RM Selection

Software

User Manual

Version 1

August 12, 2005

Dr. David Rosen
School of Mechanical Engineering
Rapid Prototyping & Manufacturing Institute
Georgia Institute of Technology
Atlanta, GA 30332-0405
404-894-9668
david.rosen@me.gatech.edu

1 PURPOSE

The purpose of the Rapid Manufacturing (RM) Selection software system is to help product developers to evaluate the usage of RM technologies for part manufacture. This evaluation can take place early in the product development process since little specific part information is needed to use this software. Instead, general principles are applied general part characteristics in order to perform the evaluation. Evaluations take place at two levels. First, given the project and part characteristics, an overall assessment of the suitability of RM as a whole is provided. Second, general build time, part cost, and technical feasibility assessments are given for the part to be manufactured by selected commercial RM machines.

A second purpose of the software is for RM machine developers to explore new machine capabilities for candidate applications. For example, a new type of ink-jet printing technology could be investigated for fabricating small, complex, custom designed parts. Technology characteristics can be entered into the software and manufacturing assessments can be compared between the new printing technology and existing commercial machines.

2 INSTALLATION

There are two ways to obtain RMSelect software, through the web or on a CD.

2.1 Web-based Distribution

Go to the URL: http://www.srl.gatech.edu/Members/drosen and scroll to the section entitled RMSelect Downloads. Two links are there. The first is to download the RMSelect user manual (you are reading it now). The second is for a Zip file containing all RMSelect software. It is about 80 MB in size.

It is best if you right-click on each link and choose the "Save Target As" option in the pop-up menu. This will enable you to save the files to your hard-drive. You can put the RMSelect software anywhere. Subsequent instructions will assume you put it in the c:\RMS folder. Upon installation, the RMSelect installer will put RMSelect into specific folders.

See Section 2.3 for installation instructions.

2.2 CD Distribution

Contact David Rosen for a CD with the RMSelect software. Upon receiving the CD, you will need to copy the files from the CD into a folder on your hard-drive. Subsequent instructions will assume you put it in the c:\RMS folder. Then, follow the installation instructions given in Section 2.3.

2.3 Installation Instructions

1. Open the folder c:\RMS or wherever you installed the RMSelect installation files.
2. Unzip the files in the RMSelect.zip file. After running Zip, the c:\RMS folder should look like the window in Figure 2.1.
3. Double-click on the 'installRMS.bat' file to begin the installation process.

A DOS command window will open and will scroll through the various commands being executed. InstallRMS will create the 'c:\Program Files\RMSelect' folder where the RMSelect executable and associated files will be installed. The installer will also create the folder 'c:\Program Files\MathWorks\MATLAB Component Runtime' where the MATLAB Component Runtime (MCR) system will be installed. This is a large system (77MB) that is required to run MATLAB applications. The MCR system need only be installed once; any number of RMSelect updates or other MATLAB applications can run on your computer after the MCR system is installed.

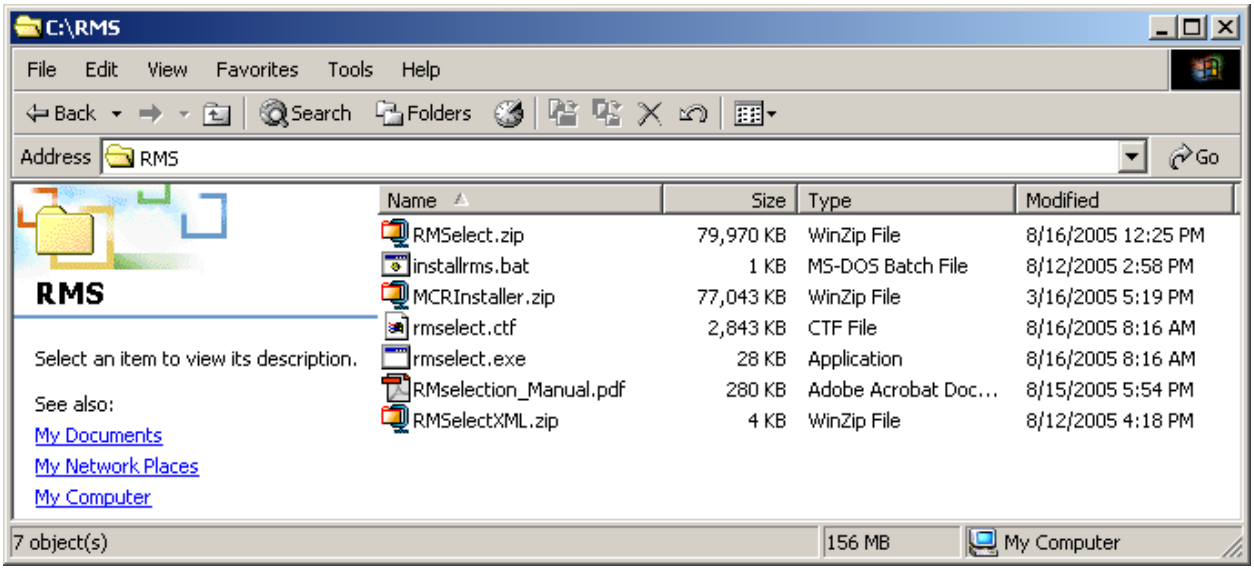

Figure 2.1 C:\RMS Folder after unzipping RMSelect files.

4. Some XML data files are required for RMSelect to execute correctly. These files are used to define RM machines and default projects for RMSelect. The XML files are delivered in one Zip file (RMSelectXML.zip). The installer automatically executes Zip on this file, but you must use the Windows extraction wizard (Windows XP) or a Zip application (Windows 2000, see Figure 2.2) to unzip these files. When the extraction wizard displays the folder containing XML files, simply click on the "Extract all files" link and ensure that the files are installed in the 'c:\Program Files\RMSelect' folder, not a sub-folder.
5. The next step is the installation of the MCR system. The MATLAB Component Runtime wizard appears and aids installing MCR. If you see a wizard screen asking if you want to repair or remove MCR, click repair and Next. The wizard takes a minute or so to extract and install MCR, but everything runs automatically from here, so no further user interaction is needed, except to click 'Close' and terminate the wizard
6. In the command window, the installer prompts you to "press any key to continue…" so do so and the installer finishes.

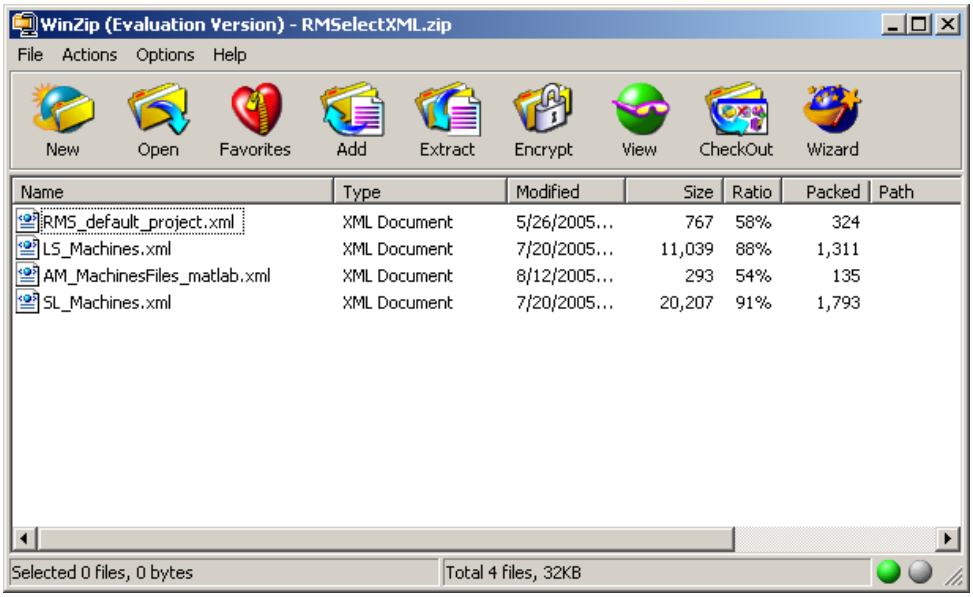

Figure 2.2 Extracting the XML files from the RMSelectXML.zip archive.

3 RM SELECTION USAGE

3.1 Start-up

Locate the RMSelect icon, or RMSelect.exe file, in the appropriate folder. By default, RMSelect is intended to be located at: c:\Program Files\RMSelect. You may have changed this during installation.

Double-click on the RMSelect.exe icon to start RMSelect. The first time you start RMSelect, the system performs a lot of initialization and this takes 20-30 seconds. When successfully started, you should see a screen similar to the one shown in Figure 3.1, along with a message box stating that you should select one of two entries in the File pull-down menu, either File->New Production or File->Open Project. See Figure 3.2 for the File pull-down menu.

If you select File->New Production, the RMSelect system creates a new project for a production manufacturing application. RMSelect prompts you for the name of your project. After entering the project name, you will be able to enter project and part information.

If you want to open an existing project, RMSelect prompts you for a project name using a typical 'file open' dialog box. This enables you to select the folder that the project file is in, as well as the project file. RMSelect remembers the folder for future file interactions with the project.

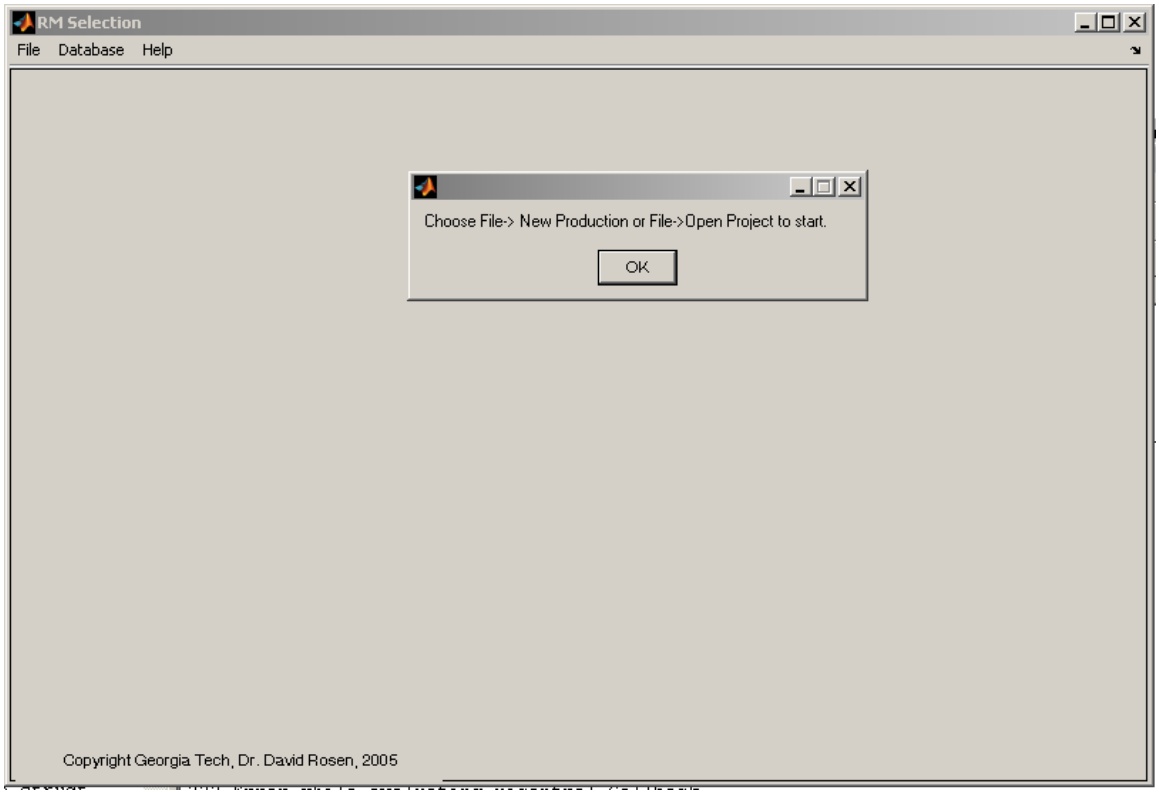

Figure 3.1 Start-up screen with instructions on how to start.

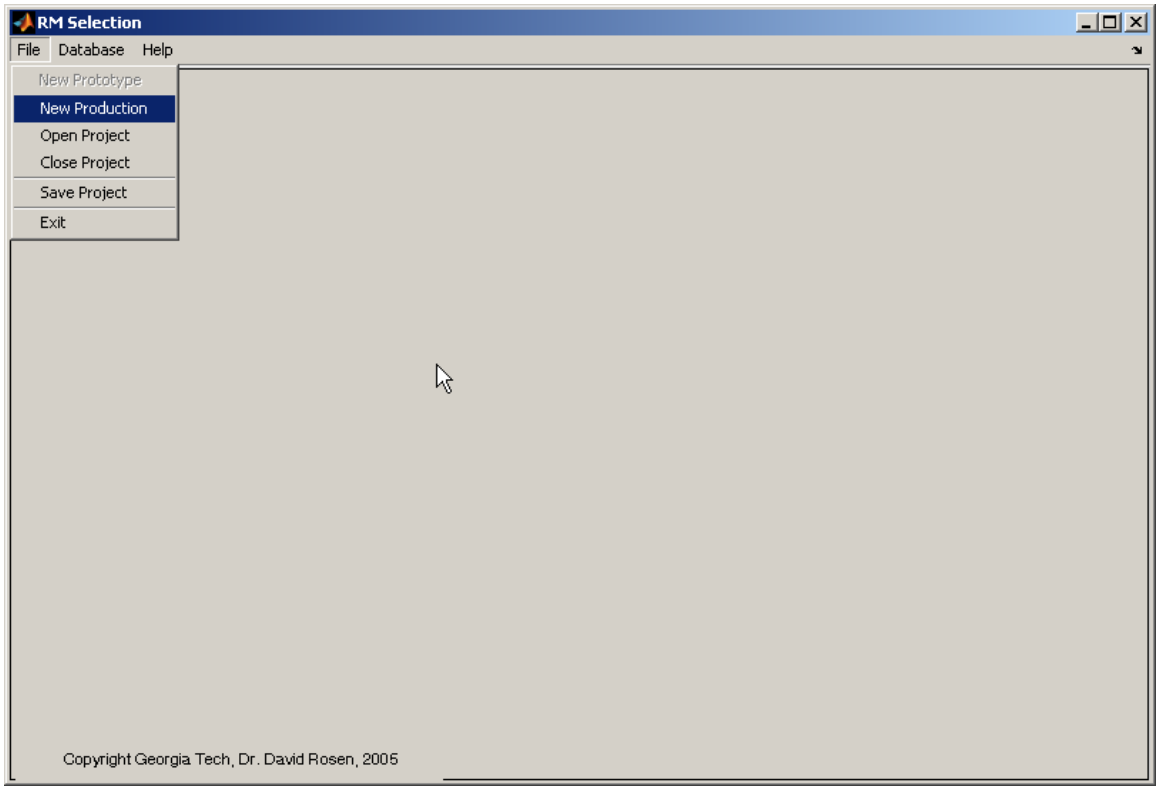

Figure 3.2 File pull-down menu with 'New Production' highlighted.

3.2 Project Interactions

After starting a production project, you can enter project and part information, then get qualitative and general quantitative assessments of your part with respect to RM machines. Start by selecting the 'Project Data' button that is just under the File pull-down menu. These five buttons lay out the main RMSelect usage procedure. When you select the 'Project Data' button, you will see a screen similar to that shown in Figure 3.3. As shown, you can enter the desired production rate as number of parts per week, the target part cost (in dollars), the estimated duration of the project in weeks (estimate how long you will need to manufacture parts at the specified production rate), and the estimated service life of the part in years.

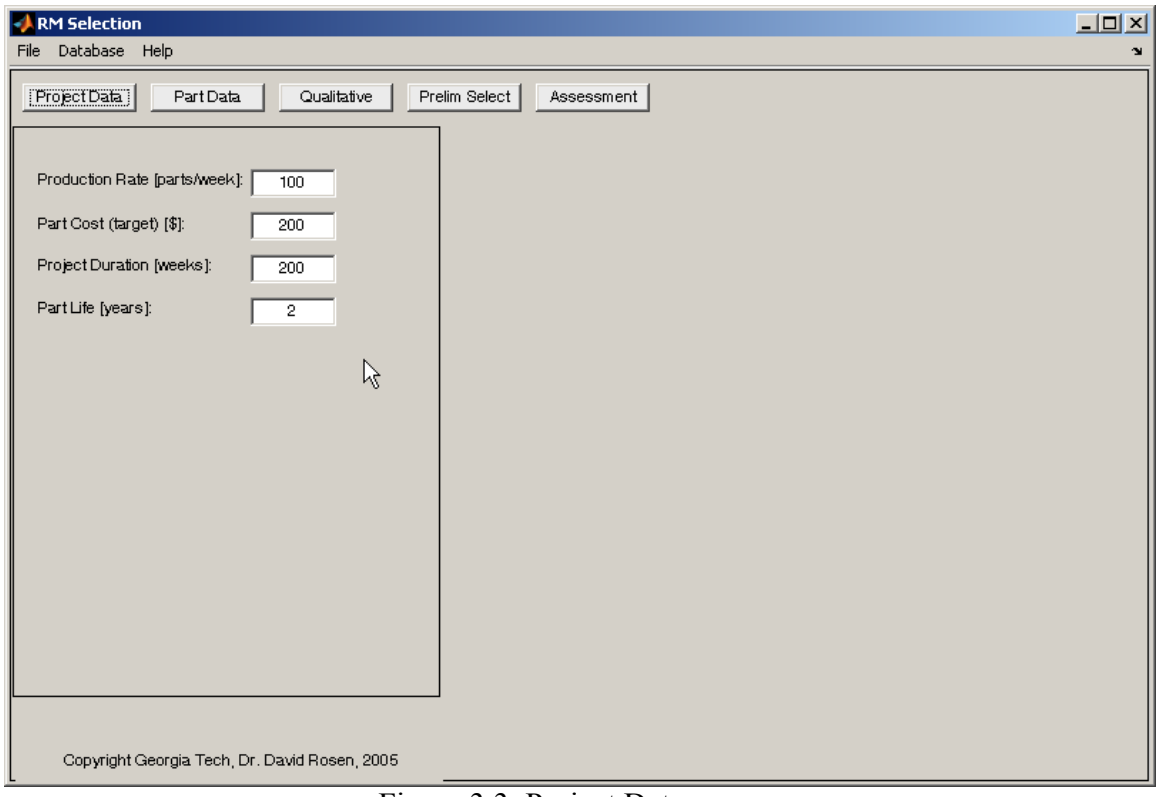

Figure 3.3 Project Data screen.

After entering project information, select the 'Part Data' button to move onto the specification of part-related information. When you do this, you will see a screen like the one in Figure 3.4. In this screen, you enter the part size (X, Y, Z bounding box in millimeters), the actual part volume in mm^3, the desired material type (polymer, metal, ceramic (note that no ceramic machines are available), and some part characteristics. Enter the smoothest surface finish (Ra) that has been specified on your part in microns (micrometers). Also, enter the tightest tolerance value that has been specified on your part (microns). Then, enter the smallest feature size, either a positive (e.g., rib) or negative feature (e.g., hole), in millimeters. Note that it is OK to enter approximate values that represent general specifications, since RMSelect does not reason directly about part build orientation, differences in materials, or many of the other details required for a careful, quantitative assessment. RMSelect is intended for use early in product development, not when most part details have been determined.

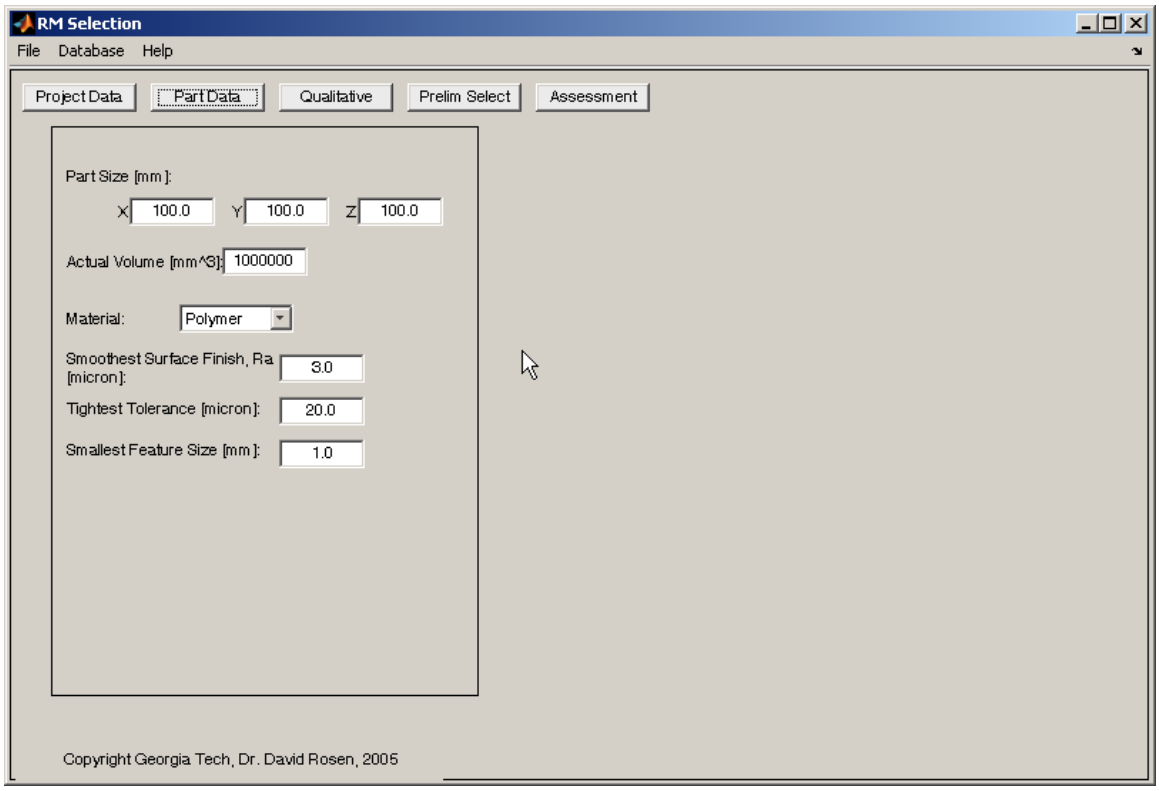

Figure 3.4 Part Data screen.

Select the button labeled 'Qualitative' for a qualitative assessment of the likely suitability of RM technologies for the specified project and part information. Figure 3.5 shows the screen you will see. Answer the four questions as best you can, dealing with the shape of parts to be manufactured, geometric complexity of the part(s), the extent to which the part replaces more than one part (part consolidation), and the turn around time for part orders.

Based on your answers, a qualitative assessment is generated, as shown in Figure 3.6, for the answers shown in Figure 3.5. Note that the overall assessment of RM feasibility is given as MUST, which indicates that the project and part characteristics indicate a good match for RM capabilities. Specifically, each part will have a unique shape (probably a custom design application) and part shape is fairly complex. Fast turn-around is required for part orders. Additionally, from an economic viewpoint, RM may be favorable since many parts are being consolidated into one. In this scenario, it is not necessary to invest in hard tooling for these replaced parts and no assembly stations must be utilized to perform part assembly. RM may yield considerable cost savings since manufacturing and assembly investments are not needed.

If desired, you can return to the Project Data or Part Data screens to change your entries and repeat the Qualitative assessment to understand how the suitability of RM changes with changes in production or part characteristics.

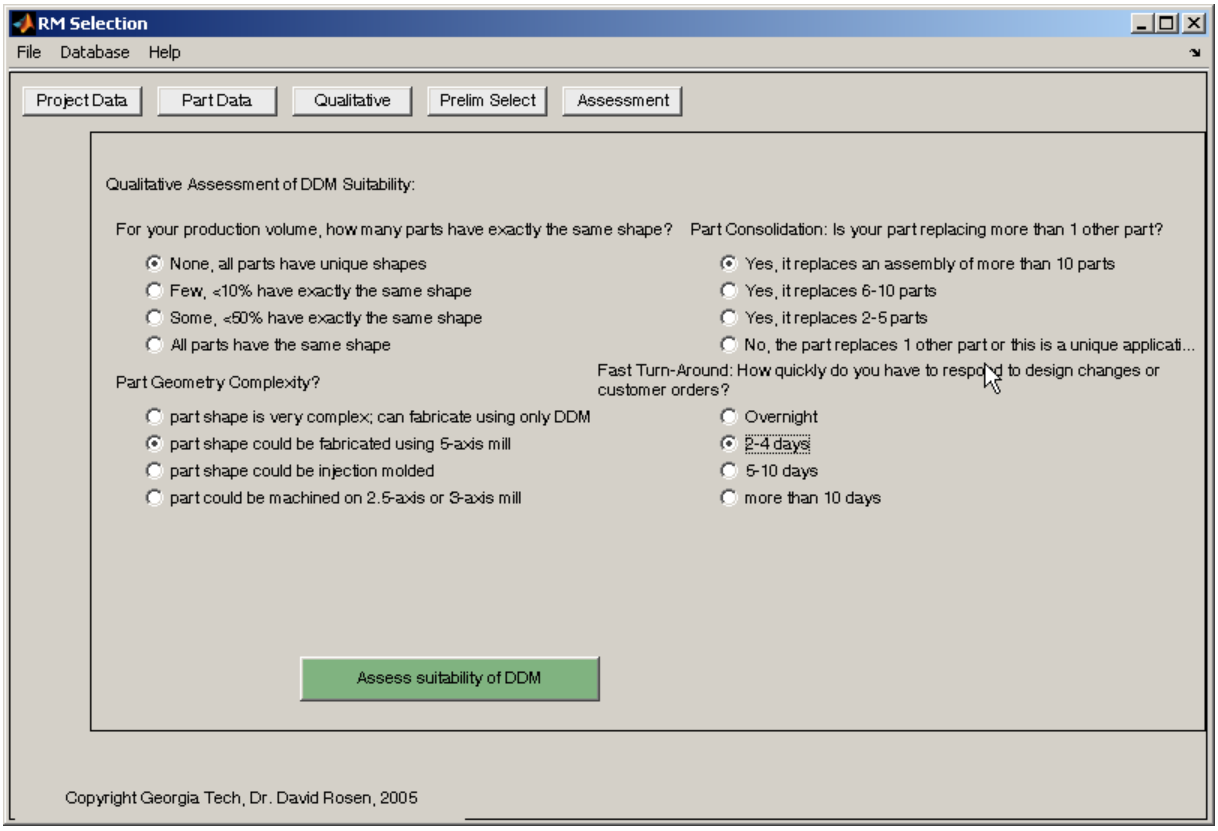

Figure 3.5 Qualitative assessment screen.

When you are finished with qualitative assessment, you can proceed to preliminary selection of RM machines by hitting the 'Prelim Select' button. This brings you to the screen shown in Figure 3.7.

This screen shows two columns of machines, those that seem to be feasible for the specified part characteristics and those that seem infeasible. You can select any number of machines from either column for further assessment. In addition, you can view a layout of the machine vat or build chamber by selecting the green or red Display buttons for a machine in the feasible or infeasible column, respectively. Four parts can fit in the SLA Viper vat, as shown in Figure 3.8. Note that you can modify part orientation as well as the gaps between parts and update the view of the vat or build chamber. You can also see how many parts you can fit in one build.

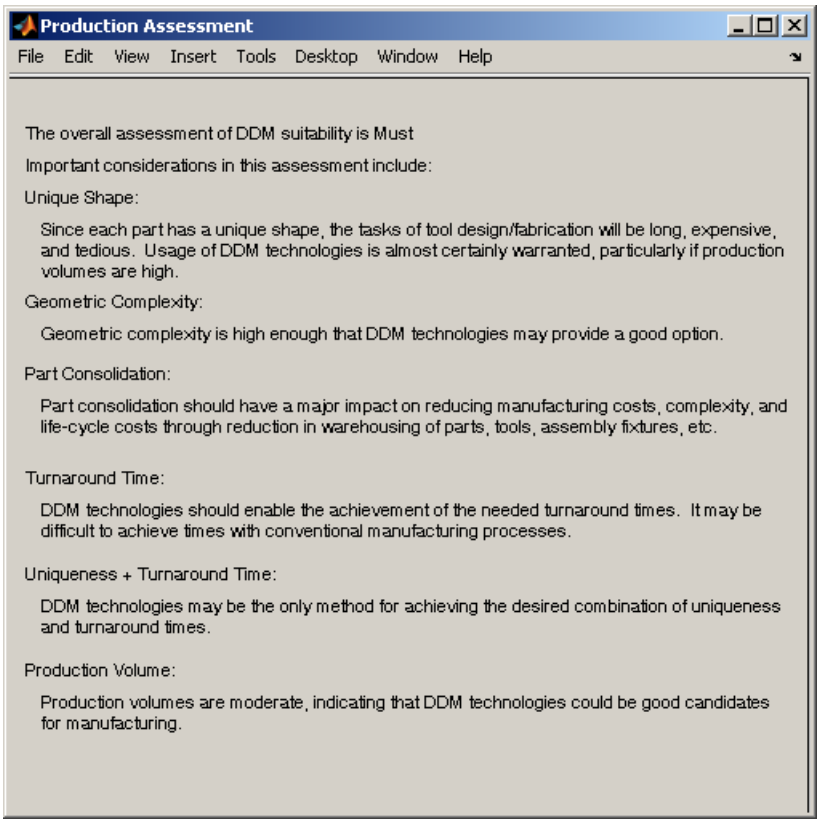

Figure 3.6 Results of qualitative assessment.

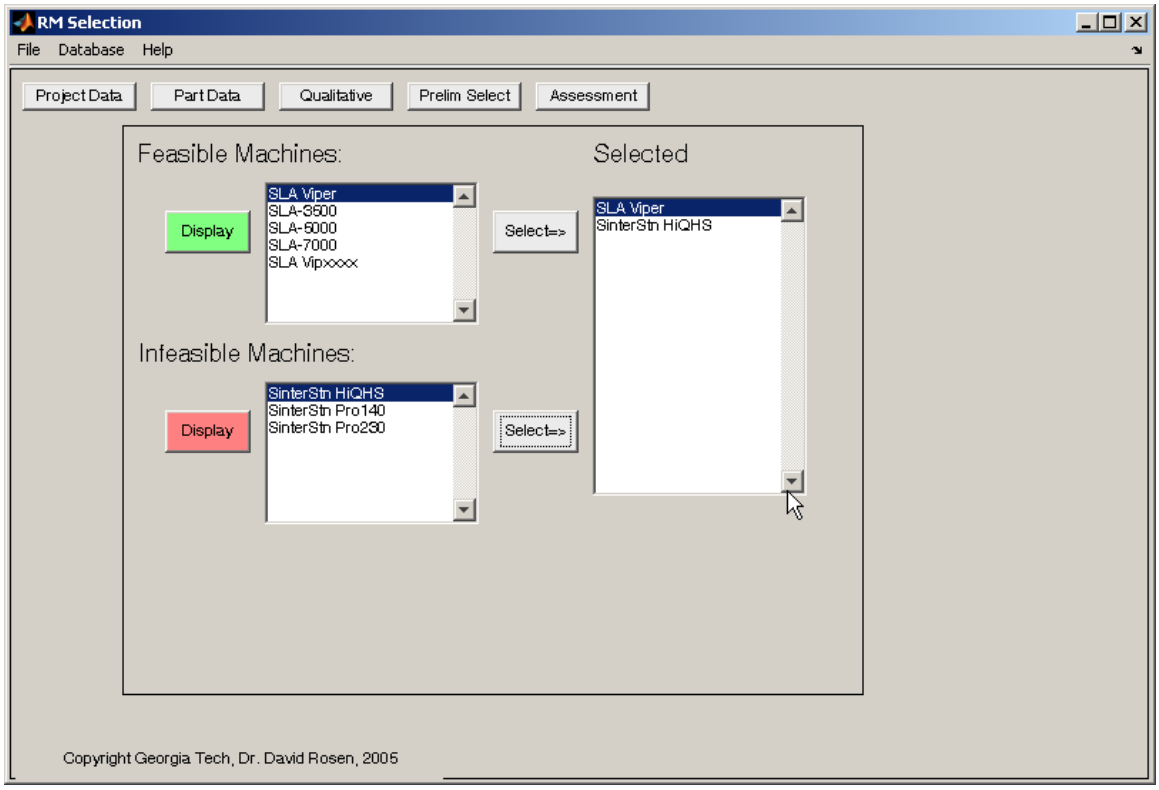

Figure 3.7 Preliminary Selection screen.

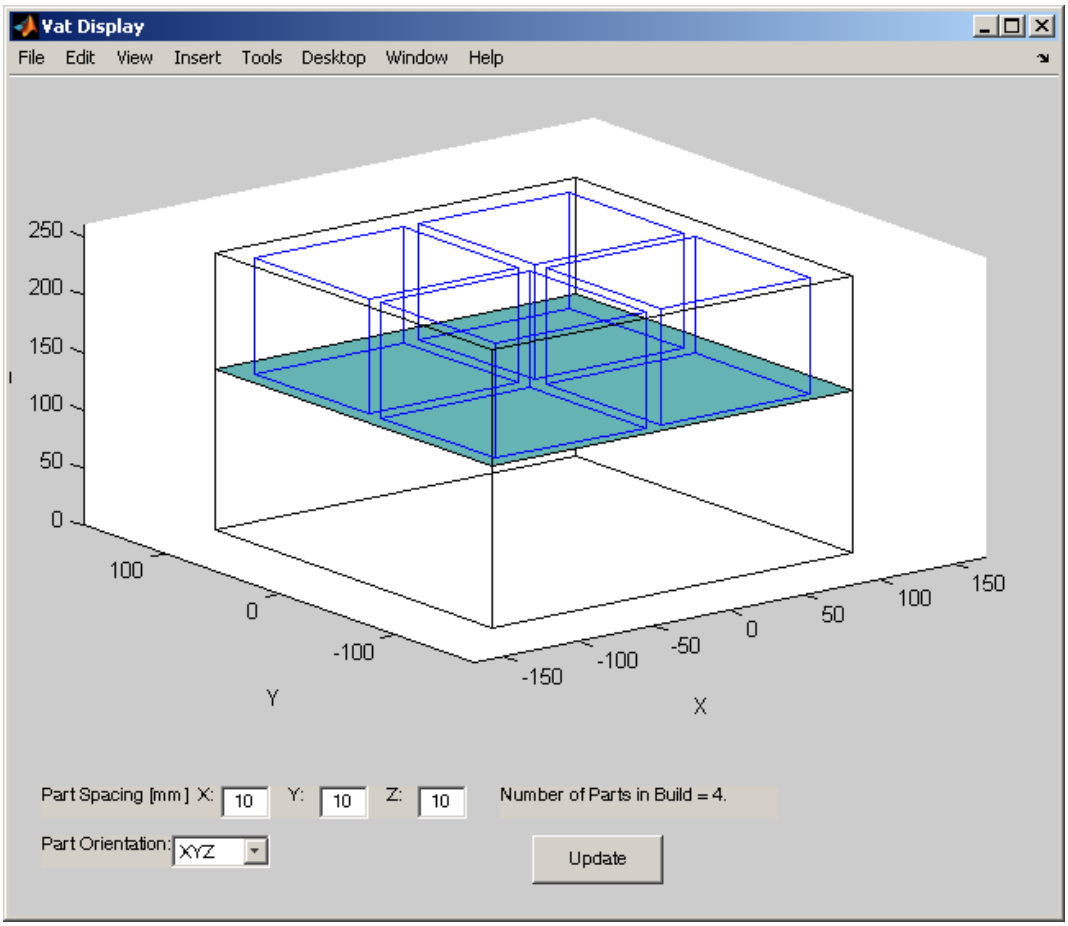

Figure 3.8 Vat and build chamber layout.

When you are finished selecting machines and possibly viewing their build layouts, you can proceed to an approximate quantitative assessment of the selected machines by hitting the 'Assessment' button. When you do this, RMSelect displays two new windows with assessment results and build time and cost estimates. Assessment results for this example are shown in Figure 3.9. Note that RMSelect compares machine capabilities to desired part characteristics and determines whether or not a particular machine can meet a specific characteristic. If it can, then a 'Y' is indicated. If not, then 'N' is shown. For the Sinterstations, neither machine can achieve the smooth surface finish specification, as indicated by the N's in the 'Surf. Fin.' column. Target values are indicated along the bottom row, for convenience. Also, the cost estimate is shown for each machine.

The other window shows build time and cost estimates for the machines. Since many aspects of machine operation may vary from part to part, ranges of time and cost estimates are given. Also, costs are broken down into operation, machine purchase, machine maintenance, and material costs. You can toggle between these cost break-downs and minimum and maximum cost estimates using the radio buttons on the left side of the cost graph.

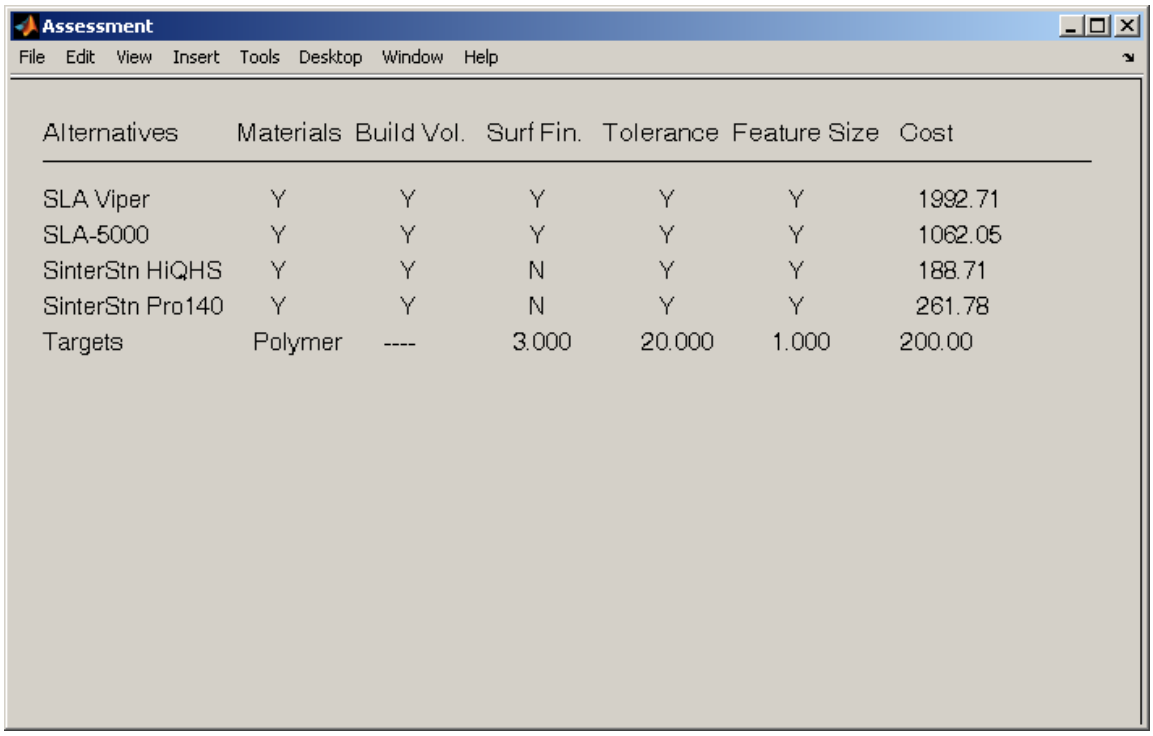

Figure 3.9 Assessment results.

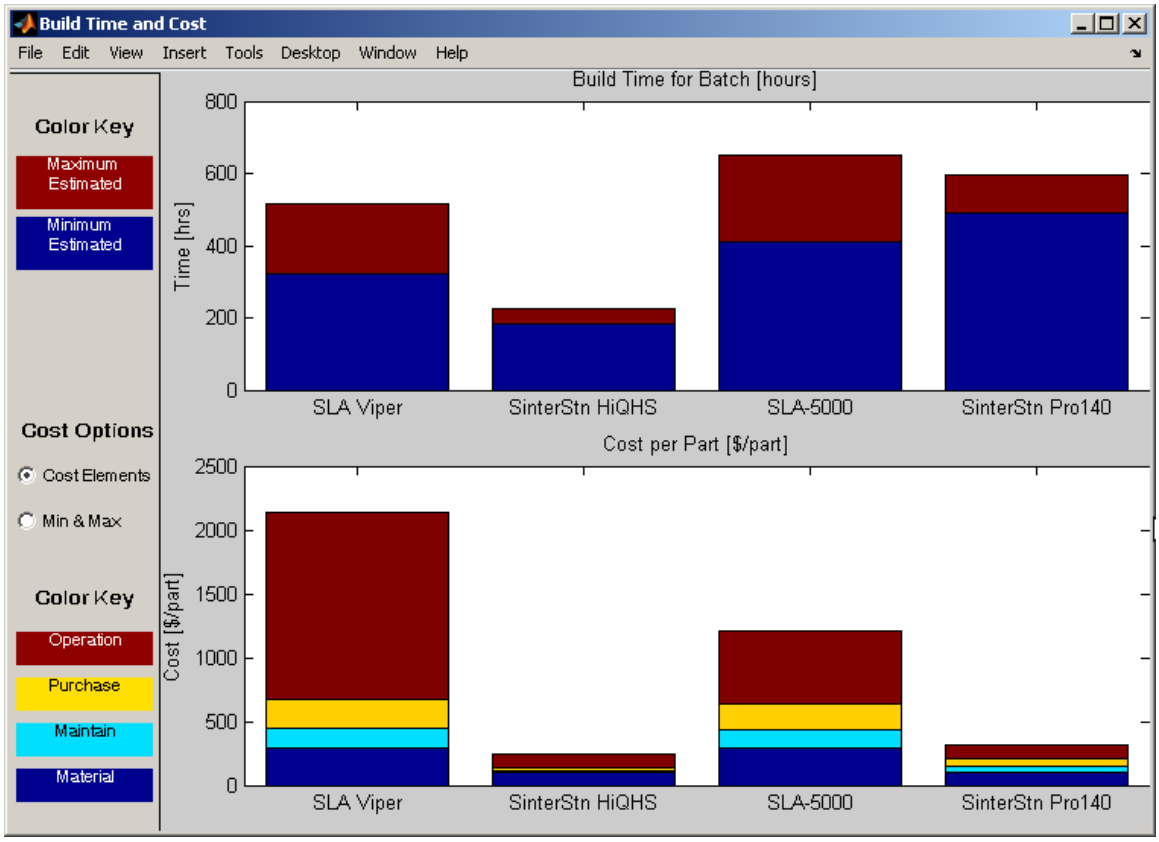

Figure 3.10 Build Time and Part Cost graphs.

If desired, you can navigate back to any of the other screens, make modifications to the project or part characteristics, or select additional machines for assessment.

4 MACHINE CHARACTERISTICS

RMSelect operates using data files (XML format) that represent the various machines and their characteristics. It is likely that each user will want to tailor the machine characteristics to their own operating practices. Furthermore, cost characteristics may vary widely between different companies, so it is a good idea to edit the machine characteristic data files to reflect your usage and company.

Under the 'Database' pull-down menu, you can define a new machine, create a new class of machines, or edit existing machines. New machines and classes of machines are created by selecting the 'New Machine' menu entry, as shown in Figure 4.1. When you select this, a screen like that shown in Figure 4.2 appears. Currently, only Stereolithography and Laser Sintering machines are defined in RMSelect. You can select either of these and create a new type of SL or LS machine. Or, you can select 'Other (specify)' to create a new class of machines, such as FDM, printing, etc. Then, you can modify the default machine (typically an SLA Viper) characteristics that represent your new machine. RMSelect remembers that you created a new machine type and makes it available for use in the current project or any new projects you work on. If you create a new machine class, RMSelect remembers that class as well. RMSelect overwrites the existing data files containing machine information. As a warning, there is no 'undo' functionality built into RMSelect at this time, so be careful about your changes. If you do make a mistake, you can always recover the original machine characteristics files from the installation CD or web-site.

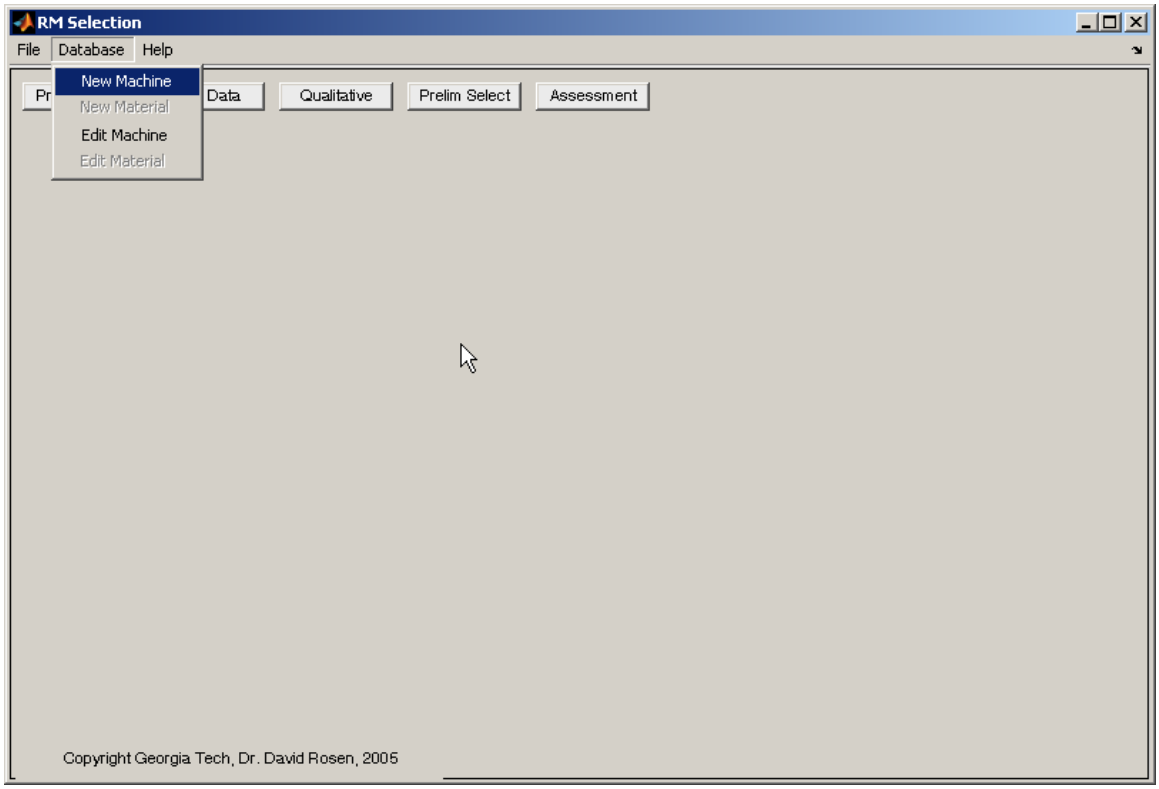

Figure 4.1 The Machine Database pull-down menu.

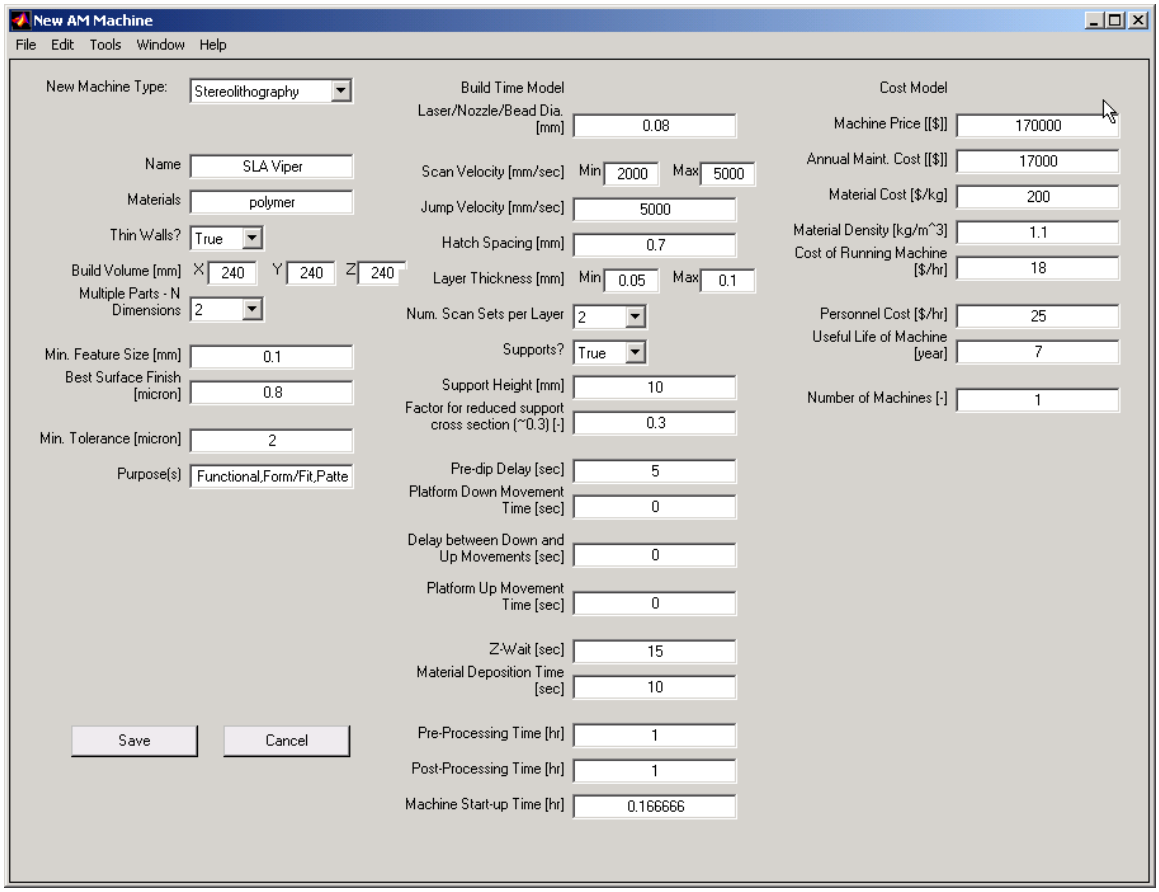

Figure 4.2 New Machine dialog box.

To edit a machine description, simply select the 'Edit Machine' entry in the Database menu. You select the desired machine to edit, as shown in Figure 4.3, and make the appropriate changes to entries in a screen similar to Figure 4.2. Hit the 'Save' button to save your changes, or 'Cancel' to ignore changes. RMSelect will remember your changes after you hit the Save button. Again, there is no 'undo' functionality in RMSelect.

Note that the SLA Viper machine is assumed to operate in high-resolution mode only for the purposes of RMSelect.

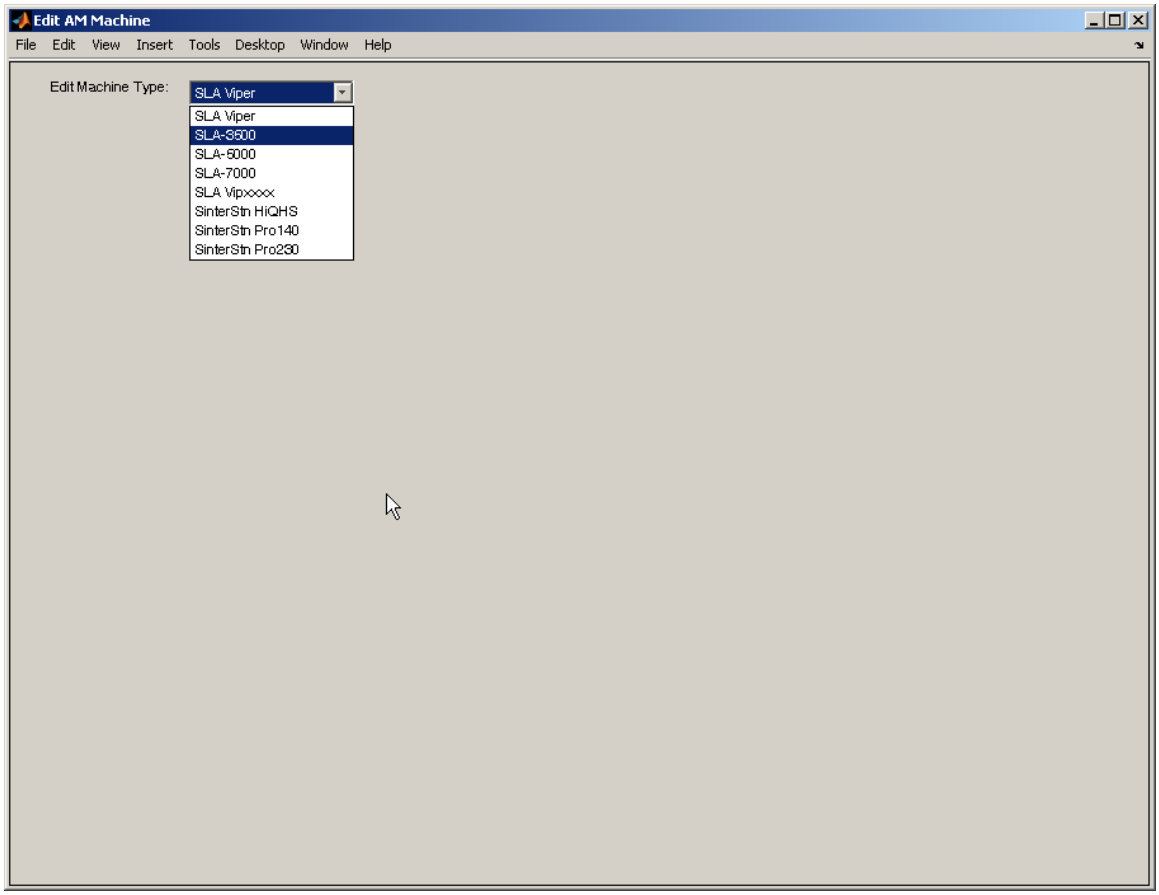

Figure 4.3 Edit Machine dialog box.