)
 - Visual Basic for Applications (VBA)

3.2. Networking

The HMI/SCADA package will:

- R3.9 Implement Client / Server Distributed Networking
- R3.10 Support industry standard network protocols such as TCP/IP, NetBEUI using COM/DCOM.
- R3.11 Operate on a network with multiple protocol stacks.
- R3.12 Plug and Play with standard routers, network Intranets and the Internet.
- R3.13 Offer a Web based Browser Plug-in so that Alarming, Graphics, Trends can be viewed from an Internet Explorer station. Also, it must permit interaction (e.g., changing set point, switching screens, etc.) from these Internet Explorer stations.
- R3.14 Permit users to perform any function in the SCADA Software from any node on the Network.
- R3.15 Be configurable as an independent distributed database regardless of the number of nodes in MachineWorX.
- R3.16 Allow configuration changes to the distributed database from any node on MachineWorX.
- R3.17 NOT require a file server. However, the HMI/SCADA software will be capable of storing and managing its database on a redundant file server.
- R3.18 Support up to 256 workstations (nodes) or greater simultaneously. Expansion of MachineWorX will be possible with the addition of non-proprietary PC based off the shelf hardware.
- R3.19 Connect to a large number of I/O Device Interfaces via OPC Servers across the network.
- R3.20 Offer a "working directory" feature, whereby multiple nodes can point to one common workstation for accessing and working with the project displays.
- R3.21 Support OPC over IP and/or SOAP/XML, configurable on a per-node basis.

3.3. Miscellaneous

The HMI/SCADA package will:

- R3.22 NOT require a hardware "dongle" key for licensing (like those plugged into the parallel port). Software-based licensing is all that should be required.
- R3.23 Provide an option for a hardware "dongle" key for licensing (like those plugged into the parallel port) as an alternative to any software-based licensing.
- R3.24 Allow such licensing to reside on each individual node in MachineWorX, or be served up from one central server (whereby all other nodes point back to that one station for its licensing).
- R3.25 Support Tool Tips, dockable toolbars, Context sensitive help and right click mouse function for easy context menu commands.
- R3.26 Be supplied as a complete package. No additional software should be required to configure or run the features of MachineWorX.

4. System Hardware

4.1. System Unit

MachineWorX will consist of stand-alone personal computers, IBM PC compatible, with the following configuration as a minimum:

- R4.1 The CPU will be an Intel Pentium or equivalent running at 400Mhz or faster. A minimum of a Pentium III running at 950Mhz or better is recommended for large implementations.
- R4.2 A minimum of 64MB RAM memory will be supplied, a minimum 512MB is recommended for large implementations.
- R4.3 A Hard Disk Drive with a capacity of 6Gb or larger, with 11ms or less access time.
- R4.4 An 8X CD-ROM Drive (for software installation, etc.)
- R4.5 At least one Floppy Disk Drive: high density 1.44Mb 3.5-inch
- R4.6 A printer port must be included.
- R4.7 All Communication Port Hardware necessary to interface to the field devices will be included.
- R4.8 Communication cards and interconnecting hardware will be provided to connect the SCADA/HMI computers to a Local Area Network.
- R4.9 The Operating System already installed will be Microsoft Windows 98, NT 4.0, 2000, or XP.

4.2. Color Monitor

A high resolution SVGA Color Monitor will be furnished with:

- R4.10 A 21-inch diagonal screen size.
- R4.11 Video resolution at least 1024x768.
- R4.12 A minimum of True 16bit colors supported.
- R4.13 Energy-Star Compliant.

4.3. Keyboard and Mouse

- R4.14 A full 80-101 key ASCII keyboard will be furnished.
- R4.15 The keyboard will be the standard QWERTY style, including cursor control keys, numeric keypad, and at least 10 special function keys.
- R4.16 A standard Microsoft mouse, or equivalent, will be provided for point-and-click system configuration, color display creation, and runtime function selection.

4.4. Printer

- R4.17 A color ink jet printer suitable for documenting the graphic displays will be provided.

5. Graphic Display Software Module

The graphical display module will:

- R5.1 Allow configuration of highly detailed screens with animation.
- R5.2 Use an object-oriented design.
- R5.3 Permit using the mouse for object creation, editing, and placing on the screen.
- R5.4 Show object properties for customization with either menu choices, right-clicking, pop-up menus, or double-click shortcuts.
- R5.5 Offer floating, dockable tool bars with drawing and animation tools for building the display.
- R5.6 Provide a grid that can be displayed on screen to assist in aligning objects precisely.
- R5.7 Permit re-sizing of the grid in both the X and Y direction (independently) in one-pixel increments
- R5.8 Allow "Snap to Grid" functionality to be turned on/off during configuration.
- R5.9 Not require compilation of the displays before use; a simple "save" is all that is needed for use.
- R5.10 Permit having multiple instances of the development environment open at the same time within the same PC.
- R5.11 Permit drag-n-drop of static and dynamic objects between the multiple instances of the development system for moving and/or copying of parts of the display.
- R5.12 Offer Password Protection of displays created.

5.1. Object Creation Tools

Standard object editing tools for creating and modifying graphic objects will consist of at a minimum the requirements outlined below.

5.1.1. Common Requirements

The following is a list of requirements common to several "object" types, including lines, polygons, rectangles, ellipses, circles, arcs, chords, pies, and text. The graphics package will offer:

- R5.13 Configurable line thickness
- R5.14 Configurable line style (solid, dash, dot-dash, etc.)
- R5.15 Configurable line color (selection from a palette of not less than 256 colors)
- R5.16 Toggle the "Fill" property of an object (so it's either solid, or transparent)
- R5.17 Configurable Fill Color of the object (selection from a palette of not less than 256 colors)
- R5.18 Configurable Fill Pattern of the object (selection from a palette of not less than 30 different styles; e.g., stripes, dots, waves, bricks, dashes, etc.)
- R5.19 A Gradient Fill (instead of a solid color, or a pattern) for an object, permitting the following:
 - Style of the gradient (horizontal, vertical, square)
 - Configurable number of detail steps used to create the gradient shades while blending the colors (e.g., 5 would be a "course" gradient, while 200 would be "very smooth")
 - Configurable Color of the fill (selection from a palette of not less than 256 colors)
 - Configurable direction, both X and Y, of the light source used for the gradient creation

- R5.20 Configurable Shadow and Shadow Color of an object (selection from a palette of not less than 256 colors)
- R5.21 Static rotation of the drawn object
- R5.22 Re-sizing of the object once drawn by using standard "resize handles" employed in common graphics packages.
- R5.23 Constraining the re-sizing of the object to the ratio it was originally drawn (so it maintains its shape during the resize edit) by holding down a modifier key (for example, while pressing the standard Shift key while dragging the mouse).
- R5.24 An option to copy just the "visible" properties of an object, and then pasting those appearance properties to other objects. This facilitates quickly making objects having a similar look and feel (for example, all having the same line thickness, gradient fills, shadow color, etc.).

5.1.2. Line, Polygon

The graphics package will have a "Line Object" creation tool offering:

- R5.25 Lines drawn to any length, any angle using the mouse to define start/end points
- R5.26 Polygon creation with joined "multi-segmented" lines
- R5.27 Add, delete, and edit the anchor points of multi-segment lines
- R5.28 Creating lines (or segments of polygons) which "snap" to 45-degree increments by holding down a modifier key (for example, while pressing the standard Shift key while dragging the mouse).
- R5.29 "Joining" of individual lines into one polygon (which can be then filled, etc) when grouping individual segments into an object. This "merging" of segmented lines into a "polyline" must be at the users choice.

5.1.3. Rectangle, Square

The graphics package will have a "Rectangle Object" creation tool offering:

- R5.30 Rectangles drawn to any length using the mouse to define corner locations
- R5.31 Creating perfect squares by holding down a modifier key (for example, while pressing the standard Shift key while dragging the mouse).
- R5.32 Rounded corners which can be applied to any rectangle
- R5.33 Independent configuration of the horizontal and vertical curve extent used in rounded corners (to be configured graphically using the mouse).
- R5.34 A rectangle object will be able to be converted to a "poly-line" equivalent (i.e., converted to a series of four segmented lines), so that these rectangles can be modified and/or merged with other poly-lines to form complex objects which can enjoy the Fill properties.

5.1.4. Ellipse, Circle

The graphics package will have an "Ellipse Object" creation tool offering:

- R5.35 Ellipses drawn to any length using the mouse to define boundary locations
- R5.36 Creating perfect circles by holding down a modifier key (for example, while pressing the standard Shift key while dragging the mouse).
- R5.37 An ellipse object will be able to be converted to a "poly-line" equivalent (i.e., converted from a curve definition to a series of segmented lines which approximate the curve), so that these ellipses can be modified and/or merged with other poly-lines to form complex objects which can enjoy the Fill properties.

5.1.5. Arc, Pie, Chord

The graphics package will have an "Arc Object" creation tool offering:

- R5.38 Arcs drawn (i.e., a portion of an ellipse) using the mouse to define its length.
- R5.39 Creating arcs of a perfect circle by holding down a modifier key (for example, while pressing the standard Shift key while dragging the mouse).
- R5.40 The angles used for the arc are to be in at least single-degree increments, defined by dragging the start/end points using the mouse
- R5.41 Joining the endpoints of the arc will create an object that can have all of the Fill properties already described.
- R5.42 The endpoints will have the option to be able to be combined by two methods:
 - Chord - connecting a straight line from each end point
 - Pie - drawing radii from each end point to the center of the ellipse, circle
- R5.43 An arc object will be able to be converted to a "poly-line" equivalent (i.e., converted from a curve definition to a series of segmented lines which approximate the curve), so that these arcs can be modified and/or merged with other poly-lines to form complex objects which can enjoy the Fill properties.

5.1.6. Text

The graphics package will have a "Text Object" creation tool offering:

- R5.44 Font family selection from the standard installed Windows True Type font list on a per-object basis.
- R5.45 Configurable Font Size on a per-object basis.
- R5.46 Configurable Font Style (Bold, Italic, Underline, Bold Italic) on a per-object basis
- R5.47 Multi-line text which remains as one object (i.e., it is NOT acceptable to have paragraphs always broken up into individual objects per line used ... it must remain as a multi-line paragraph which can be manipulated as a whole).
- R5.48 Text Alignment within the boundaries including Left-Align, Center-Align, Right-Align
- R5.49 Text size and extents can be stretched to any height or width using the mouse (thereby distorting the shape of the font).
- R5.50 An option to turn off additional stretching of the text (so the font maintains the shape drawn). Subsequent stretching of the object will merely change the rectangle area used by the text object.
- R5.51 Applying a background color to the text, thereby creating a "Filled" text object (the Fill going to the extent of the rectangle defined by the area of the text).

5.1.7. Images

The graphics package will have an "Image Object" creation tool offering:

- R5.52 Ability to import various types of images including:
 - Windows bitmaps (*.BMP)
 - CompuServe GIF (*.GIF)
 - JPEG (*.JPG;*.JPEG)
 - Adobe Photoshop Files (*.PSD)
 - C64 Koala Graphics (*.KOA)

- Dr. Halo (*.CUT)
- Icon (*.ICO)
- IFF Interleaved Bitmap (*.IFF)
- Kodak PhotoCD (*.PCD)
- Liner Bitmap Graphics (*.LBM)
- Multiple Network Graphics (*.MNG)
- Zsoft Paintbrush (*.PCX)
- Portable Network Graphics (*.PNG)
- Portable Network Media (*.PBM;*.PGM;*.PPM)
- Sun Raster Images (*.RAS)
- Truevision Targa (*.TGA;*.TARGA)
- Tag Image File Format (*.TIF;*.TIFF)
- Wireless Bitmap (*.WBMP)

R5.53 Image size and extents can be stretched to any height or width using the mouse (thereby distorting the shape of the image).

R5.54 An option to reset a distorted image back to its original dimensions.

R5.55 Select a "transparent color" for an image (e.g. selecting blue would eliminate the display of that shade of blue within the image, thereby revealing any object behind the Image, making an "irregular shaped" image).

R5.56 Support compression of simultaneous images for optimal storage and performance.

5.1.8. Metafile

The graphics package will have a "Metafile Object" creation tool (Metafiles are Vector-Based graphics, as opposed to pixel-based Images) offering:

R5.57 Ability to import Windows Metafiles (*.WMF) images into the display as an object

R5.58 Metafile size and extents can be stretched to any height or width using the mouse (thereby distorting the shape of the Metafile).

R5.59 The individual vectors defined in the Metafile can be converted to symbols native to the Graphics package (e.g., a clipart metafile of a house would be converted into the individual rectangles and lines used to draw the doors, windows, roof, etc). These converted objects can then be manipulated individually as any natively drawn graphic object would.

5.1.9. OLE Object

The graphics package will have an "OLE Object" creation tool offering:

R5.60 Ability to embed multiple OLE Documents from third party vendors (some examples include: Excel Spreadsheets, Word Documents, Wave Files, Movies, etc.)

R5.61 Support for Drag-n-Drop of OLE Documents directly from the Windows File Explorer

R5.62 Editing of the embedded OLE Object by changing the menus and tools shown in the Graphics package to those of the embedded object. (e.g., double-clicking on an embedded Excel worksheet would change the menus and tools to that of Excel, all while remaining in the Graphics package).

5.2. Drawing Utility Tools

Standard drawing utility tools for manipulating graphic objects will consist of at a minimum:

- R5.63 A Color Palette supporting at least 256 colors, including standard colors with the ability to add custom colors to the palette. Custom colors will be defined using the standard Windows color palette tools, and support "millions of colors" choices).
- R5.64 A Color Eyedropper tool whereby a color can be extracted from an object (e.g. an image) and placed as a custom color in the palette.
- R5.65 Group/Ungroup Tool to define if selected objects are grouped into one symbol or not.
- R5.66 Grouped symbols must still be able to be edited individually without destruction of the grouping or any dynamics associated with that group. For example, it should be possible to edit a pump symbol having color and pick dynamics on the pump as a whole (changing perhaps one of the individual line or arc objects used in drawing the pump) without first having to ungroup, and thereby losing the dynamics. All must be preserved.
- R5.67 Bring to Front/Send To Back Tools to move the Z-order of any object(s) forward or backward.
- R5.68 Delete Tool to delete selected object(s).
- R5.69 Alignment Tools to line up multiple selected objects based on:
 - Tops
 - Left Sides
 - Right Sides
 - Bottoms
 - Middles in the Vertical Direction
 - Centers in the Horizontal Direction
 - Evenly Distributed Across, with boundaries defined by left-most and right-most selected objects
 - Evenly Distributed Down, with boundaries defined by top-most and bottom-most selected objects
- R5.70 Make Same Height Tool to make all selected objects the same vertical length as one of the selected objects.
- R5.71 Make Same Width Tool to make all selected objects the same horizontal size as one of the selected objects.
- R5.72 Make Same Size Tool to make all selected objects the same size (both height and width) as one of the selected objects.
- R5.73 Make Same Font Tool to make all selected text objects the same font as a master text object.
- R5.74 Search/Replace Tool to allow search and replace editing of:
 - dynamic connection tag names (described later)
 - filenames used in various "Pick Action" dynamics (described later)
 - text used in Text Object labels
- R5.75 The "Scope" of the Search/Replace will be user selectable as:
 - Only those objects selected
 - The Entire Display
 - Multiple Displays as selected by the user (so an entire project can be updated at once)
- R5.76 The Search/Replace tool will provide the ability to create a report of which objects were affected by the Search/Replace.
- R5.77 Zoom options for finer control of drawing and editing of objects, including:

- Predefined percentages for easy access (e.g., 50%, 75%, 100%, 200%)
 - Custom Percentage (user enters a number between 10% and 1000%)
 - "Rubber band" or "Box" Zoom (whereby the user defines a "rectangle" defining the area to zoom to by dragging the mouse).
 - Show the Entire Display
 - Zoom to the Selected Objects
 - Return to the "home" view, the default used for the display.
 - Zoom in/out around the mouse pointer by rolling the center Mouse Wheel (for mice so equipped)
- R5.78 Auto-Panning feature, so when objects are drawn/moved beyond the zoomed section of the display, the area auto-scrolls in the direction of the mouse drag.

5.3. Animation Tools

Standard dynamic/animation features, which can be added to the various graphic objects, will consist of at a minimum the requirements outlined below.

- R5.79 Animation connections will be constructed using the mouse without the need to type point names or strings.
- R5.80 Multiple dynamics of differing type can be applied to the same object (e.g., a size dynamic, and a color dynamic both added to a rectangle).
- R5.81 Multiple dynamics of the SAME type can be applied to objects (e.g., one size dynamic tied to one variable, and another size dynamic tied to another variable both added to a rectangle).
- R5.82 Only applied dynamics associated with the object will be listed.
- R5.83 The option will be available to only copy dynamic connections from one object to others.

5.3.1. Dynamic Connections

- R5.84 For all dynamic connections, the user will be able to specify the tag or point name using point and click selection with the mouse.
- R5.85 A most recently used tag name list will allow quick selection of often-used tags.
- R5.86 Wherever a tag name can be used, an "Expression" will also be permitted (Expressions are outlined elsewhere in this specification).
- R5.87 Wherever a tag name can be used, a "Local Variable" will also be permitted. These local variables are unique for each display file, and will NOT count against any "tag count" limit imposed by the license.
- R5.88 Should a dynamic connection fail in getting a value from I/O, the dynamic must indicate such failure visually on the screen as follows:
- Visual Dynamics on graphic objects (size, color, flash, location, etc.) must change the color of the bound object (color user-definable)
 - Data Values shown numerically must have an option to show a user-defined character (question marks or asterisks, for example) instead of the last known value.
- R5.89 Wherever a tag name can be used, an "Alias" will also be permitted (Aliases are outlined elsewhere in this specification).
- R5.90 Dynamics can be applied to either individual objects, or a group of objects.

5.3.2. Size Dynamic

- R5.91 A Size Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as grouped combinations of these objects.
- R5.92 The object will grow in size in one of two methods (selectable on a per-object basis):
- Scale (the entire object grows/shrinks relative to the analog signal it's connected to)
 - Clip or Reveal (the dimensions of the overall object remain the same, but the object is revealed relative to the analog signal it's connected to)
- R5.93 The range of the analog connection through which the object can grow will be configurable by the user.
- R5.94 The starting and ending size, as a percentage, will be configurable by the user.
- R5.95 The size of the object(s) will be able to be configured to change in the following directions:
- To the Left
 - To the Right
 - To the Top
 - To the Bottom
 - To any combination of 2 directions simultaneously (e.g., left and right growing from the center, top and right growing from the lower left corner, etc.)
 - To any combination of 3 directions simultaneously (e.g., left, right, and top, etc.)
 - In all four directions simultaneously
 - To the Left or Right, with a "bias" in the middle (starting in the middle and either going to the left or to the right, but not both at the same time)
 - To the Top or Bottom with a "bias" in the middle (starting in the middle and either going to the top or bottom, but not both at the same time)

5.3.3. Flash Dynamic

- R5.96 A Flash Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as a grouped combination of these objects.
- R5.97 The object will flash based on the status of a Digital Signal (or the Boolean result of a logical expression).
- R5.98 The user will be able to select whether it flashes on the "True" or on the "False" condition.
- R5.99 The object will flash using one of two methods (selected by the user):
- Hiding the object
 - Changing the Object's Colors (either it's Line color, or Fill color, or both)
- R5.100 The rate at which the object will flash will be configurable by the user on a per object basis (range at least 50ms - 2 minutes)

5.3.4. Digital Color Dynamic

- R5.101 A Digital Color Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, and Text objects, as well as grouped combinations of these objects.
- R5.102 The object will change its color (either its line color, or Fill color, or both) based on the status of a Digital Signal (or the Boolean result of a logical expression).
- R5.103 The user will be able to select whether it changes color on the "True" or on the "False" condition.

R5.104 More than one Color Dynamic will be permitted to be configured per object, each with its own independent Boolean expression to control the color dynamic. For example, one digital signal would change the object's fill color to red, while a different digital signal would change the fill color to yellow and the line color to black, while a third digital expression evaluates an analog signal to go above a threshold to change the fill color to green.

R5.105 If more than one digital color dynamic is assigned to the same object, the user will be able to configure their order of precedence.

5.3.5. Analog Color Dynamic

R5.106 An Analog Color Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, and Text objects, as well as grouped combinations of these objects.

R5.107 The object will change its color (either its line color, or Fill color, or both) based on the value of an Analog Signal as it goes through its range.

R5.108 The range of the analog connection through which the object will change color will be configurable by the user.

R5.109 The user will be able to configure the Start color (corresponding to the low range) and the End Color (corresponding to the high range). As the Analog signal goes through this range, the object will change its color from the Start to End colors.

R5.110 The user will be able to configure if the object will revert to the default color assigned to the object if the analog signal falls below or goes above the specified range.

5.3.6. Hide Dynamic

R5.111 A Hide Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as grouped combinations of these objects.

R5.112 The object will hide based on the status of a Digital Signal (or the Boolean result of a logical expression).

R5.113 The user will be able to select whether it hides on the "True" or on the "False" condition.

5.3.7. Disable Dynamic

R5.114 A Disable Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as grouped combinations of these objects.

R5.115 The object will become based on the status of a Digital Signal (or the Boolean result of a logical expression).

R5.116 The user will be able to select whether it becomes disabled on the "True" or on the "False" condition.

R5.117 If this Disable Dynamic becomes active for a any type of user data-entry dynamic (like data entry fields, sliders, dials, check boxes, radio buttons, push buttons, etc.), then that dynamic will no longer accept input from the user while it remains disabled.

R5.118 The fill and line colors for objects that become disabled will change to reflect that the object is now disabled.

R5.119 The default "Disabled colors" for all objects on the display will be light gray for Fill, and dark gray for Line, but these will be user configurable.

5.3.8. Rotation Dynamic

R5.120 An Rotation Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, and Image objects, as well as a grouped combinations of these objects.

R5.121 The object will rotate based on the value of an Analog Signal as it goes through its range.

R5.122 The range of the analog connection through which the object will rotate color will be configurable by the user.

R5.123 The starting angle and ending angle will be configurable by the user, in one-degree increments.

R5.124 The pivot point around which the object rotates will be configurable by the user.

R5.125 Whether the object rotates clockwise or counterclockwise will be configurable by the user.

5.3.9. Dial Dynamic

R5.126 A Dial Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, and Image objects, as well as grouped combinations of these objects.

R5.127 The requirements outlined for the Rotation Dynamic will also apply to the Dial Dynamic.

R5.128 The user will be able to click and drag the object, rotating it around the pivot point defined through the angles defined. As this rotation occurs, it will write values to the connected Analog tag, with the low range corresponding to the start angle, and the high range corresponding to the end angle.

R5.129 The user will be able to select when the analog values are updated, either:

- as quickly as possible while the "dial" action is taking place (continuous updates)
- only when the user releases the mouse click.

R5.130 The user will be able to configure whether the rotation of the dial is smooth through the range, or uses just a number of discrete steps (detents) through the range.

5.3.10. Location Dynamic

R5.131 A Location Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as grouped combinations of these objects.

R5.132 The object change its location (move across the screen) based on the value of an Analog Signal as it goes through its range.

R5.133 The range of the analog connection through which the object will move will be configurable by the user.

R5.134 The location dynamic will follow one of the following paths:

- Horizontal
- Vertical
- Diagonal
- Multi-line Path

R5.135 The starting point and ending point defining the location extent will be configurable by the user graphically on the screen by dragging with the mouse.

R5.136 Should a Multi-line Path be selected, the user will be able to define, edit, remove inflection points (nodes) in the line graphically on the screen by clicking/dragging with the mouse.

5.3.11. Slider Dynamic

R5.137 An Slider Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as a grouped combinations of these objects.

R5.138 The requirements outlined for the Location Dynamic will also apply to the Slider Dynamic, with the exception of Multi-line Paths (not required).

R5.139 The user will be able to click and drag the object, sliding it along the defined path defined by the start and end point. As this slide/translation occurs, it will write values to the connected Analog tag, with the low range corresponding to the start point, and the high range corresponding to the end point.

R5.140 The user will be able to select when the analog values are updated, either:

- as quickly as possible while the "slider" action is taking place (continuous updates)
- only when the user releases the mouse click.

R5.141 The user will be able to configure whether the location of the slider is smooth through the range, or uses just a number of discrete steps (detents) through the range.

5.3.12. Animator Dynamic

R5.142 An Animator Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as a grouped combinations of these objects, when more than one such object is selected.

R5.143 The Animator Dynamic will cycle through all of the images selected at a user-specified "frame rate" (range at least 50ms to 2 minutes), thereby creating a picture slide-show animation.

R5.144 The objects will become animated based on the status of a Digital Signal (or the Boolean result of a logical expression).

R5.145 The user will be able to select whether the animation occurs on the "True" or on the "False" condition.

R5.146 When not animated, the user will be able to configure what is shown, selecting either:

- All objects in the animation become invisible
- The first object in the animation sequence is shown
- The last frame animated/shown remains shown.

R5.147 The user will be able to change the order in which the objects are shown (re-sequence the animation).

5.3.13. Digital Selector Dynamic

R5.148 A Digital Selector Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as grouped combinations of these objects, when more than one such object is selected.

R5.149 Only one of the objects within the grouping will be shown at a time, with each object in the group having its visibility tied to the status of a Digital Signal (or the Boolean result of a logical expression). For example, one digital signal would make just object one be shown, while a different digital signal would make the just second object shown, while perhaps a third digital expression evaluates an analog signal to go above a threshold to make just the third object shown.

R5.150 The user will be able to select whether each object hides on the "True" or on the "False" condition of its digital connection.

R5.151 The user will be able to configure the order of precedence (in case two conditions occur simultaneously, the higher priority object would be shown).

R5.152 The user will have access to the properties of each of the objects in the dynamic so changes can be easily made.

5.3.14. Analog Selector Dynamic

- R5.153 An Analog Selector Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as grouped combinations of these objects, when more than one such object is selected.
- R5.154 Only one of the objects within the grouping will be shown at a time, with each object in the group having its visibility tied to a portion of a range of an analog signal.
- R5.155 The user will be able to configure how the range is broken up (by percentage) and assigned to the objects selected for the dynamic. The default will evenly divide the range into the number of objects selected.
- R5.156 The user will be able to configure the order in which the objects are shown.
- R5.157 The user will have access to the properties of each of the objects in the dynamic so changes can be easily made.

5.3.15. Value Dynamic

- R5.158 A Value Dynamic will be able to be configured, with its "visible" properties matching those of Text objects described earlier.
- R5.159 The data connection will support (and be configurable as) reading the following types:
- Byte
 - Word
 - Double Word
 - Short Integer
 - Long Integer
 - Floating Point
 - Double Precision Floating Point
 - Boolean
 - String
- R5.160 The data connection will support displaying the data as any one of the above mentioned types, as well as Hexadecimal, Octal, or Binary.
- R5.161 For Floating Point and Double Precision data types, the user will be able to configure how many decimal places are shown.
- R5.162 For the String data type, the user will be able to configure the number of characters displayed.
- R5.163 For the Boolean data type, the user will be able to configure whether a simple 1/0 is shown, or two different words (e.g., stop/start, off/on, open/closed, etc.)
- R5.164 The user will be able to specify whether leading zeros are shown (e.g., 23 vs. 0023).
- R5.165 The user will be able to specify whether thousands-separators are shown (e.g., 1000000.00 vs. 1,000,000.00)
- R5.166 The thousands -separator, if shown, will conform to the local symbol (e.g., comma or period for US, Europe, etc.).
- R5.167 The user will be able to specify a text string to show for the units of the data being shown, and whether it is shown to the right or to the left of the number.
- R5.168 The text string for units will be able to be tied to a global alias or a language string (instead of just a constant text string).

5.3.16. Data Entry Dynamic

- R5.169 A Data Entry Dynamic will be able to be configured, with its "visible" properties matching those of Text objects described earlier.
- R5.170 The requirements for Value Dynamic will apply to the Data Entry Dynamic as well.
- R5.171 The user will be able to override the High and Low ranges used to define the values allowed to be entered into the field.
- R5.172 The user will have the option to specify an Initial Value.
- R5.173 The user will have the option to pop-up a dialog box confirming the user's data entry prior to downloading the Value (i.e., and "are you sure you want to change Tag1 to 100" type of message with OK/Cancel buttons).
- R5.174 The user will have the option to pop-up a keypad for the data entry (thereby facilitating touch screen installations or other such pointing devices without requiring an actual keyboard).
- R5.175 The pop-up keypad will be a numeric pad for all number data types, and automatically switch to being a QWERTY keyboard for String data types.
- R5.176 During runtime, the user will be able to increase/decrease the value by pressing the up/down arrow keys, respectively.
- R5.177 The user will be able to hit the ESC key, or simply clicking onto another object without first pressing the Enter key as the confirmation of the entry. Doing so will revert the data entry field to the value it contained prior to the user typing in values.

5.3.17. State Field Dynamic

- R5.178 A State Field Dynamic will be able to be configured, with its "visible" properties matching those of Text objects described earlier.
- R5.179 The text displayed will be based on the value of the Analog Signal it is tied to.
- R5.180 The User will be able to build a table with the state definitions. For example, a value of 0 corresponds to the string "Auto", a value of 5 corresponds to the string "Manual Mode", a value of 15 corresponds to the string "Clean Cycle Beginning", and so on.
- R5.181 A "default" string will be able to be defined, which is shown in the event that the analog signal has a value not defined in the string definition table.
- R5.182 The maximum number of states defined per dynamic will be 100 at a minimum.
- R5.183 The state table definitions will be able to be exported to a standard ASCII text file so it can be edited by Excel, Word, etc. A file so edited will be able to be re-imported back into the State Field Dynamic.

5.3.18. State Field Data Entry Dynamic

- R5.184 The State Field Dynamic described earlier will have the option to be turned into a data entry field.
- R5.185 When clicking on such a field, the user will be presented with a drop-down list of the states defined in the dynamic.
- R5.186 Selection of an entry in the list will be by:
- Mouse
 - Up/down arrow keys
 - Typing in the first letter of an entry
- R5.187 Once selected, the corresponding numerical value will be downloaded to the Analog Tag connected to the dynamic.

5.3.19. Time/Date Dynamic

R5.188 A Time/Date Dynamic will be able to be configured, with its "visible" properties matching those of Text objects described earlier.

R5.189 It will be configurable to show the current system date/time in the following manner:

- Current Date Only
- Current Time Only
- Current Date and Time (in that order)
- Current Time and Date (in that order)

R5.190 The Time format will be able to be configured as follows:

- Any combination of Hours, Minutes, Seconds (e.g., just the hour, or just the minutes, or just seconds, or hour and minute but not seconds, all three, etc.)
- Military Time (24hour) or AM/PM format
- AM/PM indicator shown or not shown

R5.191 The Date format will be able to be configured as follows:

- Any combination of Day, Month, Year (e.g., just the month, just the day, just the year, all three, etc.), and in any order (e.g., month/day/year, or day/month/year, or year/month/day, etc.).
- The separator character between fields will be user defined
- The Day will either be numeric, abbreviated string, or full name (e.g., 06, or Wed, or Wednesday)
- The Month will either be numeric, abbreviated string, or full name (e.g., 12, or Dec, or December)
- The Year will be configured to show either the last two numbers in the year, or the entire 4 numbers (e.g., 01, or 2001)

5.3.20. Display Switch Dynamic

R5.192 A Display Button Dynamic will be able to be configured to, when clicked during runtime, either:

- Load in a whole new graphic display file
- Pop-up a separate window containing a display file
- Drag/Drop load the associated display file into a graphic ActiveX Viewer control

R5.193 A miniature "thumbnail" view of the associated display graphic will be shown on the button.

R5.194 The user will be able to configure the size of this Image image, choosing from at least 5 different sizes.

R5.195 An optional text label will be shown (on either the top or bottom of the button), helping the user identify the display.

5.3.21. Button Dynamic

R5.196 A Button Dynamic will be able to be configured, with its "visible" properties matching those of Text objects described earlier.

R5.197 The Button will be able to be configured to, when clicked during runtime, either:

- Load in a whole new graphic display file. Parameters include filename with or without a path, and optional alias definitions.
- Pop-up a separate window containing a display file. Parameters include filename with or without a path, optional alias definitions, pop-up window position (centered to parent, last saved default position, or specific top, left, width, height parameters), and whether it is "Modal" or not.

- Drag/Drop load an associated display file into a graphic ActiveX Viewer control. Parameters include filename with or without a path, and optional alias definitions.
- Go Back (to the Previous Display), or Go Forward (similar to the forward/back arrows in the Internet Explorer).
- Launch a third-party application. Parameters include any EXE file name (or .BAT or .COM file) and optional command line strings for it.
- Launch a document (e.g., *.DOC, *.TXT, *.XLS, *.MDB, etc.).
- Launch a link to a web page (e.g., *.HTM, *.HTML, etc.).
- Close the current window
- Download a Value to an analog or digital tag. Parameters include whether it should be initiated via a right/middle/left mouse click, and whether the action should take place on the down-click, up-click, and/or while-held-down (in which case it is repeated at a configurable interval, range at least 50ms to 2 minutes). Also specified is the value(s) used to write, and the analog or digital tag to write to.
- Toggle a Value of an analog or digital tag between two values. Parameters include whether it should be initiated via a right/middle/left mouse click, and whether the action should take place on the down-click, up-click, and/or while-held-down (in which case it is repeated at a configurable interval, range at least 50ms to 2 minutes). Also specified are the two value to toggle between, and the analog or digital tag to write to.
- Run a Script. Parameters include whether it should be initiated via a right/middle/left mouse click, and whether the action should take place on the down-click or up-click and also includes the name of the script to invoke.
- Set Aliases in the current Display. Parameters include the alias definitions, which can be directly defined, imported from a text file, or directly loaded during runtime from the text file.
- Select a Global Alias Theme for the entire project.
- Select which Language is used (for multi-lingual installations).
- Manipulate the layers in the graphic by hiding them, showing them, or toggling their state. Parameters include whether it should be initiated via a right/middle/left mouse click, and whether the action should take place on the down-click or up-click and also includes the name of the Layer Name it should act upon.
- Pop-up a menu, which itself then contains an array of such buttons, each being able to take on the actions described in this list.

R5.198 A shortcut key will be able to be configured for each Button, using a combination of Shift, Alt, and Control keys (or none) along with other keys on the keyboard.

5.3.22. Pick Dynamic

R5.199 A Pick Dynamic will be able to be applied to Line, Polygon, Arc, Ellipse, Circle, Rectangle, Image, Text, and Metafile objects, as well as a grouped combination of these objects.

R5.200 This dynamic will offer the same capabilities as the Button Dynamic, thereby turning any object into a "button". The visible characteristics of the button would not be the text object described for normal buttons, but rather the visual graphic of the object(s) it is applied to.

5.4. Alarm/Trend Tie-In

R5.201 It will be possible to include embedded Trend Views (both Real-time and Historical) from the Trending Module of the HMI/SCADA package.

R5.202 It will be possible to include embedded Alarm Views (both Live and Historical) from the Alarming Module of the HMI/SCADA package.

- R5.203 More than one of each (Trend and/or Alarm) can be included in any given display.
- R5.204 The user will be able to configure the placement (Top, Left) and size (Width, Height) of each Alarm/Trend window.
- R5.205 All of the features enjoyed by such windows with their respective Module will also be available when embedded within the Graphics Module.

5.5. Symbol Storage Library

- R5.206 The graphics module will include a symbol storage capability that supports both static and dynamic symbols.
- R5.207 MachineWorX will be supplied with a standard set of graphic symbols in the library.
- R5.208 Symbols in the library will be able to be dragged into a graphic display for use.
- R5.209 User created Symbols will be able to be dragged into the library for storage
- R5.210 The library will include the ability to create multiple categories in which to store the symbols. This will facilitate management of many symbols.
- R5.211 A preview of the stored symbols will be provided to allow the user to view a symbol before it is selected from the library.
- R5.212 It will be possible to make the preview thumbnail large (for seeing more detail), or small (for fitting more of them on a single page).
- R5.213 The symbol library will be able to "Float" above the Graphics workspace, thus enabling the drag-n-drop of symbols with minimal screen switching.
- R5.214 The symbol library will also be able to "dock" to any side of the graphics development environment as a toolbar.
- R5.215 The ability to lock a symbol category with a password will be provided.
- R5.216 Symbols will have the ability to be linked together (by some shared keyword or the like). Objects sharing the same keyword will be able to be updated on a global basis (whereby user selects the scope of the changes via a display list). This permits objects to have their look-n-feel visual properties, as well as their associated dynamics, updated throughout the project.

5.6. Expressions

- R5.217 A built-in Expression editor will be provided by the Graphics Package.
- R5.218 Expressions will be able to be used anywhere a Tag Name can be used.
- R5.219 Functions provided by the Expression editor will include:
- Open and Closed Parenthesis (for defining order of operation)
 - Addition, Subtraction, Multiplication, Division, Modulus Division
 - Relational expressions of greater than, less than, equal to, not equal to, less than or equal, greater than or equal
 - Logical AND, Logical OR, Logical NOT operations
 - Bit-wise manipulation including AND, OR, NOT, XOR, Bit Shift Left, Bit Shift Right, and Bit Test
 - Mathematical functions Sine, Cosine, Tangent, Arc-sine, Arc-cosine, Arc-tangent, Square Root, Raised to Power of, Logarithm, Natural Logarithm, Exponential, Absolute Value, Minimum and Maximum
 - String Concatenation, Conversion to String, and String "Like" comparison functions

- Conditional If, Then, Else statement
- OPC Quality Testing (e.g., 192 - Quality GOOD) of values of OPC Tags

R5.220 Direct access will be provided to connect to OPC Tags.

R5.221 Numeric and String constants will be able to be used in the expressions.

R5.222 Functions for defining a constant as being of type String, Octal, Hexadecimal, and Binary will be provided.

R5.223 The Editor will parse the entered expression to check for syntax errors.

R5.224 "White space" (i.e., tabs, spaces, CR/LF) will be ignored, permitting better formatting for readability of the expressions.

R5.225 A list of the last 50 expressions used will be available (e.g., perhaps via a drop-down list) to aid in expression development and re-use.

5.7. Scripting

R5.226 The Graphics Package will allow the creation of buttons and pick actions that, when activated (clicked-on by the user), will run a script.

R5.227 The scripts will be "associated" with the object containing the pick action, such that if it is copied from one screen to another, or stored in the Symbol Library, the scripts will be stored along with the object.

R5.228 The user will have a choice, on a per button/pick-action basis, of which type of script will be used, choosing from:

- JScript
- VBScript

Each of these three scripting choices is further explained in the subsections that follow.

5.7.1. JScript

R5.229 The Graphics Package will provide JScript as a scripting language.

R5.230 A JScript Editor will be provided in the Graphics Package, so script creation can be done within the application.

R5.231 The JScript Editor will provide the ability to import and export scripts.

R5.232 Users will be able to define their own "keywords" and colors used in the JScript Editor.

R5.233 Graphic Displays with JScripts will be able to run over the Web in the Web Interface provided.

5.7.2. VBScript

R5.234 The Graphics Package will provide VBScript as a scripting language

R5.235 A VBScript Editor will be provided in the Graphics Package, so script creation can be done within the application.

R5.236 The VBScript Editor will provide the ability to import and export scripts.

R5.237 Users will be able to define their own "keywords" and colors used in the VBScript Editor.

R5.238 Graphic Displays with VBScripts will be able to run over the Web in the Web Interface provided.

5.8. Miscellaneous

- R5.239 MachineWorX will support networked "Portable Displays", whereby completed graphical displays can be copied to any other node without the need to edit and/or re-establish dynamic connections.
- R5.240 During runtime, the user will be able to move among the various data entry dynamics (sliders, buttons, dials, data entry fields, state field entries, pick actions) by either pointing to it with the mouse (or touch screen, etc.), or by tabbing to the field to enter data.
- R5.241 The order in which the objects are tabbed to will be configurable by the user.
- R5.242 MachineWorX will allow multiple graphic displays to be viewed on the screen simultaneously.
- R5.243 All graphic displays will be able to be configured as either "Fixed scale", or as "Scalable" which would allow automatic scaling of the display so as to maintain a full view of the graphics regardless of the window size and/or screen resolution.
- R5.244 Graphic displays will have the ability to turn off their Menu and/or Title bar during runtime.
- R5.245 Graphic displays will have the ability to make their window non-re-sizable during runtime.
- R5.246 The mouse cursor will change whenever the user hovers over an object with a dynamic for user input. An optional "focus rectangle" can be shown, whose colors can be configured.
- R5.247 An option will be provided to show tool tips during runtime (and configuration mode) that can be customized to show any combination of:
- Tag used (for dynamic objects)
 - Process Value (for dynamic objects)
 - User defined text for help/description
 - Object name
- R5.248 The graphics editor will have capability to create/edit templates and apply these on various displays.
- R5.249 The graphics module will offer a Print Preview option to show what the printout will look like prior to sending it on to the printer.
- R5.250 The graphics module will offer several print regions, selectable from: current zoom level, a default/home view, all objects in the display, and un-zoomed to minimum size.
- R5.251 The graphics editor will maintain a list of the last 9 displays that were edited (making it easier to switch between them).
- R5.252 An option will be provided to enable a display (on a per-display basis) to "Always Be on Top".
- R5.253 An option will be provided to permit one color (as selected by the user from a color pallet) to be "Transparent", enabling whatever is behind the active display to show through. Clicking on the transparent region will transfer such clicks/mouse-movements to the underlying window.

6. Alarm Monitoring Module

The Alarm Module will:

- R6.1 Be based on OPC specifications by the OPC Foundation, being compliant not only with the OPC-Data Access spec as a client, but also OPC-Alarms & Events, being both a client and a server.
- R6.2 Be of modular design, with separate components for:
 - Alarm Configuration
 - Alarm Server
 - Alarm Logging to a Database and Printer
 - Live "Active" Alarm Viewing
 - Historical Alarm Reporting

6.1. Alarm Server

The Alarm Server Module will be able to be configured to:

- R6.3 Monitor OPC Data and/or "Expressions" (Expressions are outlined earlier in this specification) for alarm conditions.
- R6.4 Contain help instructions on a per-alarm basis to assist operators in solving the alarms when viewing them.
- R6.5 Associate a default graphic display with each alarm. That way, when alarms are viewed in runtime, an operator could quickly jump to the associated display to view details on the alarm.
- R6.6 Enable monitoring of each individual alarm based on an OPC Data digital tag or the result of an expression (to aid in eliminating nuisance alarms, etc.) If the result is "true", then the alarm is monitored; if "false", then the alarm is ignored and won't even be generated.
- R6.7 Offer grouping the alarms so configured into categories and sub-categories (also known as Alarm Areas).
- R6.8 Have a delay time specified, on a per-alarm basis, that an alarm must be active before it is considered a true alarm. This delay can be defined as either a constant (i.e., 10 seconds), or tied to an OPC Tag or Expression.
- R6.9 Associate one or more (up to 10) OPC Tags / Expressions with each alarm as "supplemental" information to the alarm. For example, one could tie a "Batch ID" to a specific alarm. Then, when the alarm becomes active, a permanent record of the Batch ID is also stored along with the alarm information.
- R6.10 Run locally or over the network, supplying alarms and events to multiple alarm clients on multiple machines.
- R6.11 The storage of the alarm configuration data itself will be stored in an open database (e.g., an MS Access *.MDB file).
- R6.12 Provide the following alarm types:
 - Digital
 - Analog Limit
 - Deviation
 - Rate of Change

6.1.1. Digital Alarms

R6.13 The alarm server will generate an alarm when a digital signal goes into alarm.

The user will be able to configure:

R6.14 Whether the Alarm State is 0 or 1, being either a constant value or tied to an OPC Tag and/or expression.

R6.15 The Priority of the alarm, being either a constant value or tied to an OPC Tag and/or expression.

R6.16 The message to display when the alarm occurs. This message can be either entered directly as a string constant, or tied to a global alias.

R6.17 The message to display when the alarm returns to normal

R6.18 Whether the alarm requires acknowledgment from the operator

6.1.2. Analog Limit Alarms

R6.19 The alarm server will monitor analog signals, generating an alarm when it passes a limit threshold.

The user will be able to configure:

R6.20 Individual alarm thresholds for four different alarm states: LowLow, Low, High, HiHi

R6.21 The alarm thresholds, being either a constant value or tied to an OPC Tag and/or expression.

R6.22 A deadband through which the alarm must change before a change in state occurs, being either a constant value or tied to an OPC Tag and/or expression.

R6.23 The Priority of each alarm state, being either a constant value or tied to an OPC Tag and/or expression.

R6.24 Separate messages to display when each of the alarm states occur. These messages can be either entered directly as string constants, or tied to a global alias.

R6.25 The message to display when the alarm returns to normal. This message can be either entered directly as a string constant, or tied to a global alias.

R6.26 Whether each of the alarm states require acknowledgment from the operator

6.1.3. Deviation Alarms

R6.27 The alarm server will be able to monitor two analog signals, comparing them and generating an alarm when they deviate from one another.

R6.28 The user will be able to configure the same parameters for Deviation alarms as those available for Limit Alarms.

6.1.4. Rate of Change Alarms

R6.29 The alarm server will monitor analog signals, generating an alarm when it changes faster than a defined rate.

The user will be able to configure:

R6.30 The Rate of Change Limit, being either a constant value or tied to an OPC Tag and/or expression.

R6.31 The Priority of the alarm, being either a constant value or tied to an OPC Tag and/or expression.

- R6.32 The message to display when the alarm occurs. This message can be either entered directly as a string constant, or tied to a global alias.
- R6.33 The message to display when the alarm returns to normal. This message can be either entered directly as a string constant, or tied to a global alias.
- R6.34 Whether the alarm requires acknowledgment from the operator

6.2. Live/Active Alarm Viewing

- R6.35 The Live/Active Alarm Viewer component will be an ActiveX Control, capable of being embedded within a graphic display file or other appropriate real-time ActiveX Container.
- R6.36 A separate Alarm "container" application will be provided to contain the ActiveX (so that it can run "stand-alone" without the need to depend on being embedded within the graphics container). It will also support embedding third party ActiveX Controls. It will offer a multi document environment with a VBA Scripting interface.
- R6.37 The Alarm ActiveX will be capable of saving and re-loading various configuration files to define its operation. Details of what can be configured are described below.

6.2.1. Configuration

The Alarm Viewer ActiveX component will comply with the following configuration requirements:

- R6.38 View window dimensions (height, width, top, left) will be defined by simply clicking/dragging with the mouse.
- R6.39 Background color of the alarm window will be defined from at least 256 colors
- R6.40 Lines (grids) separating the rows and/or columns will be defined as to their color, width, line style, and visibility (shown or not).
- R6.41 Number of rows visible will be user defined (range at least 2 to 50)
- R6.42 Each row will contain one alarm message
- R6.43 A "multi-line" row will be permitted, with the user specifying the number of lines (height) of each row (range at least 1-9 lines per alarm row)
- R6.44 Different Font Styles (font name, size, bold, italic, underline, color) will be defined for the following 5 categories:
- Active alarms not yet acknowledged
 - Active alarms which are acknowledged
 - Alarms which have returned to their normal state, but which have not yet been acknowledged
 - Simple "System" Events
 - Tracking Events for following operator actions
- R6.45 Within each of the above five categories, additional font styles will be able to be defined for different priorities. For example, unacknowledged alarms are white text on red background, Arial size 12; in addition, any of those which are also over 500 in priority should also be Bold, Underline, and overriding the size to 14).
- R6.46 Columns visible in the alarm window will including any number of the following:
- Date/Time
 - Tag Name
 - Priority
 - Alarm Area

- Alarm Message
 - Alarm Type/Category
 - OPC Quality
 - Node the Alarm was generated on
 - Acknowledgment Status
 - An Operator-entered Acknowledgment comment
 - Help Information
 - Time the Alarm has been Active
 - Additional Associated Values (e.g., other live data values) related to the alarm
 - Alarm Server Name
- R6.47 An overriding font style will be able to be defined for a specific column. For example, the Help Text column might always be black text on a white background.
- R6.48 Column Text Alignment will be user-defined as either Center, Left, or Right, on a per-column basis.
- R6.49 The Alarm View will be sorted by a user-selected column, either in ascending or descending order.
- R6.50 Additional sub-sorting by another column will be permitted. For example, first sort by alarm priority (highest at the top), then by area (alphabetical order), then by Tag name.
- R6.51 A column will be able to be designated as the source for pop-up tooltips during runtime, and that column therefore be made invisible. For example, the Help column could be used so operators get context sensitive pop-up assistance while hovering over an alarm line.
- R6.52 The Alarm Viewer will be able to be configured to get its alarms from either a local alarm server, or one on the network.
- R6.53 The Alarm Viewer will be able subscribe to more than one such alarm server.
- R6.54 Filters will be able to be defined to select which types of alarms should be shown in a particular alarm view. For example, show only alarms with a priority greater than 100, or show only unacknowledged alarms, or only operator tracking events, etc.
- R6.55 Alarm Filtering will be configurable based on:
- Events vs. Alarms
 - Acknowledgment Status
 - Priority
 - Tag Name
 - Alarm Area
 - Alarm Type (limit, deviation, rate of change, digital)
 - Alarm Sub-Type (hihi, hi, low, lolo)
 - OPC Quality
 - Date/Time
 - Node
- R6.56 Multiple Alarm Filters will be able to be configured for selection by the operator during runtime operation.

6.2.2. Runtime

The Alarm Viewer ActiveX component will comply with the following requirements while it is in "runtime" mode showing live/active alarms:

- R6.57 If more alarms exist than there are rows visible, then a scroll bar will be provided such that operators can scroll through the listing.
- R6.58 If the operator scrolls down to another part of the listing and a new alarm comes into MachineWorX, a visual indicator will be given (so the operator knows the view has changed beyond what he's looking at).
- R6.59 The user will be able to select just one alarm in the list, or window a region to select multiple alarm lines at the same time.
- R6.60 The alarm selection will not affect the color of the alarm line, so that operators can still use color as an alarm indicator.
- R6.61 Alarms acknowledged at any one client will be reflected on all other subscribed alarm clients on the network
- R6.62 When an alarm is acknowledged, the operator will have the opportunity to enter in a comment to be stored in the log database.
- R6.63 Operators will have access to viewing the "Operator Comments", and append additional comments to the database.
- R6.64 Acknowledgment of alarms will be by:
 - Individual alarm, as selected by user
 - A group of alarms, selected by the user
 - All alarms belonging to the same Area
 - All filtered alarms
 - All alarms currently visible in the alarm view window
 - All alarms in MachineWorX
- R6.65 Rows and/or Columns will be able to be resized, if such option was configured to be available to the operator.
- R6.66 Which column is sorted by will be able to be changed during runtime.
- R6.67 By right-clicking on an alarm, the operator may select to jump to an associated display for that alarm (if one was configured for it).
- R6.68 More than one Alarm ActiveX Viewer will be permitted, each with its own set of configuration parameters (e.g., subscriptions, filters, styles, etc.)

7. Security

- R7.1 The software will provide a Security component for restricting access to different areas of MachineWorX.
- R7.2 It will be possible to configure different sets of individual users (range at least 1 to 1000 users) as well as categorizing those users (e.g., engineers, operators, supervisors, etc.) into groups (range at least 1 to 100 groups).
- R7.3 It will be possible to assign a person to more than one group (e.g., Fred is both an Engineer and a Supervisor).
- R7.4 The names and groups will be able to be optionally obtained from a Domain Server (NT4, 2000, XP) or the local PC's definitions.
- R7.5 If the names/groups are obtained from the Windows system, then a synchronization period will be able to be specified (to check for new user names, etc.)
- R7.6 An option will be provided so a user's information from logging into the Windows operating system (NT4, 2000, XP) can be automatically used within the HMI/SCADA system as well, thus only requiring the user to log in once.
- R7.7 For each individual user, and for each group, it will be possible to define:
- Name
 - Alternate "Full Name" (e.g., username may be "Joe", but Full Name would be "Joseph R. Smith")
 - Optional Description
 - Password, including such parameters as minimum length required, time allowed before it must be changed, uniqueness over time, and password complexity).
 - Time they're permitted to log in, specifying hours on a per-day basis (e.g., log in only on Mondays and Wednesdays from 8am to 5pm).
 - Data Points which can and cannot be written to
 - Files which can and cannot be accessed
 - Workstations which can be used to log in from
 - A custom section to define security items not anticipated by the software, accessible from the VBA environment for customized security, or from other programming environments through OLE Automation calls.
- R7.8 Besides the per-user/group restrictions on writing to OPC Data Points, an additional list of OPC Data points will be able to be identified as "Critical" points. Then, whenever a user attempts to modify the value of one of these points via the HMI interface, they will be immediately prompted to log in and re-verify themselves before the write operation is permitted.
- R7.9 It will be possible to configure an Auto-Logout period, whereby the user is automatically logged out of MachineWorX after a specified amount of time has elapsed.
- R7.10 Should Auto-Logout be in effect, there will be an early warning message prior to the logout action (time remaining configurable by the user).
- R7.11 It will be possible to optionally require a password for logging out early (so someone doesn't log another user out against their wishes).
- R7.12 A utility will be provided to show which users are logged into MachineWorX (both on the local machine, and on networked machines).
- R7.13 When the user is prompted for Username/Password for login, support for "Touchscreens" will be provided (for example, offering a pop-up keyboard for entering the information).

- R7.14 If a user fails to successfully log in, it will be possible to bring up a Graphics display offering user-configured options (e.g., re-attempt to login, go to a “home” screen, go back to previous display, etc.)
- R7.15 If a user fails to successfully log in after a configurable number of times, it will be possible to lock that account out until either an administrator clears it, or after a preset amount of time has elapsed.
- R7.16 All log-in and log-out activity (name, time, node, etc.) will be monitored and posted such that it can be logged to a database and/or printer. Such “Audit Trail” information will be able to be viewed and reports generated by other components in MachineWorX.
- R7.17 Restrictions on software module interaction will be configured on a per-user and per-group basis. Items to lock out include:
- Exiting the applications
 - Printing
 - Entering Configuration Mode
 - Switching Languages
 - Starting/Stopping of Alarm and/or Data Logging
 - Acknowledgement of Alarms
 - Alarm Filtering
 - Changing zoom factors in graphics and trends
 - Modifying and Executing Trend Reports
 - Adding, Editing and/or Deleting Trend Pens
 - Changing columns visible in Alarm and Trend viewers
 - Running a Script
 - Accessing the Windows Desktop
 - Executing each of the Pick Actions in the Graphics Module (configurable per type)
 - Opening other Graphics Displays

8. Project Management

The Project Management package will:

- R8.1 Be able to manage more than one project at a time.
- R8.2 Permit association of not only documents/files of the type provided by the HMI/SCADA software, but also integrate other file types as well (e.g., CAD drawings, images, text files, etc.)
- R8.3 Pack/Zip up all of the files required for a project into a single, compressed file format for easy deployment from one machine to another.
- R8.4 Unpack/Unzip a project back into the proper locations on the same or other PC.
- R8.5 Tie into Microsoft Source Safe (directly from within the GUI for the Project Manager), permitting “versioning” of the each of the files used in the project.
- R8.6 Permit “batching” of the Source Safe process (i.e., check in/out entire project at once)
- R8.7 Manage the publishing of projects to the Web (Intranet/Internet).
- R8.8 Generate reports on the resources used for each project (e.g., listing the files, types, etc.). Such reports will be able to be created on either the entire project, or just the files associated with a particular application used within the project (e.g., Graphics Module)
- R8.9 The reports will list all parts of the project, giving details as to when each file was created, modified, its size, as well as giving an summary of entire project disk space required.
- R8.10 Have an option to list all OPC Tag names used in a project, and flagging any points that cannot be verified.
- R8.11 Have optional project summary information field for such items as:
 - Project Name
 - Project Version Number
 - Author Name(s)
 - Last Modified By
 - Comments
- R8.12 Permit locking a packed project via a password (so it cannot be unpacked without proper authorization).
- R8.13 Serve as a location from where users can launch each application associated with a project.
- R8.14 Be able to “Start/Activate” the entire project (putting the various configured components into “runtime” mode, for example).
- R8.15 Offer links to tools for trouble-shooting a project (e.g., network connection diagnostics, OPC Server diagnostics, etc.)
- R8.16 Provide a utility to globally search and/or replace text throughout a project and all of its sub-documents.

9. Language Capabilities

MachineWorX will have full language switching capabilities.

Internet Connectivity

- R9.1 A stand-alone Web Server software module will be provided so the HMI/SCADA software can be accessed over the Internet.
- R9.2 The Web Server module will run under Windows NT, embedded NT, Windows 2000, and Windows XP.
- R9.3 The Web Server module will run on a Windows CE platform, supporting such processors as Hitachi, MIPS, Intel, Strong Arm.
- R9.4 A user will only require Internet Explorer to be installed on their machine (Thin Client) to access MachineWorX, with any "Plug-ins" automatically installed for them by the Server when they first access a graphic, trend, or alarm screen.
- R9.5 A mechanism will be provided to deliver the software and data updates through firewalls.
- R9.6 The Web Server module will manage the number of concurrent users of the Internet connection.
- R9.7 It will be possible to have "floating" web licenses, whereby if one user logs off, that license is freed up so that another user can log in.
- R9.8 The same security system employed by the HMI/SCADA software will also manage users connecting via the web.
- R9.9 The graphics files will be represented over the web in the same manner as shown on a "standard" HMI/SCADA workstation (i.e., close-approximations via HTML is NOT acceptable: the graphics should look and interact the same as a regular station). The scope of this will include:
- Visual objects drawn
 - Visual Dynamics tied to these objects
 - User interactions (data entry fields, sliders, dials, etc.)
- R9.10 Anywhere a file path name can be used within the graphics software, a URL will also be able to be specified. For example, the Working Directory can be either "C:\project1" or www.mywebserver.com, so a Display Load operation can go directly to a web server for the display file.
- R9.11 Alarms on an IE web station will look and interact the same as a standard workstation. The scope of this will include:
- Visual alarm summary
 - Alarm Viewer features such as pop-up help, jumping to associated displays, etc.
 - Acknowledgment of Alarms (resulting in the same actions as if the alarm were acknowledged on any other workstation in MachineWorX)
- R9.12 Trend View windows on an IE web station will look and interact the same as a standard workstation.
- R9.13 It will cost less per station to run via the Web than a standard workstation.
- R9.14 A "standard" workstation user will also be able to connect to a networked system of other "standard" workstations via the Internet.

10. OPC Data

- R10.1 When configuring connections to OPC Data, the OPC Tag Browser feature in the OPC Specification will be used.
- R10.2 The OPC Browser will list all registered OPC Data Servers when making a connection to I/O data, and OPC Alarm and Event Servers when configuring alarms, and OPC Historical Data Access servers when configuring trending applications.
- R10.3 It will be possible to browse OPC Servers installed on the local machine as well as those installed on any node visible on the network.
- R10.4 A list of OPC Items recently used will be maintained, facilitating faster connections to common data items.
- R10.5 On-line OPC Data Configuration changes (e.g., adding a new tag on-line) will be supported by the HMI/SCADA package.
- R10.6 OPC Data Ranges will be read in and used to configure limits on graphic dynamics, trend limits, data entry field ranges, and so on.
- R10.7 OPC Quality Flags will be used in graphic dynamics (non-good quality indicated by change in color used for objects), data logging, and alarm presentation.
- R10.8 A component for bridging/mapping OPC Data from one server to another will be provided (e.g., map an AB data point to a Modbus register).

11. Aliasing

Instead of connecting graphic dynamics, trend data, alarms, etc. directly to OPC Data tags, there should be a method of creating what some call “data pointers”, “indirect tags”, “data placeholders” or, as is designated in this document “aliases”.

- R11.1 The Graphics Module will provide its own set of “local” aliases, which can be resolved within the graphic itself.
- R11.2 The HMI/SCADA system as a whole will provide “project-level” aliasing, which will be designated in this document as “Global Aliasing”.
- R11.3 The global alias editor will permit creating user-defined names for the aliases, permitting thousands of aliases per project.
- R11.4 It will be possible to define “themes” for global aliasing. (For example, themes could relate to a product being made, a batch ID, a building number, etc.)
- R11.5 Each global alias will be tied to a theme, with each value for the alias being tied to a specific value/resolution of the theme. Therefore, simply changing the theme will change all of the associated aliases.
- R11.6 When setting a theme, it will be possible to define the “scope” of the alias changes to the entire project, just the current application, or just the current document within that application.
- R11.7 It will be possible to import/export the alias definitions from/to a text file (e.g., comma separated variable CSV file).
- R11.8 The configuration of the global aliases and themes will be stored in an open database (e.g., Microsoft Access).

12. Training

- R12.1 The software will be easy to learn, such that the only prerequisites for attending training are familiarity with personal computers, and knowledge of the fundamentals of industrial/commercial measurement and control.
- R12.2 The software supplier will offer training courses on at least a monthly basis.
- R12.3 There will be both basic and advanced classes offered.
- R12.4 Professional trainers experienced in HMI/SCADA will conduct the courses.
- R12.5 Training courses will be optionally available on-site.
- R12.6 Any on-site training course curriculum will be customized to the needs of the user if requested.
- R12.7 The training classes will be “hands-on”, such that students can work with the software while instruction is taking place (e.g., learning labs to verify understanding of the taught material).
- R12.8 There will be software-based tutorials included with the HMI/SCADA software (including, but not limited to, such things as template files, training displays, project examples, help files, and so on).

13. Technical Support

- R13.1 Technical support will be available from a Factory Regional Office or local Representative/Distributor of the software supplier.
- R13.2 Factory technical support will be available from technicians/engineers familiar with the software and typical industrial applications.
- R13.3 Technical support will be available via:
 - Telephone
 - Email
 - Fax
 - Web
- R13.4 Technical support will be available from at least 8:00 a.m. to 7:00 p.m. EST weekdays, with optional support available 24 hours a day, 7 days a week.
- R13.5 The software vendor will provide 24-hour availability of Internet ftp and world wide web (www) services.
- R13.6 Technical support will be offered for free for 90 days from product shipment, which may be extended to one year if a product maintenance plan is purchased.
- R13.7 A utility for trouble-shooting and tracing the HMI/SCADA system will be provided.

14. Software Upgrades

- R14.1 The vendor will offer an Annual Software Maintenance Service for a nominal fee.
- R14.2 This service will provide upgrades to the software for release of new features as they occur.
- R14.3 The vendor must have a record of providing a continuous upgrade path for the product.