aPriori Professional Version 2019 R2 Release Notes

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Documentation

The latest version of the documentation for these products can always be found at the aPriori Support HelpCenter (requires registration): https://support.apriori.com/hc.

What's New – Quick Summary

This section provides a brief, high-level view of what has changed. For more detailed information, see *What's New – The Details*.

Items in **bold italic** are considered *Key New Capabilities*.

Process Group or Functional Area	Changes
General Enhancements (across Process Groups)	▪ ***aPriori 2019 R2 provides a new approach for managing and updating the Labor Rate data which is used to calculate Labor Costs for all process cost models. This enhancement enables VPE Administrators to update labor rates much more quickly and easily than was possible in previous releases and provides end users more insight into the assumptions which drive labor rates.*** ▪ Material Cost calculations have been updated for several process groups to account for savings which can be achieved by selling scrap material and/or scrapped parts at a fraction of the original raw material cost. These updates were made to processes in the Bar & Tube Fab, Forging, Sheet Metal, Sheet Metal – Hydroforming, Sheet Metal – Stretch Forming, Sheet Metal – Transfer Die, and Stock Machining and 2 Model Machining process groups. ▪ Tooling cost calculations for many processes were enhanced to determine tool life and the number of tools required to manufacture the specified production volume. Tooling Costs now will include the cost of multiple tools if needed. Process setup options were added to allow users to specify tool material and tool coating material, both of which impact tool life. Also, a wider choice of tool materials and tool coatings were made available in the 2019-10 aPriori RDLs, as well as updated unit costs.
Bar and Tube Fab/ Extrusions	▪ ***A new cost model now is available for estimating the cost of parts made from custom Aluminum extrusion profiles. Licensed separately from the basic Bar & Tube Fab cost model for commodity stock forms.***
Composites	▪ ***A new cost model now is available for estimating the cost of composite laminate parts made via Hand Layup, Automated Tape Layup (ATL) and Automated Fiber Placement (AFP) processes.***

Process Group or Functional Area	Changes
Plastic Molding and Assembly Molding	▪ aPriori 2019 R2 includes several enhancements to the plastic material data available in the aPriori Regional Data Libraries. Several material compositions were added, material property values were updated, and a new methodology for determining Thermal Diffusivity was introduced in order to make it easier for customers to add additional compositions to their own VPEs.
Assembly	▪ aPriori 2019 R2 contains a change to how assembly costs are calculated initially. Assembly subcomponents that have not yet been initialized (costed) will display a value of 0 in the Finish Mass field of the Assembly Details tab. Previously, the mass was estimated, assuming the material density of a common steel material, in order to estimate pick-and-place assembling costs for the component. Therefore, assembly pick and place costs no longer will be estimated for assembly components which have not yet been costed.
Machining	▪ A new External AxiGroove Broaching operation is available. This operation represents the linear broaching of a rotationally-symmetric pattern of slots, such as the fir-tree or dovetail root joint features commonly found on turbine and compressor disks. ▪ In aPriori 2019 R2, the Machining cost model was re-architected to make the code easier to maintain and configure. This does not affect cost results but should be noted by individuals who plan to configure aspects of the machining cost model.
Casting	▪ The Gravity Die Casting routing now accounts for the time and cost for Refractory Coating of mold cores.
Sheet Metal, Sheet Metal – Transfer Die	▪ For Progressive Die and Transfer Die processes, press cycle time now is computed using a new machine property Strokes per Minute, which is readily available from press specifications. ▪ A new process setup option is available to indicate that a "cluster punching" technique is used in Progressive Die and Transfer Die processes. With cluster punching, stamping operations are slightly staggered, reducing the required press force and enabling a smaller machine to be used than if stamped simultaneously.

Process Group or Functional Area	Changes
Surface Treatment	▪ A new Manual Paint process is available and represents one or more operators manually preparing and painting the part in a paint booth facility. It is included automatically when costing Composite parts, but also is available for manual inclusion in other process group routings. The Manual Paint process is more mechanistic and has more options than the Painting process, which also still is available.
Other Secondary Process	▪ Two new non-destructive inspection processes Ultrasonic C-Scan and Ultrasonic A-Scan now are available. Ultrasonic C-Scan is included automatically in Composites routings.
Usability Enhancements	▪ aPriori now recognizes and costs thread features modeled using the "Symbolic Thread" feature in the Siemens NX CAD system. ▪ The Validation tab was updated to show the total count of tolerances applied to the part, instead of the number of GCDs with tolerances as in previous releases. ▪ The Design to Cost view for thickness violations was updated so that violations are indicated by highlighting exterior surfaces of the part, making it easier to identify where on the part the violations are occurring. This change was made in the Plastic Molding, Casting – Die and Casting – Sand process groups.
Regional Data Libraries	▪ The **2019-10 Regional Data Libraries** are available and contain updates to Material Rates, Labor Rates, Overhead Rates, Toolshop Rates, and Currency Exchange Rates for all regions supported by aPriori.

Process Group or Functional Area	Changes
VPE Management and Configuration	▪ **aPriori 2019 R2 provides a new approach for managing and updating the Labor Rate data which is used to calculate Labor Costs for all process cost models. This enhancement enables VPE Administrators to update labor rates much more quickly and easily than was possible in previous releases and provides end users more insight into the assumptions which drive labor rates.** ▪ The Search CSL feature within the Cost Model Workbench was enhanced to allow searches of file names (CSL module names) as well as file contents. ▪ The Search CSL feature now enables users to open a file returned as a search result directly into the CSL Editor. ▪ New configuration options are supported for Process Setup Options and Zero-Or-More routing nodes. ▪ Several new built-in CSL functions were implemented, and several existing functions were updated to be null-safe.
Administrative Enhancements	▪ It now is possible to provide more granular levels of administrative access to all the different tools available within the aPriori VPE Toolset (VPE Manager, Cost Model Workbench, Process Group Site Variables, Deployment Data, and BOM Loader) and the aPriori System Admin Toolset. ▪ A new Installer is available for aPriori Professional 2019 R2 which enables various settings to be specified during the installation process and preserved when upgrading to a newer version of aPriori.
Reporting Enhancements	▪ Access control rules now apply to Cost Insight (CI) Report If a user is restricted from viewing a scenario in the aPriori Professional and aPriori CI Design applications, the scenario also will not be displayed to that user in CI Report. This access control extension applies both to out-of-the-box reports and the ad-hoc reporting environment. ▪ New Upgrade Comparison and Upgrade Part Comparison reports are available in Cost Insight Report. These reports assist customers in identifying significant changes in manufacturing and cost estimates after upgrading to a new release of aPriori.
Platform Updates	▪ New versions of select CAD Systems, Database Servers, and Operating systems are supported. See details at *Platform and CAD Support Updates*.

What's New – The Details

Note: Some features described are part of separately licensed modules and may not be included in all deployments. Please direct questions to your aPriori Account Representative or to aPriori Support.

Key New Capabilities

aPriori Professional 2019 R2 introduces several significant new capabilities.

- **A new Extrusions cost model for estimating the cost of parts made from custom Aluminum extrusion profiles. It accounts for the cost of manufacturing the custom extrudates themselves, as well as the sawing, punching, and machining operations needed to remove material and any bending operations needed to produce the finished part.** This initial release is intended for parts which have light-to-moderate amounts of material removal.

  For more information, please refer to the section *Extrusions / Bar & Tube Fabrication Cost Model Enhancements* later in this document.

- **A new Composites cost model is available for estimating the manufacturing cost of parts made from continuous fiber-reinforced composite materials. The initial release is targeted at part types, material types, and layup processes common to the aerospace industry.** The cost model supports both solid laminate parts and sandwich-structure parts containing honeycomb cores, made with thermoset resin materials (epoxy and phenolics).

  For more information, please refer to the section *Composites Cost Model Enhancements* later in this document.

- **aPriori 2019 R2 provides a new approach for managing and updating the Labor Rate data which is used to calculate Labor Costs for all process cost models**. **This enhancement enables VPE Administrators to update labor rates much more quickly and easily than was possible in previous releases and provides end users more insight into the assumptions which drive labor rates.**

  Previously, the Labor Rate field for every machine for every process had to be populated and managed individually. Updating the labor rates for an entire VPE therefore required entering updated values for thousands of machines, even though typically many or all the machines for the same process use the same labor rate value. Indeed, typically there are less than 20 unique labor rate values across a VPE. Now, labor rate management is greatly centralized and streamlined through the use of several new VPE tables.

  For more information about this enhancement, please refer to the section *VPE Management and Configuration Enhancements* section, later in this document.

Enhanced Manufacturing Process Cost Model Overview

aPriori Professional 2019 R2 includes updates to various manufacturing process cost models. Updates which affect many process groups in common are described in this Overview section. Updates which are specific to individual process groups are described in separate sections below. *Note that customers must use aPriori 2019 R2 starting point VPEs or upgrade the cost model versions for their own VPEs to take advantage of these updates.*

aPriori 2019 R2 contained two enhancements which impact many different processes in many different process groups:

- **aPriori 2019 R2 provides the ability to discount a part's Material Cost, by assuming a Scrap Material Credit is achieved by selling scrap material and/or scrapped parts at a fraction of the original raw material cost.** The scrap material credit logic now is available in following Process Groups: Bar & Tube Fab, Forging,

Sheet Metal, Sheet Metal – Hydroforming, Sheet Metal – Stretch Forming, Sheet Metal – Transfer Die, and Stock Machining. (Note that the Casting-Sand, Casting-Die, Plastic Molding and Assembly Molding process groups already provided logic for re-melting and reuse of scrap material, so those process groups were not modified).

Scrap material buyback rates now are specified for each material composition in the baseline Regional Data Libraries. They are stored in the new Material field "Scrap Cost Percent" and are expressed as a percentage of raw material unit cost. The Scrap Material Credit value is determined by applying the buy-back rate to the Scrap Mass of the part. The Scrap Part Credit value is determined by applying the buy-back rate to the Rough Mass and Number of Scrapped Parts. The part's Material Cost then is determined by subtracting the scrap buy-back value from the Raw Material Cost. The final Material Cost, Raw Material Cost, Scrap Material Credit and Scrap Part Credit calculations all can be reviewed in the Formula Dependencies dialog as shown below.

Note that by default, the calculation of scrap credit is not enabled in the baseline cost models. Users may enable the scrap credit for a specific part by using the process setup options **Enable Scrap Material Credit** and **Enable Scrap Part Credit** located at the top-level node in the routing. To include scrap buyback credit by default for all parts in a given process group, a VPE Administrator should use the plant variables **enableScrapMaterialCredit** and **enableScrapPartCredit**.

When Scrap Material Credit is enabled, the Material Cost of a part will be slightly reduced, depending on the specific part geometry, process group, and scrap buyback rate applied. In a set of test parts, material costs were reduced on the order of 2%. The impact of enabling Scrap Part Credit is more variable due to the difference in Good Part Yield specified for each process.

- In aPriori 2019 R2, **tooling cost calculations for many processes were enhanced to determine tool life and the number of tools required to manufacture the specified production volume.** The tool life calculations determine the number of parts which can be produced with a given tool before it wears to the point it needs replacing. The following processes now account for tool life:

  o Bar & Tube Fabrication – Extrusion

  o Die Casting - Gravity Die Casting, High Pressure Die Casting & Trim

  o Forging - Hammer, Press & Trim

  o Sheet Metal - Generic Press, Standard Press, Tandem Press & Progressive Die

  o Sheet Metal Transfer Die - Transfer Die & Offline Blanking

  o Sheet Metal Hydroforming - Hydroform & Offline Blanking

  o Sheet Metal Stretch Forming - Stretch Form Cycles, Router & Bench Operation

  o Sheet Plastic - 2 Cavities Drape Forming, 2 Cavities Vacuum Forming, 4 Cavities Drape Forming, 4 Cavities Vacuum Forming, Single Cavity Drape Forming, Single Cavity Vacuum Forming

  o Roto & Blow Molding - Extrusion Blow Mold, Rotational Mold

  o Plastic Molding - Injection Molding, Reaction Injection Molding, Structural Foam Molding

  o Assembly Molding - Insert Injection Molding

  o Powder Metal - Compaction Pressing

  For most of these processes, tool life estimates are determined by considering the part material, the tool material, and the tool coating type. The part material is used to determine a starting number of hits or shots which then is adjusted based on the tool material and coating type, since some tool materials wear more quickly than others and some coatings provide more protection against wear than others.

  Sheet Metal Stretch Forming uses an alternate approach in which the number of tools required is derived from a process setup option input. This process is unlikely to be involved with production volumes that will wear tools out so much that more than one tool is required. Extra tooling may be required for meeting a specific production rate though, so the process setup option provides for this scenario. The Forging cost model continues to make use of plant variables to specify the number of parts which can be made with the Hammer, Press, and Trim Die processes before the respective tools must be replaced.

  The estimates of Tool Life and resulting Number of Tools can be viewed by using the Formula Dependencies dialog and/or in the Investments tab.

  Note that as part of this effort, the 2019-10 aPriori Regional Data Libraries were updated to provide a larger set of tool materials and tool coating types for the processes listed above, and to provide up-to-date unit costs for these items. For example, Plastic Molding now provides tool material choices of Aluminum and Epoxy in addition to various Carbon and Stainless-Steel alloys. There are 40 unique tool material choices available across the set of processes mentioned above (though only

a subset of these are available in any given process). 12 tool coatings are available for all the processes listed above. Process setup options for specifying the desired tool material and tool coating were added to the processes listed above (if not already available).

Due to the inclusion of these tool life calculations and updated tool material and coating costs in aPriori 2019 R2, tooling cost estimates will change somewhat compared to those in a previous release of aPriori. Cost increases will occur if production volumes are such that multiple tools are required. As a trend, as production volumes increase the Hard Tooling costs increase significantly, but Fully Burdened Cost is not expected to increase significantly as the extra tool cost is amortized across a larger number of parts. Additionally, even if multiple tools are not required, costs may change somewhat due to the updated data for tool material and tool coating unit costs. Across a set of test parts and manufacturing processes, hard tooling cost increases on the order of ~1.5% were observed due to these data updates.

Extrusions / Bar & Tube Fabrication Cost Model Enhancements

aPriori 2019 R2 provides a new Extrusions cost model for estimating the cost of parts made from custom aluminum extrusion profiles. It accounts for the cost of manufacturing the custom extrudates themselves, as well as the sawing, punching, and machining operations needed to remove material and any bending operations needed to produce the finished part. This initial release is intended for parts which have light-to-moderate amounts of material removal.

The Extrusions cost model is available from within the Bar & Tube Fabrication process group but is separately licensed. If you have licensed the Extrusions cost model, aPriori will recognize the part is made from extruded stock with a custom cross-section profile. (Specifically, the CrossSection GCD will have a Shape property value of "GENERIC_EXTRUSION.") Without the license, aPriori simply will try to match the part against the various commodity bar & tube stock forms available in the Bar & Tube process group and will not recognize the part as being made from a custom extrusion profile.

The Extrusion routings in the aPriori baseline cost models include the following processes:

- **Billet Preheat** and **Die Preheat** – ovens for heating the billet and die respectively, before they are placed into the extrusion press

- **Extrusion** – this process includes all the operations and equipment sold with an Extrusions work center:

  o Release Agent application – an acetylene torch is applied to the billet end to form a soot which helps prevent billet from sticking to the ram of the press

  o Pressing of the raw billet stock through the extrusion die, via a traditional extrusion press

  o Cooling of the extrudates as they emerge from the press, via either Standing Wave, Water Spray, or Air Spray quench tank

  o Rough Cutoff – long sections of the cooled extrudates are cut off and then pulled down to the opposite end of a runout table to make way for more extrudates emerging from the press

- o Clamping and Straightening – the long sections and clamped and pulled in order to straighten them and remove stress introduced by the forming or subsequent cooling operations

- o Semi-Finish Cutoff – the extrudates are cut into shorter lengths (but not necessarily finished part length), to enable Racking of extrudates in preparation for Aging

- Aging – for strengthening the raw extrudates

- Secondary processing of the raw extrudate, including

  - o Band Saw, Circular Saw, and Reciprocating Saw processes for cutting extrudate to finished part length,

  - o Tube Punch, 3-Axis Router and 5-Axis Router for material removal

  - o Rotary Draw Bending, Compression Bending, and Bar Bend Brake processes if finished part is bent

  - o Optional surface treatment processes which may be included manually if desired

The cost model estimates Material, Tooling, and Process costs for producing the extrudates as well as secondary processing to produce the finished part from the extrudates.

- Material costs are computed based on the unit costs of round billet stock and account for three types of scrap produced by the extrusion process.

- Tooling cost is estimated based on the size and type of die required for the part (solid or hollow profile). Tooling Cost estimates also account for expected tool life; the cost of multiple dies will be included if the die is expected to fatigue before the specified production volume is produced.

- Extrusion process costs are based on extrusion process cycle time. The extrusion process cycle time is computed by determining a billet size, number of cavities, and ram speed which will result in the extrudates exiting the die within a recommended speed range for the selected material and maximizes material throughput for the various viable solutions.

A new **Cutout GCD** has been introduced for parts made from custom extrusion profiles. The Cutout GCD represents a volume of material which is removed either interior to the part or adjacent to an end of the part. This GCD was introduced in order to support more accurate estimates of the cycle time and cost of material removal operations, as it provides more information about the the accessibility of the geometry and applicable tool sizes than the ComplexHole GCD. Cutout GCDs may either be machined with a 3-Axis or 5-Axis CNC Router, or may be punched with a Tube Laser, depending on the size and location of the feature and various preference settings available as process setup options.

Note: for parts made from the standard commodity Bar & Tube stock forms, GCD extraction and routing assignments generally are unchanged in aPriori 2019 R2. Specifically, for parts made from standard commodity stock forms, Cutout GCDs will not be extracted and ComplexHole GCD still will be extracted. However, some small improvements were made and are described in the section *Issues Resolved in aPriori Professional* below.

Note: Parts which have heavy amounts of material removal may be estimated more accurately by using the Extrusion cost model in conjunction with the 2-Model-Machining cost model. In particular, if the finished part is made from a custom extrusion such that the entire perimeter of the extruded profile has been machined away, aPriori will not be able to determine what the original extruded stock looks like by costing the finished part in isolation. Both the extrusion and machining cost estimates likely will be inaccurate in this case. To handle this case, you can cost a CAD model of the custom extrusion profile in the Bar & Tube process group, then use 2-Model Machining to cost the finished part, specifying the custom extrusion profile scenario as the "Source" scenario.

Please refer to the *Known Issues and Workarounds* **section below for a description of some limitations in the initial release of the Extrusions cost model and workarounds.**

For more information about the extrusion cost model, please refer to *Version 2019 R2* of the *aPriori Cost Model Guide.*

Composites Cost Model Enhancements

aPriori 2019 R2 provides a new Composites cost model for estimating manufacturing costs for parts made from continuous fiber-reinforced composite materials. The initial release is targeted at part types, material types, and layup processes common to the aerospace industry. The cost model supports both solid laminate parts and sandwich-structure parts containing honeycomb cores, made with thermoset resin materials (epoxy and phenolics).

Three different Layup processes are supported in this initial release of the Composites cost model:

- Hand Layup – a manual process in which large rolls of pre-impregnated ("pre-preg") material are cut to produce the final ply shapes; the plies then are placed onto the tool by human operators. This process typically is used for smaller parts which have more complex geometries, such as small radii or bi-directional curvatures that may require darts in the material. Hand Layup also commonly is used for sandwich-structured composite parts which include lightweight honeycomb cores. The aPriori cost model automatically determine the number of hand layup cycles required. A cycle consists of placing some number of plies, then enclosing them in a vacuum bag, applying the vacuum to compact the plies and remove trapped air, then removing or rolling back the vacuum bag to enable placing the next set of plies. This incremental compaction or debulking improves the part's quality by preventing air bubbles or voids forming within it. A user also may override the aPriori-computed number of hand layup cycles if desired.

- Automated Tape Layup (ATL) – an automated process in which rolls of a uni-directional composite tape material (typically 6 – 12 inches wide) are laid down by an automated head. ATL typically is used for large, fairly flat parts such as wing skins as it is not well-suited for achieving complex geometries or even laying into concave barrel-shapes such as fuselage skins. It also is not well suited for parts with cores since pressure from the machine head may crush the core material.

- Automated Fiber Placement (AFP) – an automated process similar to ATL but uses very narrow rolls or "tows" of tape material (typically 1/8 to ¼ of an inch wide). The machine head can lay down up to 36 individual spools of tape simultaneously, allowing each tow to follow more complex curvatures than typically can be achieved

with ATL. It also is not well suited for parts with cores since pressure from the machine head may crush the core material.

Other processes included and costed in the Composites routing are:

- Ultrasonic Cutting (included when Hand Layup is the chosen layup process) – One or more layers of pre-preg material are rolled out onto an ultrasonic cutter bed and a pre-determined pattern of plies are cut from it. Multiple layers can be cut simultaneously if desired to reduce cutting cycle time per part.

- Mold Preparation – estimates the time and cost of (a) applying and curing a mold release agent to the tool, which helps ensure that plies don't stick to the tool and the part can be removed after curing, and (b) applying and curing a Tool Tack substance to the tool to help the plies stay in place as they are being laid up.

- Autoclave –the part is placed into a chamber which produces and maintains the specific pressure and temperature conditions required to cure the resins within the plies.

- Tool Breakdown – accounts for moving the part from the Autoclave to a bench area, dismantling the final vacuum bag package and removing the part from the tool.

- Tool Cleaning – after the previous part is removed from the tool, it needs to be cleaned in preparation for the next part to be laid up.

- Trim and Drill – the profile of the part is machined with a 5-Axis Mill cost model to produce clean edges on the finished part, and to drill any holes.

- Ultrasonic Scan – an inspection process in which an ultrasonic probe is used to detect defects in the composite part. aPriori provides two types of Ultrasonic Scanning processes: Ultrasonic A-scan, in which the part is submerged in a tank and an ultrasonic probe scans the part surface; and Ultrasonic C-Scan, in which the part is placed between a waterjet and the ultrasonic probe.

- Manual Paint – this process is included automatically since composites parts are usually painted for both cosmetic purposes and for functional purposes such as to provide a moisture barrier and protect the composite from damaging fluids such as hydraulic fluid, fuel and de-icer. The new Manual Paint process cost model is more sophisticated than the existing Painting process. It assumes multiple coats of primer and finish coat, with sanding performed in-between coats, and assumes the use of some paints common in the aerospace industry.

- Final Inspection –a final visual inspection performed in order to detect any defects on the surface of the part.

A unique aspect of the aPriori Composites cost model is that it accounts for how ply geometry and material impacts manufacturability and cost. The apriori algorithm considers the size, shape, curvature, material, and fiber orientation of each ply to determine how this will affect the layup rate for each of the three layup processes.

Supported modeling formats: Note that in industry, there is a wide variety of practices and formats used to model composite parts. In order to cost a composite part, aPriori requires that information necessary to define the ply and core geometry be present in the CAD file (and ideally in the CAD model tree hierarchy itself). **The ply and core geometry also must be displayed, not hidden.** This is necessary for aPriori to read and determine the size and shape of a ply, which affect both processing time and cost and material cost. aPriori also

can read ply and core meta-data from the CAD file in order to determine the specific material used for each ply or core, or the orientation of the ply fibers. These inputs affect both material cost and layup times, as less-flexible materials take longer to lay up. For aPriori to determine material information from the CAD model, this material-related meta-data also must be contained in the CAD model tree hierarchy or in an annotation that is associated with CAD model geometry.

As a result of this dependence on the CAD modeling practice, **this initial release of the aPriori Composites cost model will officially support 3 formats for composite parts, which are generated by using the following combinations of CAD system and Composites Design tools:**

- CATIA with Fibersim

- CATIA with CATIA CPD/CWB

- NX with Fibersim

Note that there is some capability to cost composite models even when not all relevant information can be read from the CAD model. For example, if ply material cannot be read from the CAD file OR the material can be read but isn't found in the aPriori material database, aPriori assigns a common material as a default. Users then can assign the desired material to each ply manually.

aPriori also provides a flexible mapping layer to adapt to other modeling practices. If you follow a different modeling practice than those listed above, aPriori still may be able to work with your composites models by developing a new mapping, rather than waiting for a future release of aPriori. Please contact your aPriori account manager to learn more.

Please refer to the *Known Issues and Workarounds* **section below for a description of some limitations in the initial release of the Composites cost model and workarounds.**

Plastic Molding Cost Model Enhancements

aPriori 2019 R2 includes several enhancements to the plastic material data available in the aPriori Regional Data Libraries. Several material compositions were added, material property values were updated, and a new methodology for determining Thermal Diffusivity was introduced in order to make it easier for customers to add additional compositions to their own VPEs.

- **Eight additional material compositions now are included in the Plastic Molding and Assembly Molding** process groups, at the request of several customers:

    o Acrylic (PMMA)

    o PBT (Polybutyleneterephthalate)

    o PBT GF30

    o PBT GF40

    o PPS (Polyphenylenesulfide)

    o PPS GF30

    o PPS GF40

- o Polystyrene (General Purpose)

- **The Materials table for the Plastic Molding and Assembly Molding, and Roto & Blow Molding process groups now includes three new fields: Specific Heat of Melt, Thermal Conductivity of Melt, and Density of Melt.** These new fields are used to calculate a value for the Thermal Diffusivity of a material, which in turn is an input to Cooling Time calculations. Previously, the Material Table included a field directly for Thermal Diffusivity; however, it often was difficult to determine the value of this field directly from material specification data sheets. In contrast, Specific Heat and Thermal Conductivity values are readily available, making it much easier for customers to add materials to their configured VPEs and provide all the necessary material properties.

  By default, the historical field for Thermal Diffusivity now is hidden in the baseline Material Table, as the value now is computed instead. However, this field still exists and has a value, enabling the updated Material RDLs to be used with older cost model versions if desired. Also note that the current cost model will fall back to using the value of the Thermal Diffusivity field if the values for Specific Heat, Thermal Conductivity, and Density of Melt are not populated. *To ensure the most accurate cooling time estimates, customers who upgrade to the latest cost model version are advised to populate the new Specific Heat and Thermal Conductivity and Density of Melt fields for the materials in their VPEs.*

  Note: For some materials, the computed value of Thermal Diffusivity used in aPriori 2019 R2 is somewhat different than the material field value which was used in previous releases. As a result, the calculated Cooling Time for a part made from one of those materials also has changed somewhat. The amount of change depends on the specific material and part. See more information at the end of this section for a summary of the impact of this and other changes on plastic part estimates.

- aPriori expanded the data sources from which we gather plastic material property information in order to validate the plastic material property data available in our Regional Data Libraries. As a result, various material property values were updated for many of the material compositions included in the Plastic Molding, Assembly Molding, and Roto & Blow Molding process groups. Material fields which may have been updated for a given material include Density, Melt Density, Eject Deflection Temperature, Melting Temperature, Mold Temperature, Min Injection Pressure, and Max Injection Pressure.

  In most cases, data value adjustments were small-to-moderate. In some isolated cases a more significant correction was made (for example, the Density of Nylon 66 previously was significantly too high and was reduced to an appropriate value; for some ABS compositions the Eject Deflection Temp, Melting Temperature and Mold Temperature values all were changed by a moderate amount).

Because of these various updated material property values and the new method for computing Thermal Diffusivity, calculated estimates of cooling time may change, and therefore the selected machine, labor time and cost, overhead rate, time, and cost, and/or material cost estimates will change for a given plastic part when comparing aPriori 2019 R2 results to previous releases. The amount of change depends on the molding process, material, part geometry, and production volume and can be either an increase or decrease. Change to thermal diffusivity values for ABS materials resulted in significant increases in estimated cooling time (in a set of test parts, we observed ~45 – 95% higher depending on grade) and therefore cost (~ 30 – 55% increase in our test set for parts with thickness <= 4mm, and ~ 60 – 95% increases for parts with higher thickness, often made with Structural

Foam molding process). For Nylon materials, changes to the values of Thermal Diffusivity values, Eject Deflection Temperature, Melting Temperature and Mold Temperature resulted in decreases in estimated cooling time (~ 14 – 80% lower in the test set) and therefore cost (~0 – 30% lower in the test set). For more details, see *Impact to Cost Estimates When Upgrading to aPriori Professional 2019 R2* (also referred to as *Version 2019 R2* of the *aPriori Cost Impact Guide*).

Assembly Cost Model Enhancements

- **aPriori 2019 R2 contains a change to how assembly costs are calculated initially. Assembly subcomponents that have not yet been initialized (costed) will display a value of 0 in the Finish Mass field of the Assembly Details tab.** Previously, the mass was estimated, assuming the material density of a common steel material, in order to estimate pick-and-place assembling costs for the component. **Therefore, assembly pick and place costs no longer will be estimated for assembly components which have not yet been costed.** Previously aPriori estimated pick and place handling costs based on the mass the part would have if made of the assumed steel material. Now no values will be computed or displayed for Finish Mass or any Pick and Place costs until the component actually has been cost with a specific material (or if a Finish Mass value actually was specified for the component using the BOM Loader capability).

  Similarly, if an assembly contains manually-costed components (those cost in the Manually Costed process group), these also no longer will display a non-zero estimate of Finish Mass in the Assembly Details tab (unless a Finish Mass value was specified through use of the BOM Loader).

Machining Cost Model Enhancements

- **aPriori 2019 R2 provides a new External AxiGroove Broaching operation. This operation represents the linear broaching of a rotationally-symmetric pattern of slots, such as the fir-tree or dovetail root joint features commonly found on turbine and compressor disks.** In this operation, a linear broach with a series of roughing and finishing teeth is applied in turn to each slot comprising the AxiGroove GCD. Note that this is different than the Internal Gear Broaching operation, which assumes that all slots are cut simultaneously by a broach which has teeth distributed around the circumference of the broach.

  The External AxiGroove Broaching operation now will be assigned automatically to external AxiGroove GCDs which are determined to be feasible for broaching but not for hobbing. To determine feasibility for broaching, a new AxiGroove property isStraightExtrude was introduced; when set to true it indicates the AxiGroove geometry can be generated by extruding the tooth/valley profile in a straight direction and therefore can be created by a linear broaching motion. Feasibility for hobbing is determined by checking the value of the existing AxiGroove property Radial Undercut Volume Ratio. A **value greater than zero indicates that some geometry of the axiGroove "teeth" obstructs the adjacent slots or "valleys"** when approached from the radial direction and therefore hobbing is not feasible. In the baseline cost models, External AxiGroove Broaching will fail if the slots are unobstructed, so that Hobbing is assigned instead. If broaching is desired in this situation, override the feasibility rule checks for the operation.

- **In aPriori 2019 R2, the Machining cost model was re-architected to make the code easier to maintain and configure.** A significant portion of machining operation logic was consolidated into centralized library files. Specifically, operation costTaxonomy and toolLookup files were consolidated for a targeted set of processes and operations. Previously the logic was defined separately for each unique combination of process, operation, and GCD, even though much of the logic was identical or near-identical.

  This code-consolidation resulted in greatly streamlining the cost model. the targeted processes and operations, the number of distinct files and the number of lines of code each were reduced by roughly 90%; overall the number of distinct files and lines of code in the entire Machining cost model was reduced by almost half. As a result, it will be much easier for both aPriori developers and customers to extend or configure cost models, as new operation logic needs to be implemented in only one centralized location instead of tens of locations.

  The logic and functioning of the cost model were not altered (with the exception of some bug fixes identified during the code consolidation process). Therefore, general cost model behavior and results have not changed as a result of this consolidation effort. Customers who plan to configure the Machining cost model should familiarize themselves with this file consolidation approach and adopt the use of centralized library files as practical, in order to make future upgrades faster and easier.

Casting Cost Model Enhancements

- **aPriori 2019 R2 includes the ability to account for the time and cost of Refractory Coating cores for Gravity Die Cast parts.** (Support for refractory coating of molds and cores for sand casting was previously introduced in aPriori 2019 R1 SP1.) Refractory coatings also commonly are referred to as foundry coatings, protective coatings, washes, and blackings. The coating is designed to withstand the high temperatures of molten metal and act as a barrier between molten metal and a core or mold surface, which helps to improve the surface quality of the casting and reduce defects, rework and scrap.

  Parts costed with the Gravity Die Cast routing in the Casting – Die process group now will have Core Refractory Coat and Refractory Coat Oven Dry processes automatically included for each core, to accounting for the time and cost associated with both applying and drying the coating for each individual core. Both labor cost and coating material cost are computed. The Routing Selection dialog can be used to exclude refractory coating for the entire part, if needed. The Routing Selection dialog also can be used to specify the drying method; by default, an oven drying process is applied but air drying may be chosen instead. Process Setup Options on the individual coring operations can be used to specify whether a specific core is coated, the application method for the core (spraying, brushing, or flow coating), the number of coating applications, and the preparation time required. Note that refractory coating was added previously to the Casting – Sand process group in aPriori 2019 R1 SP1.

  The cost estimate for a gravity die-cast part in aPriori 2019 R2 will increase somewhat compared to the estimate in a previous release due to the inclusion of refractory coating. The amount of increase will vary based on the number and size of cores in the part. For a set of test parts, Piece Part Cost increased by an average of 2.8 and Cycle Time increased by an average of 4.7%.

For more information about the Refractory Coating and Refractory Drying processes, please see the 2019 R2 edition of the *aPriori Professional Cost Model Guide.*

Sheet Metal Cost Model Enhancements

- **aPriori 2019 R2 improves how press cycle time is computed for Progressive Die and Transfer Die processes and makes it easier for customers to provide machine data for their VPEs.**). Progressive Die and Transfer Die machines (in the Sheet Metal process group and Sheet Metal – Transfer process group, respectively) now include a new machine property **Strokes Per Minute** which can readily be found on press specification sheets. During costing, this new field now is used to compute press cycle time. In previous releases, press cycle time was taken directly from the machine property **Press Cycle Time**.

  In addition, data for the various presses in the aPriori Regional Data libraries was validated. For a few machines, the computed value for press cycle time differs somewhat from the machine property (**Press Cycle Time**) value used in previous releases. As a result, press cycle time for these machines increase by 0 - 60% or decrease by 0 - 90%, compared to the previous release of aPriori.

  Note that, in this release, if the **Strokes Per Minute** field is not populated for the current machine, the cost model will continue to use the value of the machine property **Press Cycle Time** (which now is hidden by default in machine property displays).

- **aPriori 2019 R2 now includes an option to indicate that a Progressive Die press or Transfer Die uses a "cluster punching" technique which reduces the maximum required press force.** By default, the baseline cost model assumes that all GCDs (features) are stamped simultaneously, so that the required press force is the sum of force required for all stamped features. However, in practice a press can be configured to stagger the stamping of groups of features, reducing the total press force required. The Progressive Die process (in the Sheet Metal process group) and the Transfer Die process (in the Sheet Metal – Transfer Die process group) both now provide a process setup option **Number of Shear Planes**, which defaults to 1 to indicate all features are considered to be stamped simultaneously. A user may specify a value more than one to indicate how many staggered stamping operations occur. This may allow a part to be manufactured on machine that would not have sufficient press force to stamp all features simultaneously, changing the selected machine and related costs.

Surface Treatment Cost Model Enhancements

- **aPriori 2019 R2 includes a new Manual Paint process** in the Surface Treatment process group. This process is included automatically when costing Composite parts, but also is available for manual inclusion in other process group routings. Manual Paint represents one or more operators manually preparing and painting the part in a paint booth facility. The cost model accounts for the cost of priming and painting the part, including sanding and cleaning of the part prior to both priming and painting, and spraying and curing of both the primer and topcoat. Generally, painting times and costs are driven by the surface area of the part to be painted as well as the number of holes which must be masked.

The baseline cost model assumes the use of aerospace-grade primers and paints and corresponding unit costs; customers may add specific paint and primers used for their part types in their VPEs. Process setup options are provided, enabling users to specify inputs such as the types of primer and paint used, number of coats required for each, and the rates (area per time) at which the part is sanded and at which primer and paint is applied, if different from the default assumptions.

Other Secondary Processes Cost Model Enhancement

- **aPriori 2019 R2 introduces two new nondestructive inspection processes for detection of defects within materials**, available within the Other Secondary Processes process group:

  o Ultrasonic C-Scan: scans for defects, using a probe and waterjet. This process is included by default for Composites routings and may be included manually in other process group routings.

  o Ultrasonic A-Scan: uses a probe on a part that is submerged in a bath tank. This process may be included manually if desired in any routing.

Usability Enhancements

- **aPriori 2019 R2 now recognizes and costs thread features modeled using the "Symbolic Thread" feature in the Siemens NX CAD system.** When opening a model containing Symbolic Thread features, aPriori now will set the Threaded property to "true" for GCDs such as SimpleHoles and CurvedWalls if those corresponding features or surfaces have Symbolic Threads applied to them in the NX CAD model, and will assign thread-making operations to those GCDs as appropriate. Previously for NX models, aPriori only recognized and costed threads that were modeled using the "Threaded Hole" feature. As a result, when costing an NX model that contains Symbolic Thread features in aPriori 2019 R2, you will see thread-making operations and costs assigned to the corresponding GCDs, which were not present when costing the same part in earlier versions of aPriori.

- **Two enhancements were made to improve the usability of cost and manufacturability outputs in the Validation tab and Design to Cost tab:**

  o The Validation tab was updated to show the total count of tolerances applied to the part, instead of the number of GCDs with tolerances as in previous releases. This change will allow users to confirm more easily that desired tolerances have been imported from the CAD model or entered from a print. This change was made in the Sheet Metal, Casting – Die, Casting – Sand, 2 Model Machining and Stock Machining process groups. This change will not impact costing results.

  o The Design to Cost view for thickness violations was updated so that violations are indicated by highlighting exterior surfaces of the part, making it easier to identify where on the part the violations are occurring. This change was made in the Plastic Molding, Casting – Die and Casting – Sand process groups. This change was made in the Plastic Molding, Casting – Die and Casting – Sand process groups has been This change impacts only the display and will not affect costing results.

aPriori 2019-10 Regional Data Libraries

Below is an overview of updates and key data changes that have been made to the Regional Data Libraries (RDLs) for this release. For more detailed information including the magnitude of changes since the previous 2019-08 RDL release, see the *Regional Data Libraries 2019-10 Release Notes*.

- Standard economic updates were performed for all regions and all cost models, including updated Currency Exchange Rates, Material Rates, Labor Rates, Overhead Rates, and Toolshop Rates.

- Currency Exchange Rates have remained relatively stable relative to the US Dollar.

- For most regions, Labor Rates decreased from the previous RDL data, largely tracking to corresponding changes in Exchange Rates. The largest changes were for Brazil (decrease of ~ 6%), Norway (decrease of ~ 7%), and Switzerland (decrease of ~ 7.5%). Labor rates for Belgium, South Korea, Taiwan, Thailand, United Kingdom increased (by 1% – 3%)

- There were no changes to plastic material rates between the 2019-08 and 2019-10 RDL releases, other than for Polypropylene and Polystyrene (which increased by about 3% and 2%, respectively).

  Steel rates rose by ~ 5% compared to the previous RDL data. Rates for heat-resistant super alloys rose by 12%, but non-ferrous metal material rates generally declined (between 2% and 12%).

The 2019-10 Regional Data Libraries are available in versions compatible with both aPriori 2019 R2 and with aPriori 2019 R1 SP2.

VPE Management and Configuration Enhancements

aPriori 2019 R2 includes several improvements to the Cost Model Work Bench (CMWB) which make it faster and easier for customers, aPriori Partners, and aPriori employees to update VPE data and develop or configure cost models.

- **aPriori 2019 R2 provides a new approach for managing and updating the Labor Rate data which is used to calculate Labor Costs for all process cost models. This enhancement enables VPE Administrators to update labor rates much more quickly and easily than was possible in previous releases, and also provides end users more insight into the assumptions which drive labor rates.** Previously, the Labor Rate field for every machine for every process had to be populated and managed individually. Updating the labor rates for an entire VPE therefore required entering updated values for thousands of machines, even though typically many or all of the machines for the same process use the same labor rate value. Indeed, typically there are less than 20 unique labor rate values across a VPE.

  Now, labor rate management is greatly centralized and streamlined through the use of several new VPE tables. The **Wage Grades table** is used to specify the labor rates corresponding to different worker skill levels and process types. Skill levels are defined and described in a separate **Skill Levels table**. Both the Wage Grades table and the Skill Levels table apply to an entire VPE and are located at the VPE level within the VPE Manager. A specific wage grade then can be associated with each process, using the new **Wage Grade Associations table** for each Process Group. Machines will use the wage grade specified for the process, unless a different Wage Grade is specified for that individual machine using the new Wage Grade Name field. Pictures of these tables are shown below.

VPE: aPriori USA

Wage Grades
Edit ▼

Skill Level	Labor Rate	Process Type	Wage Grade
-	0.00	Metal industry	0 - Metal industry
1	14.27	Metal industry	1 - Metal industry
2	22.50	Casting	2 - Casting
2	17.31	Metal industry	2 - Metal industry
2	16.45	Plastic industry	2 - Plastic industry
3	27.29	Casting	3 - Casting
3	20.99	Metal industry	3 - Metal industry
3	19.94	Plastic industry	3 - Plastic industry
4	32.48	Casting	4 - Casting
4	24.98	Metal industry	4 - Metal industry
4	23.73	Plastic industry	4 - Plastic industry
5	35.59	Casting	5 - Casting
5	27.38	Metal industry	5 - Metal industry
6	30.48	Metal industry	6 - Metal industry

VPE: aPriori USA

Wage Grade Associations
Edit ▼

Process Name	Wage Grade Name
⊞ 2 Axis Router	3 - Metal industry
⊞ 2 Roll Bending	4 - Metal industry
⊞ 3 Roll Bending	4 - Metal industry
⊞ 3D Laser	3 - Metal industry
⊞ 4 Roll Bending	4 - Metal industry
⊞ Bend Brake	3 - Metal industry
⊞ CTL	2 - Metal industry
⊞ Deslag	2 - Metal industry
⊞ Generic Press	3 - Metal industry
⊞ Laser Cut	3 - Metal industry
⊞ Laser Punch	3 - Metal industry
⊞ Material Stock	0 - Metal industry

VPE: aPriori USA

Skill Levels
Edit ▼

Skill Level	Name
1	Basic Skills, no training
2	Basic Skills, some on the job training
3	Intermediate Skills and job experience, limited vocational training
4	Intermediate Skills and job experience, standard vocational training
5	Advanced Skills and job experience, standard vocational training
6	Advanced Skills and job experience, specialized training and certification
7	Master Skills and job experience, advanced vocational training
8	Expert Skills and job experience, professional education
9	Expert Skills, high academic training, professional certification

Benefits of the new Labor Rate data architecture include:

o **Greatly streamlined data update process** – this new data architecture reduces the number of fields that typically need to be updated by ~ 99%.

o **Improved ability to leverage and inherit from aPriori Regional Data Libraries (RDLs)** – Previously, if a company and its suppliers used a different skill-level operator for a given process than assumed in the aPriori RDLs, they would have to enter a different labor rate value at the machine level. This updated labor rate then no longer was associated with the RDL data, necessitating manual updates from that point forward. With the new data architecture, you can simply update the wage grade level associated with that

process and maintain inheritance to the RDLs, so that future RDL labor rate updates automatically will continue to apply to the process and its machines.

- o **Visibility into Labor Rate assumptions** – Users can see the Skill Level assumed for a given labor rate in the Formula Dependencies dialog, providing transparency that can be useful during cost estimate validation and fact-based negotiation

Note: if desired, labor rates still can be managed in the previous manner, in which you update the Labor Rate field for each individual machine. This provides your company the flexibility to convert to the new data architecture at a convenient time.

Note: in order to update an existing VPE which is using per-machine Labor Rate fields so that it uses Wage Grade Associations instead, you must clear the per-machine values to establish the Wage Grade Associations. For more information on how to do this, see the section titled "To assign a wage grade to a process" in the 2019 R2 version of the *aPriori VPE Administration Guide.*

Note: A new Wage Grades report is available from within the VPE Manager by selecting **File ➔ Export ➔ Wage Grades.** This report is an Excel spreadsheet with one row for each machine in the VPE, grouped by process group and process; it displays Labor Rate, Skill Level, and Wage Grade field values for each machine. When you are ready to update your VPEs to use wage grades rather than labor rates for individual machines, you can use this report to review the spectrum of labor rates assigned to different processes and machines within a given process. You can even convert the report to a pivot table using standard functionality in Microsoft Excel, to help analyze the data. This can help you to determine how many wage grades should be established, and which wage grade should be associated with each process or machine.

You also can use this report to determine if a machine has a labor rate or wage grade specified in its machine field or if it is inheriting a labor wage grade association specified at the process level. If the labor rate or wage grade is specified for an individual machine, the Labor Rate, Skill Level, and/or Wage Grade columns will be populated in the row for that machine. If the machine is inheriting its values from the wage grade association at the process level, those fields will be blank.

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- ▪ **Two usability enhancements were made to the Search CSL feature within Cost Model Workbench.**

  - o **The Search CSL tool (invoked from the Tools menu) now can search for filenames which contain the specified search string, as well as file content which contains the search string.** This is particularly useful when looking for a specific library file in a cost model which contains many library files, and you recall only a portion of the library file name of interest. For example, to identify which library file in the Machining cost model contains logic related to achievable tolerance capability when all you recall is that it contains the string gtol, you could enter gtol in the Search String field and set the Search Type field to Filename, as shown below:
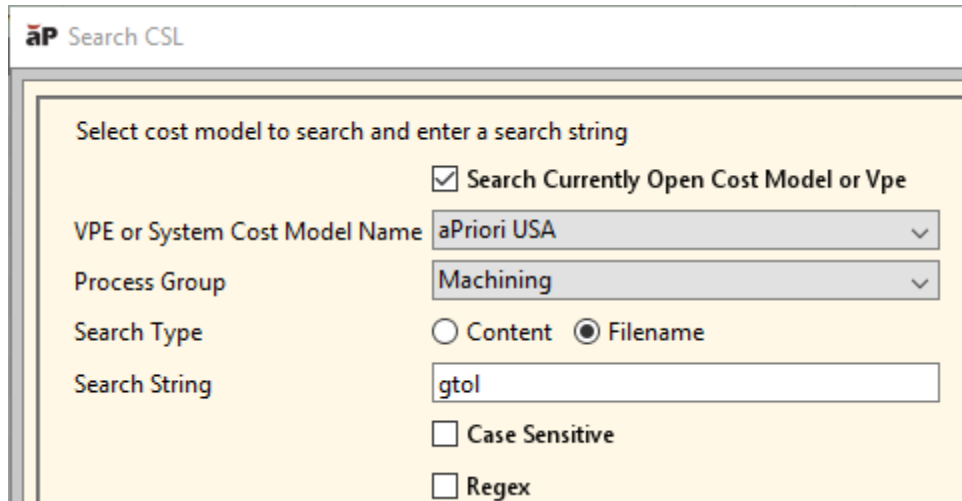
This search will return the names of any library files containing that string, and in this case would include the desired file (*libGtolProcessCapabilities.csl)*

- o **When using the Search CSL tool, files returned as search results now can be opened directly in the CSL Editor, enabling the user to easily inspect or edit the file of interest.** Previously there was no direct way to open the file of interest; instead users had to browse through the cost model hierarchy displayed in the CMWB navigation pane to find it, which required knowledge of the cost model structure and many mouse clicks. Now the correct file can be opened with a single click via the new button **Open in Workbench**, located at the bottom of the Search Results pane as shown below.
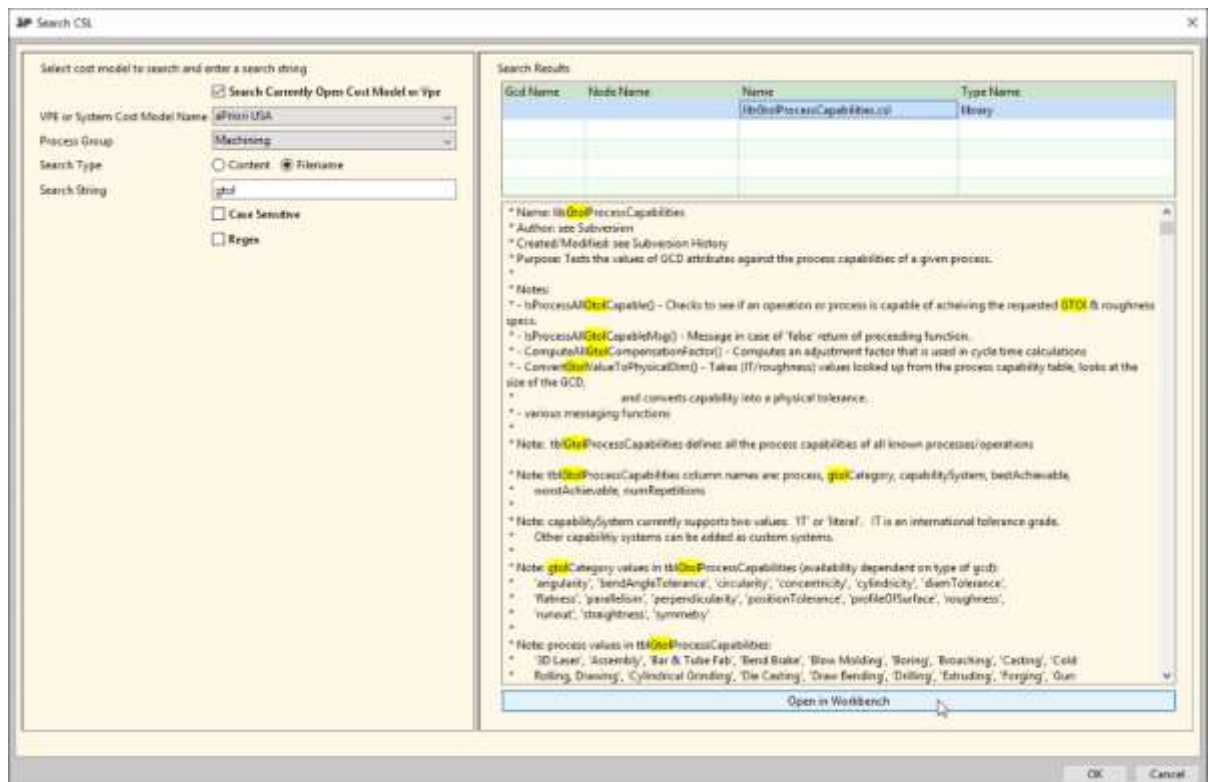
- **The cost model artifacts Process Setup Options and Zero-or-More Routing Nodes were enhanced to provide additional control and simplify cost model configuration:**

  - **For process setup option modes of type "List", the expression for the available values now can be provided as a formula.** Previously the values in the list had to be defined either from a custom CSL expression defined just for that node or from a comma-separated list of hard coded values. This improvement means that code can be simplified for list type PSOs.

  - **It now is possible to specify whether end-users can manually override the number of occurrences of "zero-or-more nodes" in a routing.** These are routing nodes which can appear multiple times in succession as needed depending on part geometry and other factors, such as the Die Station operation for the Progressive Die process. This control is useful for situations where the calculation of number of occurrences is defined by another input or set of inputs, so that allowing manual override is not ideal for overall cost model behavior. For example, Core Refractory Coat instances are driven by the number of cores that require refractory coating, so the override should be made on individual cores not on the number of instances. To disallow manual override of the number of instances, set the value of the node attribute **allowNumOccurrencesOverride** to **false** on the zero-or-more node.

- **Several new built-in CSL functions were implemented:**

  - logAndReturn(label, expression) – evaluates the given expression and writes the result to the aPriori log before returning it. The log entry takes the following form: <label>: <value>. This is particularly useful for places where CSL can be used to but debugging capabilities are limited, such as in CAD Attribute Mapping Files or Access Control.

  - repeatString(string, count) – returns a string created by repeating the given string parameter count times. An empty string is returned if the string parameter is null or count is zero.

  - isCollection(object) – returns true if the object passed in is a collection (e.g. a list)

  - trim(string) – removes any whitespace from the start and end of a provided string

- **Several existing functions were updated to be null-safe; for these functions null string parameter values are now treated as equivalent to an empty string:**

  - index(str1, str2, [index])

  - lastIndex(str1, str2, [index])

  - mid(string, startIdx, [endIdx])

  - prefix(string, separator)

  - suffix(string, separator)

  - suffix2(string, separator)

Administrative Enhancements

aPriori 2019 R2 provides several enhancements concerning administration of aPriori deployments and data:

- **It now is possible to provide more granular levels of administrative access to all the different tools available within the aPriori VPE Toolset** (VPE Manager, Cost Model Workbench, Process Group Site Variables, Deployment Data, and BOM Loader) **and the aPriori System Admin Toolset** (System Administrator and Migration Import Tool)**.** This allows companies to distribute the tasks involved in managing an aPriori deployment to multiple individuals while still ensuring their data is protected. For example, you can grant an administrator the permission to Add Users to a Group, but not allow that user to add or edit the access control rules for that group.

  These more granular permissions are added by default when you perform a new installation of aPriori 2019 R2 or if you perform a Baseline Update. For more information about this capability and guidance on adding these new permissions to an existing access control model, please refer to the Access Control chapter in Version 2019 R2 of the *aPriori Professional System Administration Guide.*

- **A new Installer is available for aPriori Professional 2019 R2** which enables various settings to be specified during the installation process and preserved when upgrading to a newer version of aPriori. These settings include:

  - Settings in apriori.properties or user.apriori.properties such as production information defaults, scenario naming conventions, and various others (16 properties in total)

  - Bulk Costing and Analysis properties such as default batch size, watchpoint file name and many others (30 properties in total)

  - Memory allocation settings

  NOTE: The syntax for a silent client installation command is updated. For more information, see the *aPriori Professional Installation Guide*.

  For more information, please refer to the Access Control chapter in Version 2019 R2 of the *aPriori Professional Installation Guide*.

Reporting Enhancements

- **In aPriori 2019 R2, the aPriori Access Control model is extended to Cost Insight (CI) Report for Server Platform 19.2.** If a user is restricted from viewing a scenario in aPriori Professional and aPriori CI Design applications, the scenario also will not be displayed to that user in CI Report. This access control extension applies both to out-of-the-box reports and the ad-hoc reporting environment.

  For more information about access control in CI Reports, refer to Version 2019 R2 of the *Cost Insight Report User Guide.*

- **Two new reports are available in Cost Insight Report to assist customers in analyzing the impact of upgrading to a new version of aPriori. These reports are called the Upgrade Comparison report and the Upgrade Part Comparison report.** They identify and summarize key differences in manufacturing and cost

estimates for a set of test parts, when cost in the newer version of aPriori compared to the previous (installed) version. Using these reports helps focus customers on key discrepancies so that they may analyze them further and determine if the changes observed can be explained by functional enhancements in aPriori (as documented by the aPriori Release Notes and Cost Impact Guide), or if some characteristics of their parts suggests some configuration of the cost model logic may be desired.

For more information about how to run and use these reports, please refer to the *aPriori Upgrade Validation Playbook* (available from your aPriori account representative).

Platform and CAD Support Updates

- **aPriori Professional 2019 R2 certifies support for recent versions of various CAD file formats**:

    - Creo 6.0 (in both standalone aPriori and Creo Direct Integration)

    - NX 1847 through NX 1863.

- **aPriori is discontinuing support for Pro/ENGINEER Wildfire 4.0 and Wildfire 5.0 in this release.** To cost Wildfire files in aPriori 2019 R2, first open and save them in a newer version of Creo.

- The Cost-in-aPriori Plug-ins are certified for use with aPriori 2019 R2 and supported versions of NX, CATIA, and SolidWorks.

Note that previously supported CAD, database, and operating system versions continue to be supported. Please consult the **System Requirements for aPriori Professional 2019 R2** *document for a complete listing of all versions of supported CAD systems, Operating Systems, Database platforms, and Graphics Cards and Drivers.* **Please make aPriori aware if your company is planning to upgrade to a CAD version which is NOT listed in the System Requirements document.**

Language Support Updates

At this time, the new capabilities added to aPriori 2019 R2 have not yet been translated into other languages. New portions of the User Interface appear in English, even when you run in a French German, Chinese, or Japanese locale. Portions of the user interface that were already translated in previous releases are displayed in the locale's native language. French, German, Chinese, and Japanese versions of aPriori 2019 R2 will be available in a forthcoming service pack.

Issues Resolved in aPriori Professional

- The Rivet Operation again is available to be applied to assembly subcomponents. aPriori 2019 R2 corrects a situation that affected only aPriori 2019 R1 SP1, in which the Rivet Operation of the Mechanical Assembly process was not available in that service pack release only, preventing users indicating that an assembly sub-component was assembled by riveting.

- aPriori 2019 R2 now displays process feasibility failure indications within the simplified Routing Selection dialog which is invoked from the Cost Guide (via the button under the Process Routing heading). This is a lightweight version of the complete routing editor which is invoked from the Edit menu in the Manufacturing Process pane. Previously, if a process in the routing failed a feasibility rule, the failure indicator was displayed in the complete routing editor but not in the simplified Routing Selection dialog. Now both dialogs display the failure indicator.

- aPriori 2019 R2 corrects a cycle time calculation error that sometimes occurred for turning processes (3-Axis Lathe, Mill Turn, and 3-Axis Bar Feed Lathe). Previously, cycle time calculations for operations performed with live tooling sometimes erroneously used the machine's main spindle power and speed rather than the live tooling power and speed.

- aPriori 2019 R2 resolves an issue in the Stock Machining process group which affected "plate stock" materials. Previously when adding a new plate stock material to a VPE, the drop-down menu which is used to specify the cost per mass units (e.g. Cost per KG or Cost per LB) was not available and the cost was assumed to be in units of Cost per KG. Now the drop-down menu is available and can be used to specify the desired unit system for the material cost.

- In the Bar & Tube Fabrication process group, aPriori now allows Punching operations to be assigned to holes which lie on non-planar surfaces, such as a hole punched through the walls of a round tube. Punching such holes previously failed operation feasibility rules, but now will be allowed as long as the walls of the holes are parallel to one another.

- In the Casting – Sand process group, machine selection logic for the Shakeout process was updated to account for the presence of multiple cavities and the gating system mass. Note that for the purposes of machine selection only the default values for all gating system elements will be used, not the value provided by a PSO override

- For high-pressure die cast parts, the Special Mold Tooling section of the Design To Cost tab now correctly displays all GCDs which require cores. Previously GCDs which required Insert Coring or Side Coring were neglected

- aPriori 2019 R2 resolves an issue for die casting parts, in which the Design to Cost tab sometimes indicated that a part had a tolerance value specified which was driving Machining operations to be applied, when in fact no machining was assigned or required. The Driving Machining field now correctly will display a value of 0, indicating that there are no specified tolerances which require machining operations to achieve.

- In the Sheet Metal process group, the Materials dialog which is invoked from the Design to Cost tab now includes a Material Type filter for "All Materials" so that the relative cost for all available materials can be compared. This filter previously was available in other process groups but was missing in the Sheet Metal process group.

- In the Forging process group an issue related to machine selection for the Hammer process has been resolved. The required impact energy calculation now correctly uses weight as an input instead of mass. This correction will result in an increase in the calculated value of the required impact energy; as a result, a larger machine with a higher overhead rate will be selected than in the previous release of aPriori. The overall impact on cost typically will be small, on the order of a few percent.

- In the Plastic Molding, Casting – Sand and Casting – Die process groups an issue related to the display of Proximity Issues in the Design to Cost view has been resolved. Previously SimpleHole GCDs that are children of a ComboVoid GCD were not evaluated for Proximity Issues. Now these GCDs also will be included in the Proximity Issues list if they violate minimum spacing thresholds. This change will have no impact on cost but will result in more DTC issues displayed for some parts.

- aPriori 2019 R2 corrects an issue in which the Plastic Molding process setup options Cavity Plate Height and Core Plate Height did not affect the calculated Mold Height required for a part. Now these process setup options have an impact; in some cases, a different machine now may be selected when these options are used, due to the change in overall mold base thickness

- In the Formula Dependencies dialog for all process groups, the field **Number of Scrapped Parts Down Stream** was updated to display the correct value, which is computed based on the Good Part Yield specified for processes occurring later in the routing. Previously the value always displayed 0, although the correct value was computed internally and used in calculations as appropriate. Since this is a display-only issue, this update will not have any impact on part cost.

Known Issues and Workarounds

The following Known Issues have been identified in aPriori Professional 2019 R2:

- The calculation of Scrap Part Credit does not account for parts scrapped due to processes that occur before the designated "utilization process" in the routin. For some routings, this issue can result in a calculated Scrap Part Credit value that is just slightly less than the value that you could otherwise achieve.

- The Continuous Extrusion process which is used for extruding powder metal or solid feedstock into continuous rods is not yet supported in the aPriori baseline cost model.

- For bent parts made from custom extrusions, aPriori may fail to correctly extract the extrusion cross-section profile and/or fail to recognize bent geometry as Bend GCDs. This can occur when the CAD model contains incorrectly modeled geometry, such as having a bend which is not tangent to adjacent surfaces of the extrusion or having a cross-section which is not oriented normal to the trajectory of the bend along the entire length of the bend.

- Some bent extrusion parts may not cost completely in the initial release, due to a lack of feasible bending processes in the aPriori baseline cost model. aPriori intends to provide additional Bending processes in a near-future release in order to accommodate such parts.

- aPriori assumes the use of a single Router tool to machine each Cutout GCD. In some cases, aPriori may choose a smaller or larger tool than would be used in practice to machine a Cutout, leading to incorrect cycle time and cost estimates. For example, if the Cutout includes some small-radius fillet surfaces, this could drive aPriori to choose a small-diameter tool when in practice the majority of the Cutout would be machined with a much larger tool.

  To prevent excessive cycle time and cost estimates, aPriori applies a minimum limit on the size of curved wall geometry that can impact the tool size determination. By default, curved walls < 4 mm in diameter will not impact the tool used to machine a cutout; this value is controlled by the Machining cost model variable **minToolDiameterForCutoutBasedOnCurvedWall.** The minimum limit also can be specified on a per-part basis using the process setup option Minimum Tool Diameter for a Cutout based on its Curved Wall diameters). This limit will help prevent excessive cycle time estimates but may result in machining times and costs being underestimated for some cutouts. In a future release, aPriori plans to provide feedback to the user regarding the presence of small-radius cutout geometry and any tool size limits which have been applied, so that the user may adjust either the part design or the tool size assumptions as appropriate.

- If an extrusion part contains a MultiStepHole GCD, the SimpleHole GCDs which comprise it will fail to cost in aP 2019 R2. This issue is expected to be addressed in aP 2019 R2 SP1.

- If a part's cross-section contains a curve which is not an arc (e.g., a spline), aPriori will not recognize the part as a custom extrusion.

- It is possible to manually select a routing which includes a 3 Axis Mill or 5 Axis Mill for secondary machining of extrusions, however the Cutout GCDs will fail to cost.

Workaround: Select routings which include Router processes not Mill processes.

- For Composite parts, Material utilization is determined by assuming an average per material, rather than on a per-ply or per-part basis

- For Composite parts, Cores are assumed to be bought in a pre-cut state. The cost for core materials in the database represent the area-based cost of the given thickness of the core material. The user has the ability to override this assumption and specify the cost of the core piece in the GCD properties window.

- In the Composites process group, if holes are not modelled, no holes can be detected and therefore the costs associated with hole-making are not included in the aPriori estimate.

- Co-cured parts such as structural integrated panels are not supported in the initial release of the Composites cost model.

- The new Manual Paint process is located as a peer of the Paint node, at the end of the Surface Treatment routing choices. In a near future-release, it will be moved to appear under the Paint node, so that it is grouped logically with other Paint processes such as Wet Coat Line and Powder Coat Cart and easier to find and select.

- If the AxiGroove geometry has edge breaks (rounds) on the edges of the disk as shown at right, the isStraightExtrude property may incorrectly be set to false, even though the slot/valley geometry is in fact feasible for broaching.

  Workaround: Manually assign the External AxiGroove Broaching operation and override operation feasibility rule checks to allow this operation to be assigned and costed.
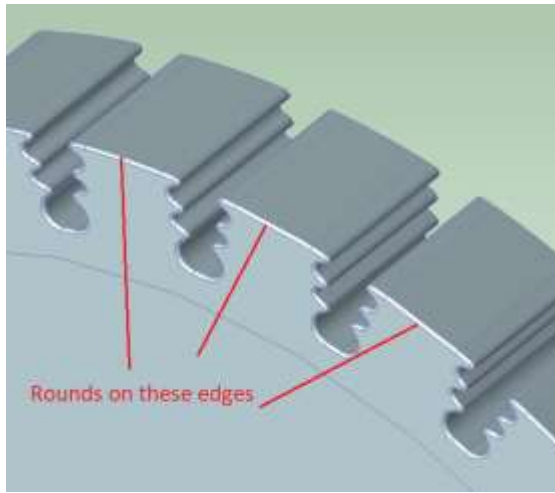
- When upgrading to aPriori 2019 R2 from a previous release of aPriori, a user's preference setting for Exchange Rate Version is not preserved if it was set to any value other than **Default**.

  Workaround: After the upgrade, users should select **View ➜ Change Currency…** from the aPriori Professional menu bar and re-select the desired exchange rate version.

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- When you upgrade to a new release of aPriori Professoinal, if your aPriori password was saved as clear text in the aPriori database for the prior release, the aPriori login generates an error when you try to log in to the new release.

  Workaround: To avoid the error, before you upgrade, change your password from clear text. To resolve the error, after you upgrade, ask your customer administrator to reset your password.

Upgrading to aPriori Professional 2019 R2

For aPriori Cloud customers, upgrades are handled by aPriori personnel.

On-Premise customers can upgrade directly to 2019 R2 from either:

- 2019 R1
- 2019 R1 SP1
- 2019 R1 SP2

Use the procedures in the 2019 R2 Version of the *aPriori Professional Installation Guide*. Before you upgrade from earlier release to aPriori 2019 R2, as a best practice, promote an existing system administrator to a super-user account in your current release by associating the admin user id to the super user group. If you do not promote an admin to a super user, you must complete additional steps during the upgrade.

For information about adding and modifying access control permissions, refer to the Access Control chapter in Version 2019 R2 of the *aPriori Professional System Administration Guide.*

For any questions about upgrades, please contact the aPriori Customer Support team.

Contacting aPriori Customer Support

To contact aPriori Customer Support, use one of the following options:

Internet Web site:	http://www.apriori.com/support
Email:	support@apriori.com