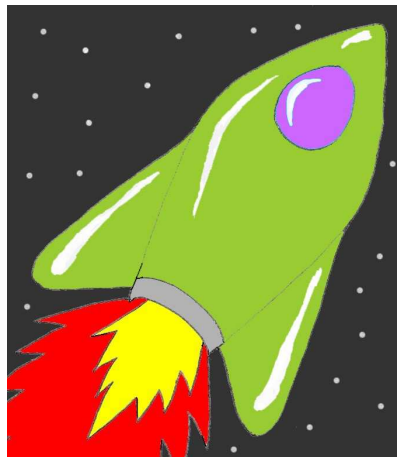


# Process Capability

## Pro

Version: 1.0



## User's Manual

Created by  
Simanima

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## Process Capability Pro Overview

The *Process Capability Pro* software tool allows the User to generate a list of recommended Mission Assurance process activities based on specified program processes and process capability levels. The Mission Assurance program covers Reliability, Maintainability, Availability, and Dependability (RMAD), System Safety, and Quality Assurance (QA) programs. This tool is compliant with S-102 Mission Assurance Standards.

Project files from *Program Processes Pro* software tool (i.e., files with extension \*.pppf) can be opened in the *Process Capability Pro* software tool. The *Program Processes Pro* tool helps to identify the set of recommended S-102 Mission Assurance Standard processes that are commensurate with a User defined product unit-value. When opening *Program Processes Pro* files with *Process Capability Pro*, the recommended processes will be carried over and recommended process capability levels by life cycle phase will be automatically assigned to complement the set. For more details, see section 1.2.3.1.2 of this User's Manual.

## 1.0 Running and Navigating Process Capability Pro

### 1.1 Starting the Program

If the *Process Capability Pro* icon (Fig.1.1-1) is on the *Desktop*, *double-click* it to execute the *Process Capability Pro* software tool.

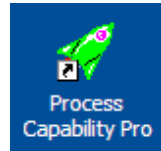


Figure 1.1-1. Process Capability Pro Icon

If the icon is not on the *Desktop*, go to the *Start Menu*. Under the *All Programs* listing, look for a program folder titled *Simanima*. Within the *Simanima* folder, look for the *Process Capability Pro* folder. Select the *Process Capability Pro* program, contained in the *Process Capability Pro* program folder. It is recommended that a shortcut to the program be created and placed on the *Desktop*, if one does not already exist. This can be done by *right-clicking* the *Process Capability Pro* executable located in the installation location and selecting *Create Shortcut*.

### 1.2 Navigating the Tool

After the splash screen has disappeared, which is displayed for a short time when the program is executed, the main menu of the *Process Capability Pro* tool is displayed as shown in Figure 1.2-

1. The main menu is comprised of four (4) major areas:

1. Available life cycle phase lists;
2. Drop-down menus;
3. Buttons toolbar; and
4. Open/Import project button.

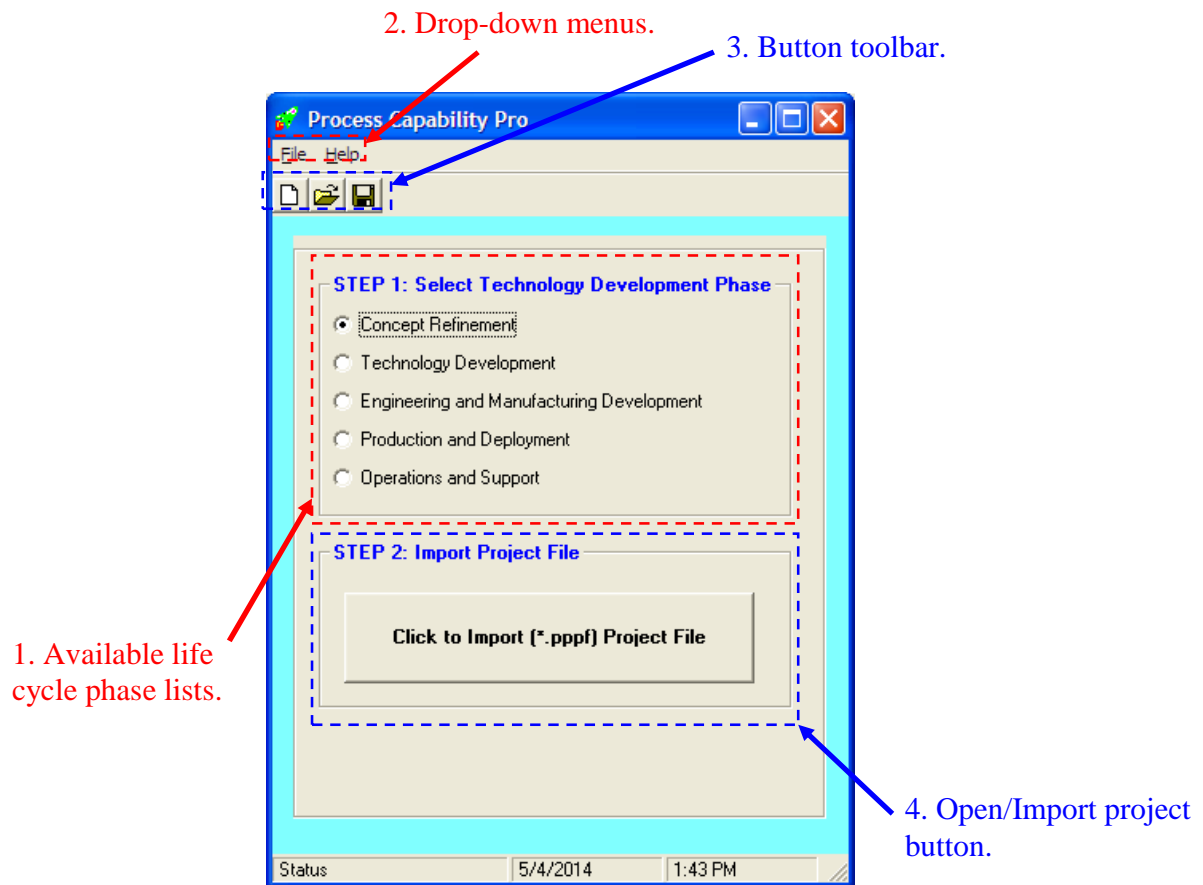


Figure 1.2-1. Process Capability Pro Main Menu

There are 2 key steps required in order to access information on Mission Assurance process activities by capability level and life cycle phase using the Process Capability Pro software tool:

- Step 1 – select applicable life cycle phases;
- Step 2 – import desired *Program Processes Pro* file (i.e., files with extension \*.pppf)

### 1.2.1 Step 1: Selecting Technology Development or Life Cycle Phase

The *Process Capability Pro* software tool also allows the desired technology development or life cycle phase to be selected. As shown in Figure 1.2.1-1, select the phase that you would like to process.

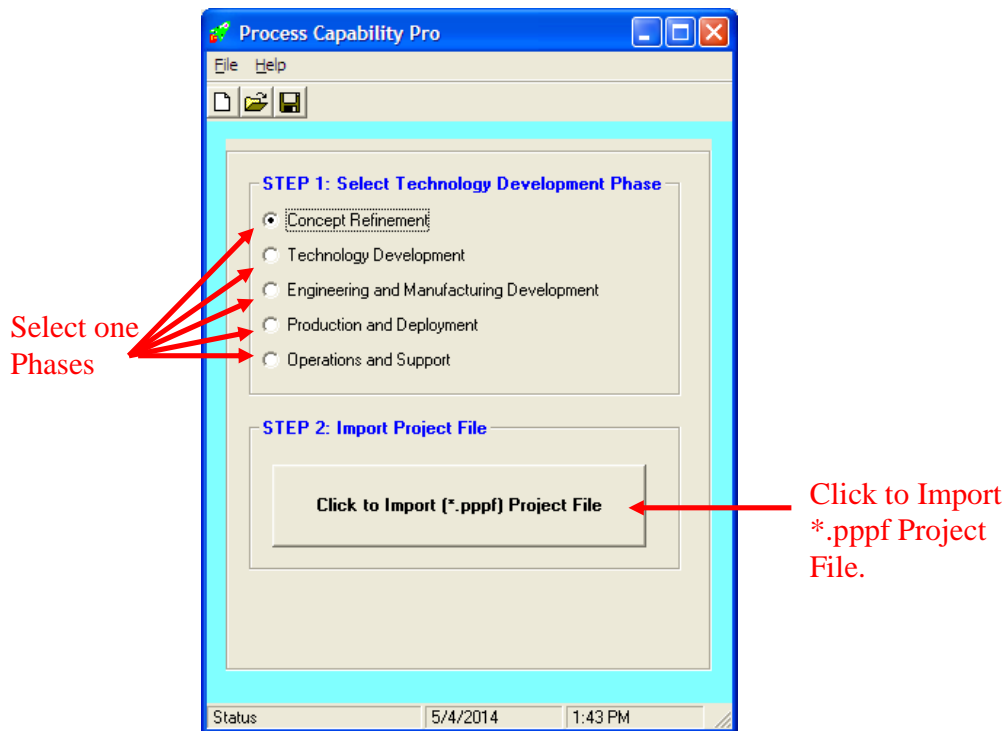


Figure 1.2.1-1. Available Life Cycle Phases

### 1.2.2 Step 2: Import Program Processes Pro Project File

After selecting the desired “Technology Development Phase”, *left-click* the *Click to Import (\*.pppf) Project File* button, which will open the *Import* dialog. The *Import* feature is used to import *Program Processes Pro* project files (i.e., projects with the file extension “\*.pppf”). Figure 1.2.2-1 shows the *Import* dialog box. A project file can be imported by either one of three ways:

1. *Double-click* a file listed in the *Available file(s)* section of the dialog box.
2. Select a file listed in the *Available file(s)* section of the dialog box, then press the *Open* button.
3. Type a file name into the *File Name* text box, then press the *Open* button.

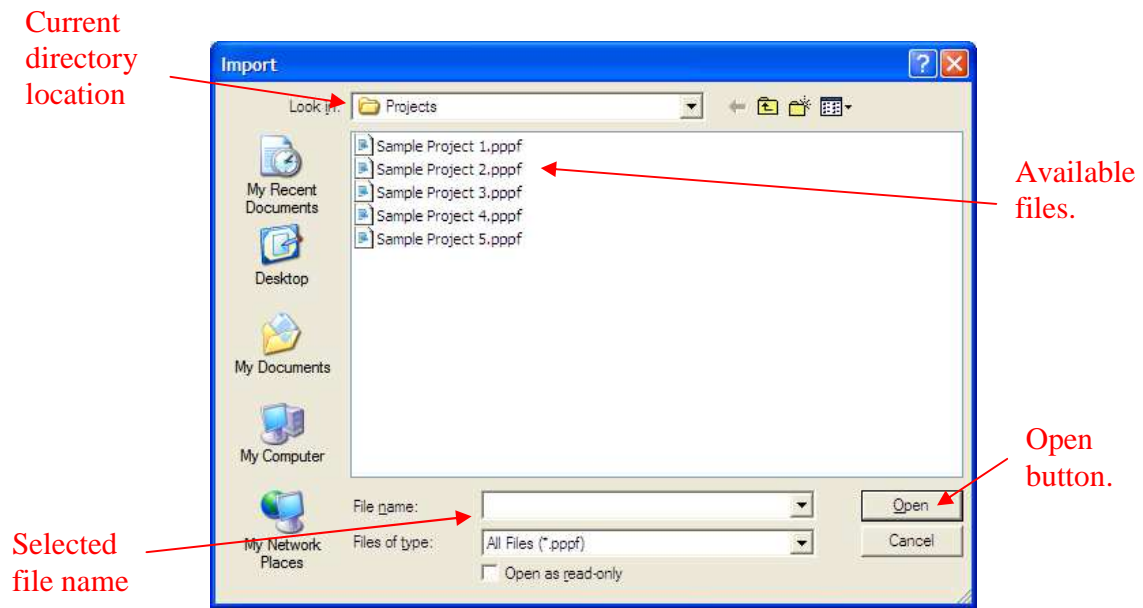


Figure 1.2.2-1. *Import* project dialog box

Once a project is imported, the *Results* screen will appear, as shown in Figure 1.2.2-2. From the Results screen, additional information will be displayed by either *left-clicking* on any of the identified processes or capability levels.





Figure 1.2.2-2. Results Screen

### 1.2.2.1 Display Recommended Process Activities by Capability Level

To display recommended process activities that are comensurate with the desired process capability level, *left-click* the *Capability Level*, as shown in Figure 1.2.3-1 (Item 3). The activities list will appear and display the S-102 Mission Assurance Standard activities for the selected process capability level (see Figure 1.2.2.2-1).

References

	ACTIVITY REFERENCE NUMBER	ACTIVITY DESCRIPTION
	1.1	Timely establishment of the requirements and analytical ground-rules for the FDM (This is a process validation activity when it includes evaluation of the appropriateness of the FDM process prior to its use).
	1.2	Timely establishment of FDM Technical Performance Metrics (TPMs).
	1.3	Timely collection and evaluation of sufficient system design information to identify all hardware functional and physical dependencies that fall within the analytical ground-rules to be specified by the contractor. The scope of system design information that is collected and evaluated shall include, but not be limited to, the following: (i) Indentured parts lists; (ii) Hardware functional and physical designs at all system levels; (iii) Wiring diagrams; and (iv) Descriptions of mission phases, operating environments, and all normal, degraded, and system contingency modes that are applicable to each mission phase.
	1.4	Timely development of narrative or graphical descriptions of the system hardware functions to represent all levels of system internal and interface hardware functional interrelationships, from the lowest replaceable, switchable or testable item, to the system level inputs and outputs.
	1.5	Timely development and documentation of the System Functional Diagram Model Report that reflects the current state of the system design to the greatest extent practical, and identifies the hardware or functional elements of the system that are not included in the functional diagrams, along with rationale for each element's exclusion from the model.

Figure 1.2.2.2-1. Process Activities List

### 1.2.2.2 Display Process Purpose

To display recommended process purpose, *left-click* on one of the listed *Processes*, as shown in Figure 1.2.3-1 (Item 2). The process purpose will appear (see Figure 1.2.2.3-1).

	PROCESS PURPOSE
	To define and oversee subcontractor and supplier processes which are: 1) implemented to achieve product and process RMAD requirements, and 2) the means by which product and process deficiencies are identified and mitigated or controlled in a timely manner.

Figure 1.2.2.3-1. Process Purpose Window

### 1.2.3 Main Drop-Down Menus

The available program *Drop-Down* menu is located at the top right corner of the screen, as shown in Figure 1.2.3-1. The *Drop-Down* menu has the following main options:

- File
- Help

## Main Drop-Down Menus



Figure 1.2.3-1. Drop-Down Menus

### 1.2.3.1 File menu

To get to the *File* menu, *left-click* on *File*, which is located in the drop-down menu near the top left side of the screen (Fig. 1.2.3-1). The *File* drop-down menu focuses on project file handling functions and contains the following options:

- New
- Open
- Save
- Save As
- Exit

#### 1.2.3.1.1 New

To start a new project, go to *File* ---→ then select *New*. A new project will be created.

NOTE: Only one (1) project can be open and worked on at a time.

### 1.2.3.1.2 Open

To open a saved project, go to *File* ---→ then select *Open*. A dialog box will appear that can be used to navigate and select a project file to open. The *Open* feature is used to load *Process Capability Pro* project files (i.e., projects with file extension “\*.pcpf”) and import *Program Processes Pro* project files (i.e., projects with the file extension “\*.pppf”).

#### 1.2.3.1.2.1 Open Project Options

Figure 1.2.3.1.2.1-1 shows the *Open* dialog box. A project file can be opened by either one of three ways:

4. *Double-click* a file listed in the *Available file(s)* section of the dialog box
5. Select a file listed in the *Available file(s)* section of the dialog box, then press the *Open* button.
6. Type a file name into the *File Name* text box, then press the *Open* button.

NOTE: Only project files with format and extension “\*.pcpf” or “\*.pppf” can be opened by this program.

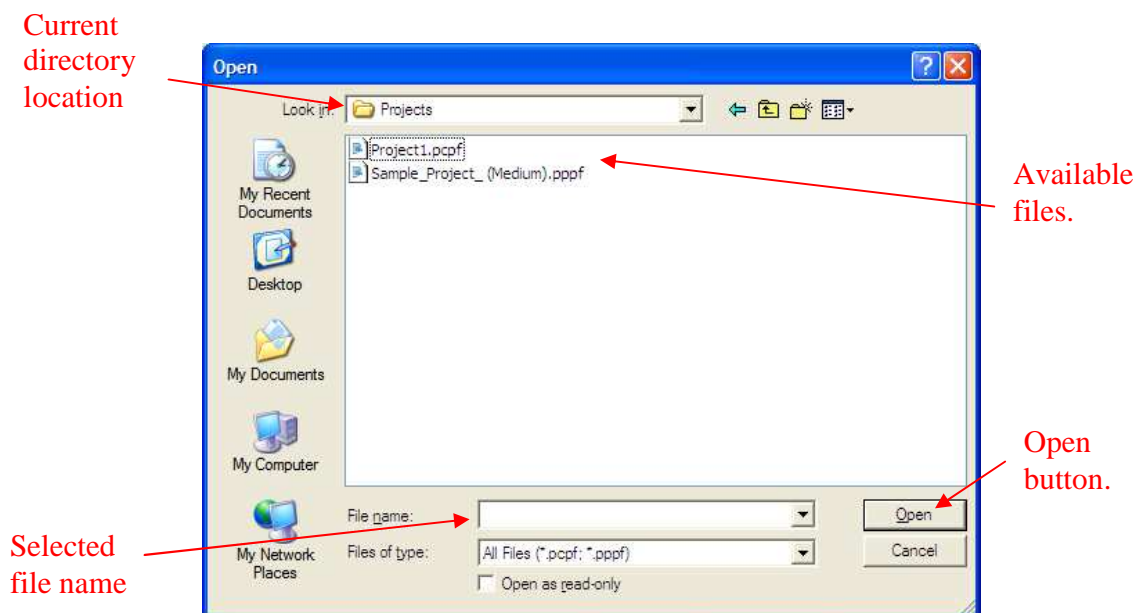


Figure 1.2.3.1.2.1-1. *Open* project dialog box

### **1.2.3.1.3 Save**

Once a Project has been saved under a specified file name, if the User is still working on that same project file, then the project can be re-saved quickly by using the *Save* option. To use the *Save* option, go to *File* ---→ *Save*.

### **1.2.3.1.4 Save As**

To save a project file and label it with a specific name, go to *File* ---→ *Save As* ---→ *Save As \*.pcpf Project*. A dialog box will appear that can be used to name and save the current project file to a specified location.

#### **1.2.3.1.4.1 Save Project Options**

The *Save* dialog box is shown in Figure 1.2.3.1.4-1. A project file can be saved by either one of three ways:

1. *Double-click* a file listed in the *Existing file(s)* section of the dialog box to save over and existing file.
2. Select a file listed in the *Existing file(s)* section of the dialog box, then press the *Save* button to save over and existing file.
3. Type a file name into the *File Name* text box, then press the *Save* button.

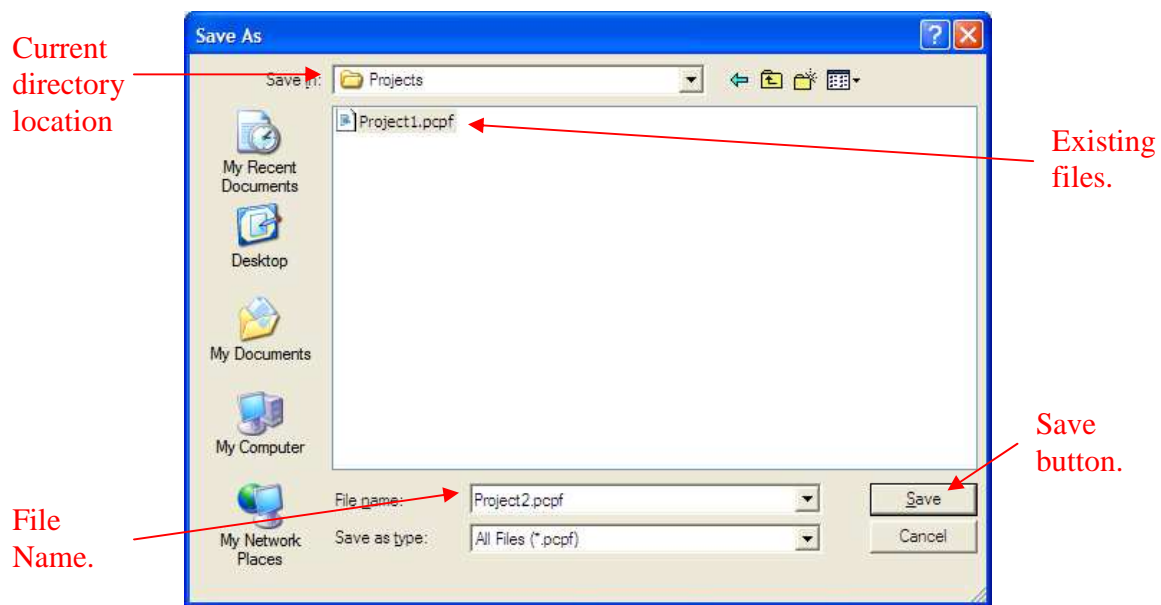


Figure 1.2.3.1.4-1. Save project dialog box

The project file extension will be “.pcpf”.

NOTE: If the project file already exists, the User will be prompted to confirm that they wish to overwrite an existing project.

### 1.2.3.1.5 Exit

The *Exit* option will exit the *Process Capability Pro* program. To initiate the *Exit* option, go to *File* ---→ *Exit*.

### 1.2.3.2 Help

To get to the *Help* menu, *left-click* on *Help*, which is located in the drop-down menus near the top left side of the screen (Fig. 1.2.3-1). The *Help* drop-down menu contains the *About* and *User’s Guide* options. From the *Help* drop-down menu, select *About* to display an information screen about the *Process Capability Pro* software tool (Fig. 1.2.3.2-1). To open a PDF version of the User’s Guide for this tool, select *User’s Guide* from the *Help* drop-down menu. Also, the License Agreement can be viewed by clicking the *View License Agreement* button.



Figure 1.2.3.2-1. About Screen

### 1.3.1 Main Buttons Toolbar

As shown in Figure 1.3.1-1, *Process Capability Pro* software tool provides buttons for quick access to the following functions that are performed on projects:

- New
- Open
- Save

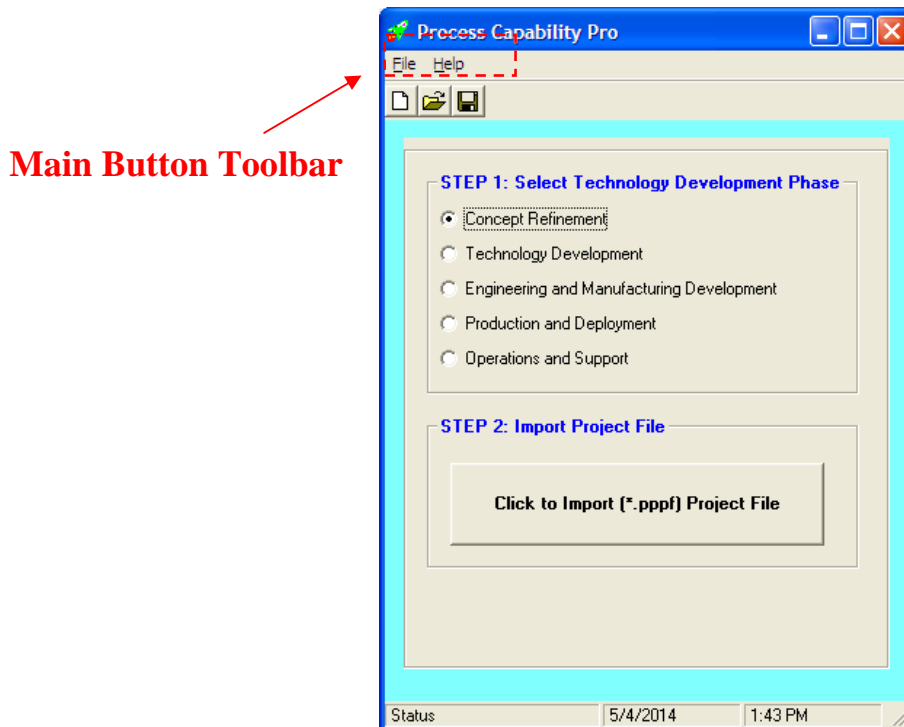


Figure 1.3.1-1. Button Toolbar

### 1.3.1.1 New

*Left-click* the *New* button to create a new project.

NOTE: Only one (1) project can be open and worked on at a time.

### 1.3.1.2 Open

The *Open* button provides quicker access to the *Open* project dialog box. For details on the dialog box, see section 1.2.3.1.2.1 for details.

### 1.3.1.3 Save

Once a Project has been saved under a specified file name, if the User is still working on that same project file, then the project can be re-saved quickly by *left-clicking* the *Save* button.



## 1.4 Results Screen Drop-Down Menus

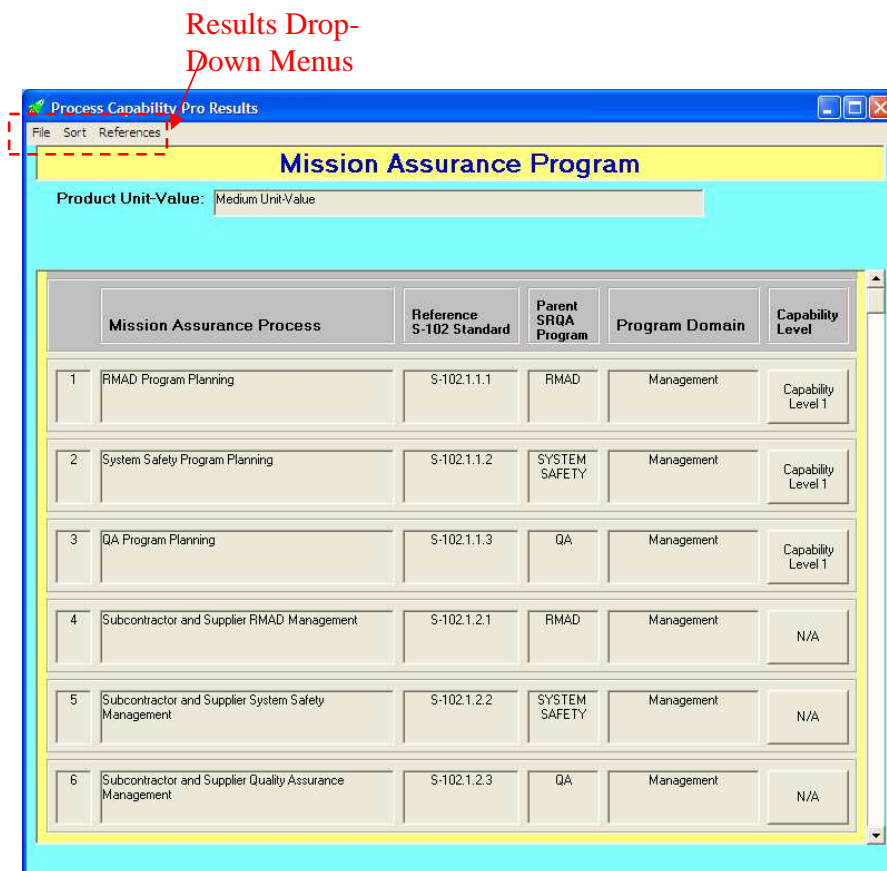


Figure 1.4-1. Results Screen

The *Results* windows offers *Drop-Down* menus located at the top right corner of the screen, as shown in Figure 1.4-1. The *Drop-Down* menus have the following options:

- File
- Sort
- References

### 1.4.1 File

The results “*File*” *Drop-Down* menu has the following options:

- Save As
- Export Results to Excel File

- Print Results
- Close

#### 1.4.1.1 Save As

See section 1.2.4.1.4 for details.

#### 1.4.1.2 Export Results to Excel File

To export results into Excel, *left-click* on *File*, which is located in the drop-down menus near the top left side of the *Results* screen (Fig. 1.4-1). In the *File* drop-down menu, select *Export Results to Excel File*. Once selected, a dialog screen will appear that will allow the User to specify the file name and location of where to save the Excel file that will contain the results (Fig. 1.4.1.2-1). An example of the Excel export file is shown in Figure 1.4.1.2-2.

**NOTE: This feature utilizes Microsoft® Excel® and requires that it is already installed.**

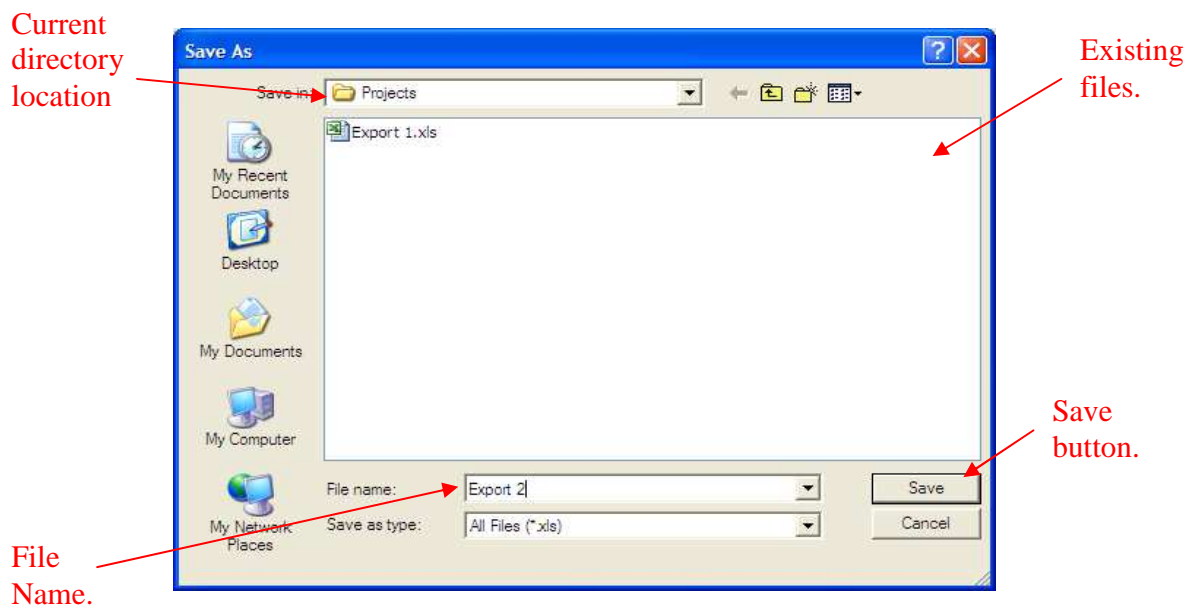


Figure 1.4.1.2-1. Save Export Data To Excel Dialog

	REFERENCE S-102 STANDARD	PARENT SR&QA PROGRAM	PROGRAM DOMAIN	CONCEPT REFINEMENT	PROCESS PURPOSE
MISSION ASSURANCE PROCESS					
RMAD Program Planning	S-102.1.1.1	RMAD	Management	1	To define processes which are: 1) implemented t processes for mitigating or controlling product d
System Safety Program Planning	S-102.1.1.2	SYSTEM SAFETY	Management	1	To define processes which are: 1) implemented t define processes for mitigating or controlling pro
QA Program Planning	S-102.1.1.3	QA	Management	1	To define processes which are: 1) implemented t processes for mitigating or controlling product d
Subcontractor and Supplier RMAD Management	S-102.1.2.1	RMAD	Management	N/A	To define and oversee subcontractor and supplie RMAD requirements, and 2) the means by which controlled in a timely manner.
Subcontractor and Supplier System Safety Management	S-102.1.2.2	SYSTEM SAFETY	Management	N/A	To define and oversee subcontractor and supplie System Safety requirements, and 2) the means b controlled in a timely manner.
Subcontractor and Supplier Quality Assurance Management	S-102.1.2.3	QA	Management	N/A	To define and oversee subcontractor and supplie requirements, and 2) the means by which produ

Figure 1.4.1.2-2. Exported Result in Excel

### 1.4.1.3 Print Results

To print the result of a current output, *left-click* on *File*, which is located in the drop-down menus near the top left side of the *Results* screen (Fig. 1.4-1). In the *File* drop-down menu, select *Print Results*. Once selected, a dialog screen will appear that will allow the User to specify the printer options (Fig. 1.4.1.3-1). To start printing, *left-click* the *Print* button.

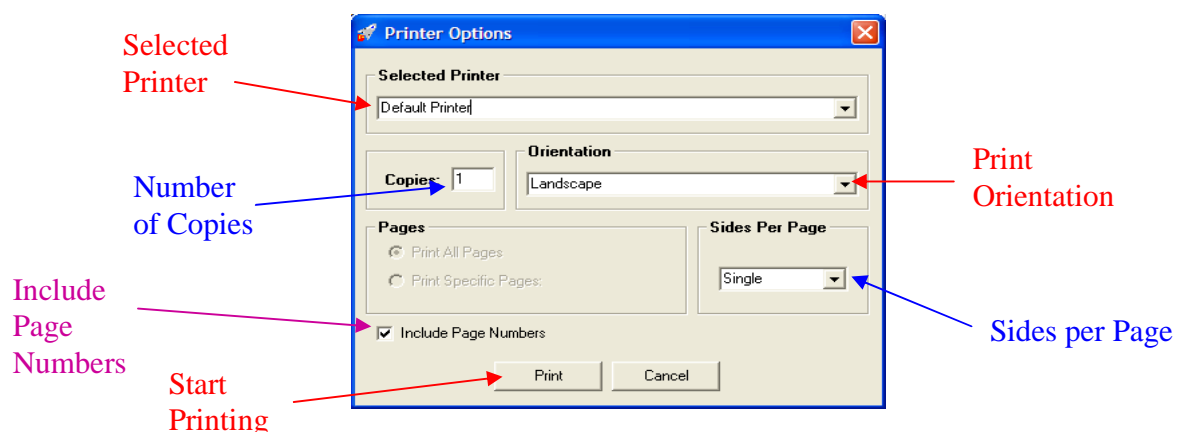


Figure 1.4.1.3-1. Printer Options

#### 1.4.1.4 Close

To close *Results* window and return back to the main menu, *left-click* on *File*, which is located in the drop-down menus near the top left side of the *Results* screen (Fig. 1.4-1). In the *File* drop-down menu, select *Close*.

#### 1.4.2 Sorting

The results can be sorted alphabetically in ascending order (i.e., “**A to Z**”) or descending order (i.e., “**Z to A**”) for the following sort types:

- Mission Assurance Process
- Reference S-102 Standard
- Parent SRQA Program
- Program Domain

To change the sort type, select the desired type from the *Sort* drop-down menu.

#### 1.4.3 References

To access additional reference material, in PDF format, sorted by process and activity, select *References* from the drop-down menu, then select the reference material process and activity.

## 2.0 Acronyms

Ao	Availability Analysis
CA	Criticality Analysis
CIRM	Critical Item Risk Management
CN	Criticality Number
DCA	Design Concern Analysis
Do	Dependability Analysis
ESS	Environmental Stress Screening
ETA	Event Tree Analysis
ETC	Estimate to Complete
FDM	Functional Diagram Modeling
FMEA	Failure Mode and Effects Analysis
FMECA	Failure Mode, Effects, and Criticality Analysis
FRACAS	Failure Reporting, Analysis, and corrective Action
FRB	Failure Review Board
FTA	Fault Tree Analysis
HA	Hazard Analysis
HW	Hardware
LLAA	Lessons Learned Approval Authority
LOE	Level of Effort
MAP	Mission Assurance Program
MAPP	Mission Assurance Program Plan
MAWG	Mission Assurance Working Group
MCLP	Multiple Capability Level Process
PMP	Parts, Materials & Processes
PoF	Physics of Failure
QA	Quality Assurance
R&M	Reliability and Maintainability
RD/GT	Reliability Development/Growth Testing
RMAD	Reliability, Maintainability, Availability and Dependability

SCA	Sneak Circuit Analysis
SCLP	Single Capability Level Process
SEC	Standards Executive Council
SPFM	Single Point Failure Mode
SR&QA	Safety, Reliability & Quality Assurance
SSP	System Safety Program
SW	Software
TAAF	Test, Analyze and Fix
V&V	Verification & Validation

### 3.0 Terms and Definitions

The definitions contained in this section were taken from the *AIAA S-102.0.1 Mission Assurance Program General Requirements Standard*.

#### **anomaly**

apparent problem or failure affecting a configured product, process, or support equipment/facilities that is detected during product verification or operation.

NOTE: Anomalies are distinguished from discrepancies, product defects which do not violate project requirements which may or may not be documented in the FRACAS.

#### **acquisition authority**

an organization (Government, contractor, or subcontractor) that levies requirements on another organization through a contract or other document.

#### **approximation<sup>1</sup>**

a value that is nearly but not exactly correct or accurate.

#### **audit**

an independent examination of accounts and records to assess or verify compliance with specifications, standards, contractual agreements, or other criteria (Ref. IEEE STD 1624-2008).

#### **baseline process**

the minimum set of functions that constitute a specific type of process.

#### **baseline program**

the minimum set of functions that constitute a specific type of program.

---

<sup>1</sup> Definition source: IEEE 100, *The Authoritative Dictionary of IEEE Standards Terms*

**capability**

one or more processes or activities that describe how SR&QA programs are used, treated, or developed within an organization (Ref. IEEE STD 1624-2008).

**capability-based mission assurance program**

the set of processes that assesses and controls product deficiency risk at one or more predefined capability levels.

**capability level**

measure of the ability of a mission assurance process, as specified by a set of activities, to address the pertinent mission assurance needs of a systems engineering process.

**capability level growth**

a measurable improvement (e.g., an increase in resources, scope of effort, or maturity of input data) in the ability of a mission assurance process to support the mission assurance needs of a systems engineering process.

**chaos**

the random occurrence of unpredictable and unrelated events.

**control**

a method used to reduce the consequences, likelihood, or effects of a hazard or failure mode

NOTE: Controls include special design features, procedures, inspections, or tests.

**credible failure mode or hazard**

a failure mode or hazard with a probability of occurrence greater than  $1.0\text{E-}6$ , 0.000001, or one in a million.



**engineering judgment**

a properly trained engineer's technical opinion that is based on an evaluation of specific data and personal experience.

NOTE: Engineering judgments are a reality that cannot not be avoided when insufficient time, data, or funding are available to perform a detailed quantitative analysis. (See Sections 5.5.1 and 5.5.2 for more information.)

**environmental safety assurance**

to give appropriate consideration to potential environmental impacts prior to beginning any action that may significantly affect the environment.

**estimation**

a tentative evaluation or rough order magnitude calculation

**failure**

termination of the ability of a unit to perform its required function

NOTE: A fault may cause a failure.

**failure mode**

consequence of the mechanism through which a failure occurs, or the manner by which a failure is observed.

**fault<sup>2</sup>**

[1] [Software reliability] a manifestation of an error in software; [2] [Hardware reliability] any undesired state of a component or system; [3] [Components] a defect or flaw in a hardware or software component; [4] [Human reliability] procedure (operational or maintenance) or process (manufacture or design) that is improperly followed;

NOTE: [1] An accident may cause a fault; [2] A fault may cause a failure; [3] A fault does not necessarily require failure.

---

<sup>2</sup> Definition source: IEEE 100, *The Authoritative Dictionary of IEEE Standards Terms*

**hazard**

a condition that is prerequisite to a mishap and a contributor to the effects of the mishap.

NOTE: A single point failure mode (SPFM) item is a hazard with respect to its potential to lead directly to loss of a safety-critical or mission-critical system function.

**maturity level**

measure of the degree of accuracy of a data product, as developed using a specified set of input data, in relation to what is considered the best achievable results.

**mishap**

an unplanned event or series of events resulting in death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment.

**mission**

the purpose and functions of the space system (sensors, transponders, boosters, experiments, etc.) throughout its expected operational lifetime, and controlled reentry or disposal orbit time period. A space system may have multiple missions (e.g., primary mission, ancillary mission, and safety mission).

**mission assurance**

the program-wide identification, evaluation, and mitigation or control of all existing and potential deficiencies that pose a threat to system safety or mission success, throughout the product's useful life and post-mission disposal.

NOTE: Deficiencies include damaging-threatening hazards, mission-impacting failures, and system performance anomalies that result from unverified requirements, optimistic assumptions, unplanned activities, ambiguous procedures, undesired environmental conditions, latent physical faults, inappropriate corrective actions, and operator errors.

**mission capability**

This term encompasses the purpose and functions of the space system (sensors, transponders, etc.) throughout its intended system mean mission duration (the expected life of the space vehicle). (Ref. AFMAN 91-222 SUPL1).

**mitigation**

(1) a method that eliminates or reduces the consequences, likelihood, or effects of a hazard or failure mode; (2) a hazard control.

**modeling**

act of producing a representation or simulation of one or more items.

**non-credible failure mode or hazard**

a failure mode or hazard with a probability of occurrence equal to or less than  $1.0\text{E-}6$ , 0.000001, or one in a million.

NOTE: In System Safety Engineering, the qualitative probability values of an improbable hazard and a non-credible hazard are equivalent.

**plan**

a method for achieving an end.

**practice**

one or more activities that use specified inputs to develop specified work products for achieving specified objectives (Ref. IEEE Standard 1624-2008).

**process-based lesson learned**

important information created, documented, and retrieved according to a process or procedure descriptor.

**product-based lesson learned**

important information created, documented, and retrieved according to a system or device life cycle specific functional or physical descriptor.

**program**

[1] the managed collection of an organization's practices that is structured to ensure that the customers' requirements and product needs are satisfied (Ref. IEEE Standard 1624-2008); [2] a defined set of managed processes conducting to an end under a single plan.

NOTE: A program does not have to consist of related, managed process. Compare with definition of "system".

**process**

a sequence of tasks, actions, or activities, including the transition criteria for progressing from one to the next, that bring about a result (Ref. IEEE Standard 1624-2008).

NOTE: A process can be unmanaged or managed. An unmanaged or "free" process does not have its inputs or outputs controlled. The rain and melted snow that replenishes a lake is an example of an unmanaged process. A managed or "controlled" process has its inputs and outputs controlled. An electrical power station is an example of a managed process.

**quality**

a measure of a part's ability to meet the workmanship criteria of the manufacturer.

NOTE: Quality levels for parts used by some of the handbook methods are different from quality of the parts. Quality levels are assigned based on the part source and level of screening the part goes through. The concept of quality level comes from the belief that screening improves part quality.

**reliability**

probability that an item will perform its intended function for a specified interval under stated conditions.

**residual risk**

risk associated with significant failure modes or hazards for which there are no known control measures, incomplete control measures, or no plans to control the failure mode or hazard.

**root cause(s)**

most fundamental reason(s) an event might or has occurred.

**root cause analysis**

a process for identifying the fundamental cause of an event or failure.

**safety**

freedom from those conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment.

**safety critical**

a term applied to a condition, event, operation, process or item of whose proper recognition, control, performance or tolerance is essential to safe system operation or use; e.g., safety critical function, safety critical path, safety critical component.

**specialty engineering**

a subgroup of the engineering processes that make up the Mission Assurance Process

Note: Traditionally, this subgroup includes Reliability, Maintainability, PMP, Survivability, and Supportability.

**system**

[1] a defined set of related processes.

[2] elements of a composite entity, at any level of complexity of personnel, procedures, materials, tools, equipment, facilities, and software, that are used together in an intended operational or support environment to perform a given task or achieve a specific purpose, support, or mission requirement.

NOTE: A system that consists of one or more unmanaged processes is susceptible to becoming “unbalanced” and changing over time (e.g., an ecological system). For a system to maintain stability it must be “balanced” and consist only of managed processes.

**system safety**

the application of engineering management principles, criteria, and techniques to optimize all aspects of safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system lifecycle (Ref. MIL-STD-882C).

**systems engineering**

An interdisciplinary approach encompassing the entire technical effort to evolve and verify an integrated and life-cycle balance set of system product and process solutions that satisfy customer needs. (Ref. MIL-STD-499B Draft).

**tailoring**

process by which the individual requirements (tasks, sections, paragraphs, words, phrases, or sentences) of a standard are evaluated to determine the extent to which each requirement is most suited for a specific system acquisition and the modification of these requirements, where necessary, to ensure that each tailored document invokes only the minimum needs of the customer.

**timely**

performance of a task, subtask, or effort when planning and execution results in the output being provided with sufficient time for management, if need be, to identify and implement cost-effective action.

EXAMPLE: An action that avoids or minimizes schedule delays and cost increases.

**validation**

the act of determining that a product or process, as constituted, will fulfill its desired purpose

**verification**

the process of assuring that a product or process, as constituted, complies with the requirements specified for it