

2D Cutting Stock Optimization Software Survey

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Abstract

We present a detailed survey of software packages for two-dimensional cutting stock problems. Cutting stock problems (CSP) may involve a variety of objectives and constraints, which directly depend on technological and organizational parameters of each company. Therefore, this comparison was based on some of the packages' main features, the most relevant to the problem's context.

Generally speaking, CSP are optimization problems consisting of placing a given set of small objects, called *items*, into a given set of larger ones, called *stock sheets*, usually with the objective of reducing the waste to a minimum. These problems, with all their extensions and variants, are well known to be NP-hard [1]. This means that all algorithms currently known for finding optimal solutions require a number of computational steps that may grow exponentially with the problem size rather than according to a polynomial function. There are two main approaches to solve this problem: exact and heuristic methods. Heuristic methods have greater flexibility in taking into account problem-specific constraints and offer a good trade-off between the quality of a solution and its computational effort. They are required to provide good, but not necessarily optimal

solutions. Exact algorithms are mainly based on linear/dynamic programming and branch-and-bound techniques. Many researchers provided surveys and categorized bibliographies on this subject (Dowsland and Dowsland [2], Dyckhoff and Finke [3], Lodi et al. [4, 5], Dyckhoff et al. [6], among others). Moreover, Dyckhoff [7] defined a formal typology for cutting and packing problems, in which he systematically integrated various kinds of problems and notions. This typology was improved by Wäscher et al. [8] with the definition of new categorization criteria.

The two-dimensional version of the cutting stock problem (2D-CSP) can be stated as follows: a given set of small items, each item $i \in \{1, \dots, m\}$ of width w_i , height h_i and demand of b_i pieces, has to be cut out of a virtually infinite supply of stock sheets of width W and height H (where $0 < w_i \leq W$ and $0 < h_i \leq H$, $\forall i \in \{1, \dots, m\}$), usually in order to minimize the number of stock sheets used.

The 2D-CSP can be further classified into several categories, depending on the problem's specific constraints. It can be regular, if the shapes of the items to be cut can be described by few parameters, or irregular, otherwise. Cutting irregular shapes is also known as nesting. Regular cuts can be rectangular or non-rectangular, according to whether the items are rectangles or have a different shape, respectively. Rectangular cutting is called oriented, if an item of width w_i and height h_i is considered to be different from another one of width h_i and height w_i , and non-oriented otherwise. If a sheet (or any sheet fragment produced during operation) can only be cut from side to side, then we speak of guillotine-type cutting patterns; observe that problems allowing non-guillotine patterns are generally much harder to solve. A staged pattern is a guillotine pattern cut into pieces in a limited number of phases. The direction of the first stage cuts may be either horizontal or vertical (parallel to one side of the stock sheet), and the cuts of the same stage are in the same direction. The cut directions of any two adjacent stages must be perpendicular to each other. If the maximum number of stages is not allowed to exceed n , the problem is called n -staged. When there is no such restriction, the problem is called non-staged. Whenever a final stage is allowed only to separate small items from waste areas, the problem is called non-exact. Otherwise, it is called exact.

Optimization software packages for 2D-CSP are tools used to produce the most efficient cutting patterns on several stock sheet material boards, taking into consideration technological and organizational parameters of production. Optimized cutting is vital for economic production of cut component pieces, particularly for mass-production industries, because small improvements in the cutting patterns can result in major savings in material and a considerable reduction in production costs.

Although waste minimization is usually the main objective of this problem, there may be others, like minimizing the total cost, or the number of different cutting patterns. Besides this, in cutting processes, and in particular in the wood industry, a multitude of additional constraints are very often necessary, and so the software may provide features such as saw kerf compensation, guillotine or free type of cuts, cutting patterns based on wood grain orientation, edge banding specifications, among others.

The software technology is based on algorithms designed to achieve optimal or near optimal solutions for the cutting patterns. These algorithms are often heuristic approaches and use a number of user-definable parameters, which constrain the number of combinations to be examined in the search of the optimal solution, so that the computational time turns out to be acceptable, even in high dimensional problems.

This software survey aims at highlighting the differences among industry-oriented software packages presently available in the market.

A full version of this paper is available online at <http://www.scoop-project.net>.

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ABSTRACT

We present a detailed survey of software packages for two-dimensional cutting stock problems. Cutting stock problems (CSP) may involve a variety of objectives and constraints, which directly depend on technological and organizational parameters of each company. Therefore, this comparison was based on some of the packages' main features, the most relevant to the problem's context. The software's technology is based on algorithms designed to try to achieve optimal or near optimal solutions for the cutting patterns. These algorithms are often heuristic approaches and use a number of user-definable parameters, which constrain the number of combinations to be examined in the search of the optimal solution, so that the computational time turns out to be acceptable, even in high dimensional problems. The software survey aims at highlighting the diversity of software packages, oriented to industrial applications, available on the market.

Keywords: two-dimensional cutting stock problems, software

1 Introduction

Cutting stock problems (CSP) are among the earliest ones studied in Operations Research, as they occur, with different constraints, in many real-world applications of business and industry, motivating several areas of research. Generally speaking, they are optimization problems consisting of placing a given set of small objects, called items, into a given set of larger ones, called stock sheets, usually with the objective of reducing the area of generated waste to a minimum.

These problems, with all their extensions and variants, are well known to be NP-hard [1]. This means that all algorithms currently known for finding optimal solutions require a number of computational steps that may grow exponentially with the problem size rather than according to a polynomial function.

Over the years, two main approaches to solve this problem have emerged: exact and heuristic methods. Heuristic methods have greater flexibility in taking into account problem-specific constraints and offer a good trade-off between the quality of a solution and its computational effort. They are required to provide good, but not necessarily optimal solutions. Exact algorithms are mainly based on linear/dynamic programming and branch-and-bound techniques.

Due to the complexity and extensive nature of these problems, many different optimization formulations and solution approaches arise in the literature, according to their dimension, application field and special constraints and requirements. Therefore, many researchers provided surveys and categorized bibliographies on this subject (Dowsland and Dowsland [2], Dyckhoff and Finke [3], Lodi et al. [4, 5], Dyckhoff et al. [6], among others). Moreover, Dyckhoff [7] defined a formal typology for cutting and packing problems, in which he systematically integrated various kinds of problems and notions. This typology was improved by Wäscher et al. [8] with the definition of new categorization criteria.

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width W and height H (where $0 < w_i \leq W$ and $0 < h_i \leq H$, $\forall i \in \{1, \dots, m\}$), usually in order to minimize the number of stock sheets used.

The 2D-CSP can be further classified into several categories, depending on the problem's specific constraints.

It can be regular, if the shapes of the items to be cut can be described by few parameters, or irregular, otherwise. Cutting irregular shapes is also known as nesting. Regular cuts can be rectangular or non-rectangular, according to whether the items are rectangles or have a different shape, respectively. Rectangular cutting is called oriented, if an item of width w_i and height h_i is considered to be different from another one of width h_i and height w_i , and non-oriented otherwise. If a sheet (or any sheet fragment produced during operation) can only be cut from side to side, then we speak of guillotine-type cutting patterns; observe that problems allowing non-guillotine patterns are generally much harder to solve. A staged pattern is a guillotine pattern cut into pieces in a limited number of phases. The direction of the first stage cuts may be either horizontal or vertical (parallel to one side of the stock sheet), and the cuts of the same stage are in the same direction. The cut directions of any two adjacent stages must be perpendicular to each other. If the maximum number of stages is not allowed to exceed n , the problem is called n -staged. When there is no such restriction, the problem is called non-staged. Whenever a final stage is allowed only to separate small items from waste areas, the problem is called non-exact. Otherwise, it is called exact.

Optimization software packages for 2D-CSP are tools used to produce the most efficient cutting patterns on several sheet materials boards, taking into consideration technological and organizational parameters of production. Optimized cutting is vital for economic production of cut component pieces, particularly for mass-production industries, because small improvements in the cutting patterns can result in major savings in material and a considerable reduction in production costs.

Although waste minimization is usually the main objective of this problem, there may be others, like minimizing the total cost, or the number of different cutting patterns. Besides this, in cutting processes, and in particular in the wood industry, a multitude of additional constraints are very often necessary, and so the software may provide features

such as saw kerf compensation, guillotine or free type of cuts, cutting patterns based on wood grain orientation, edge banding specifications, among others.

The software technology is based on algorithms designed to achieve optimal or near optimal solutions for the cutting patterns. These algorithms are often heuristic approaches and use a number of user-definable parameters, which constrain the number of combinations to be examined in the search of the optimal solution, so that the computational time turns out to be acceptable, even in high dimensional problems.

2 Detailed Software Survey

Cutting stock problems may involve a variety of objectives and constraints, which directly depend on technological and organizational parameters of each company. Therefore, this comparison between the referred software packages was based on some of the packages' main features, the most relevant to the problem's context, that are displayed in several tables, grouped in eleven different topics. The topics and corresponding tables, as well as the information they contain, are listed below.

2.1 A – General Information

2.1.1 Table 1:

2.1.1.1 *Product*

Software's commercial name.

2.1.1.2 *Company*

Company that developed the product.

2.1.1.3 *Country*

Company's head office country.

2.1.1.4 *Year Introduced*

Year of the product's commercialization.

2.1.1.5 URL

Product's web page.

2.1.2 Table 2:

2.1.2.1 Languages

All the languages supported by the product.

2.1.2.2 Latest Version

The most recent product's version released.

2.1.3 Table 3:

2.1.3.1 System Requirements

Recommended system requirements to run the software.

2.1.3.2 Price Information

Product's purchase price.

2.2 B – Optimization

2.2.1 Table 4:

2.2.1.1 Minimize waste

Option to set as main optimization objective the minimization of the material waste.

2.2.1.2 Minimize cost

Option to set as the main optimization objective the minimization of the project's total cost.

2.2.1.3 Minimize number of different layouts

Option to set as main optimization objective the minimization of the number of different layouts.

2.2.1.4 Best sheet size calculation

Option to determine the best sheet's dimensions for the set of defined items.

2.3 C – Cutting Constraints

2.3.1 Table 5:

2.3.1.1 Guillotine cutting

Option to impose that cuts are only allowed to be uninterrupted, going from one side of the sheet to its opposite side, i.e., that the items are obtained through a sequence of edge-to-edge cuts, parallel to the edges of the sheet.

2.3.1.2 Free cutting

Option to include cuts without the guillotine constraint.

2.3.1.3 Rotation of items / Fixed Orientation

Option to rotate items (by 90°) during calculations, to obtain greater efficiency, or, on the other hand, to fix their orientation.

2.3.1.4 Maximum cut length

Option to not include cuts longer than the specified. This option applies to situations where the cutting tool can only handle cuts up to a certain length.

2.4 D – Performance

2.4.1 Table 6:

2.4.1.1 Time limit

Definition of a maximum period of time, after which the calculation will stop.

2.4.1.2 Adjustable optimization level

Possibility to define a balance between the speed and the quality of the optimization.

2.5 E – Cutting options

2.5.1 Table 7:

2.5.1.1 *Kerf width consideration*

Consideration of the material's loss (width of the saw blade) due to cut.

2.5.1.2 *Reuse of offcuts*

Whether the leftover pieces from other cuts, that satisfy pre-defined minimum size requirements, can be stored for later use.

2.5.1.3 *Safety margins*

Allowance to define a certain part of waste around the perimeter of a sheet that will be cut off.

2.5.1.4 *Sheets priority*

Option to settle, in a same calculation, different priorities for different sheets to be used.

2.5.2 Table 8:

2.5.2.1 *First cut orientation*

Option to settle the first cut's orientation.

2.5.2.2 *Sheets of different sizes*

Possibility to use sheets with different sizes (of different materials) in the same calculation.

2.5.2.3 *Edge banding calculation*

Automatic adjustment of the items' rough dimensions, to result in the correct finished size after applying banding, to the specified edges, according to the banding's material thickness.

2.6 F – Import/Export Data

2.6.1 Table 9:

2.6.1.1 *Import from*

Some applications from which data can be imported.

2.6.1.2 *Export to*

Some applications to which data can be exported.

2.6.1.3 *CNC G code for cutting machine*

Ability to export G code to CNC machines.

2.7 G – Other Features

2.7.1 Table 10

2.7.1.1 *Material database*

Whether a materials database is provided.

2.7.1.2 *Inventory tracking*

Whether it is possible to keep track of how much inventory there is on hand, and to adjust its level after each project is completed.

2.7.1.3 *Customer proposals creation*

Automatic creation of a well formatted pricing document to present to potential customers.

2.7.1.4 *Pricing tool*

Possibility to calculate the total price of a project, based on a variety of inputs of direct or indirect costs.

2.8 H – Manual layout rearrange

2.8.1 Table 11:

2.8.1.1 *Items position*

Ability to manually rearrange the automatically generated cut maps by changing the items' position in the layout.

2.8.1.2 *Items rotation*

Ability to manually rearrange the automatically generated cut maps, by rotating items.

2.8.1.3 *Items removal*

Ability to manually rearrange the automatically generated cut maps by removing items from the layout.

2.8.1.4 *Items insertion*

Ability to manually rearrange the automatically generated cut maps by inserting new items or inserting into a certain layout an item from another one.

2.8.1.5 *Items size altering*

Ability to manually rearrange the automatically generated cut maps by changing the items' sizes.

2.9 I – Outputs

2.9.1 Table 12:

2.9.1.1 *Cuts coordinates*

Indication of each item's coordinates in the corresponding sheet.

2.9.1.2 *Number of cuts*

Indication of the total number of different saw cuts.

2.9.1.3 Trajectory of cuts

Option to visualize the lines that indicate the cutting-out sequence of each layout.

To fill in the referred tables, a thorough analysis of the twenty two software packages' trial versions, as well as of the available manuals, was performed, in order to collect all the information as accurately as possible. In those cases where the software comes in more than one version, the information below always refers to the most complete one.

TABLE 1

Product	Company	Country	Year Introduced	URL
ACE Cutting Optimizer	Adelaide Computer Energy	Australia	2002	http://www.acecut.com/default.htm
Astra R-Nesting	Technos Ltd	Russia	1999	http://www.techno-sys.com/
Corte Certo	Dimensions softwares	Brazil	1997	http://www.cortecerto.com/english/main.htm
Cutlist Plus	Woodworking Software	USA	1999	http://cutlistplus.com/default.aspx
Merick Calc 3.15	Soft Consult	Czech Republic	1995	http://www.softconsult.cz/us/index.asp
Optimik	RK Software	Slovakia	1999	http://www.rksoft.sk/
Plan IQ	MagicLogic Cutting Software	Canada	1998	http://www.cutting-stock.com/home.cfm
Real Cut 2D	Optimal Programs	USA, UK	2004	http://www.optimalprograms.com/
Sheet Cutting Suite	XY Soft	USA	1999	http://www.optimizecutter.com/
SmartCUT	Rasterweq Software	USA	2003	http://www.rasterweq.com/index.php
The Itemizer	R&R DRUMMOND	USA	2002	http://www.rdrummond.com/
2D Load Packer	Asrokette Algorithms	USA	2000	http://www.astrokettle.com/index.html
BestCut	VRSoft Ltd	Belarus	2001	http://vrsoft.msk.ru/index.htm
Cut Master 2D	Cutting Optimizer	Serbian	1999	http://www.cutmaster2d.com/index.html
Cutlight	Joiners Placet	Austria	2003	http://www.itmanagement.at/joinersplanet/english/index.html
CutLogic 2D	TMachines, s.r.o.	Slovakia	2003	http://tmachines.com/cutlogic-2d.htm
Cutting 3	Cutting Home	Russia	2007	http://www.cuttinghome.com/index.html
GNcutter 32	Optimalon Softwares	Canada	2004	http://www.optimalon.com/default.htm
Opticut	Boole & Partners	France	1996	http://boole.club.fr/english/index_eng.php
Panel Optimizer	Small BITS	South Africa	2005	http://www.smallbits.co.za/index.htm
Plus 2D for Woodworking	Nirvana Technologies Private Limited	India	1999	http://www.nirvanatec.com/
Sheet Layout 9	Productivity Software	USA	1999	http://www.sheetlayout.com/

TABLE 2

Product	Languages	Latest Version
ACE Cutting Optimizer	Most European, East Asian, or right-to-left languages	Version 6.2.1
Astra R-Nesting	English	Version 4.2
Corte Certo	English, Portuguese, Spanish, French and Dutch	Version 2.43
Cutlist Plus	Same language as Windows	Version 2006
Merick Calc 3.15	English	Version 3.15
Optimik	Czech, German, Netherlands, Greek, English, Spanish, French, Croatian, Italian, Hungarian, Polish, Portuguese, Romanian, Slovak, Serbian, and Bulgarian	Version 2.36c
Plan IQ	English, German, French, Spanish (South America), Portuguese (Brazil) and Dutch	Release 2.7.1 (Build 1)
Real Cut 2D	English, French, German, Spanish, Italian, Romanian, Portuguese, Swedish and Dutch	Version 5.7.1
Sheet Cutting Suite	English	Version 4.7.9
SmartCUT	Dutch, English, Finnish, French, German, Greek, Italian, Norwegian, Polish, Portuguese, Russian, Spanish, Swedish and Turkish	Version 2.3
The Itemizer	English	Version 7.0
2D Load Packer	English, French and Italian	Version 1.85
BestCut	English and Russian	Version 1.52
Cut Master 2D	English, German, Spanish, French, Italian, Dutch, Serbian and Croatian	Version 1.3.2.7
Cutlight	English and German	Version 1.0
CutLogic 2D	Chinese, English, German, Italian, Portuguese, Spanish and Turkish	Version 1.5
Cutting 3	English and Russian	Version 1.43
GNCutter 32	English	-
Opticut	English, French, German, Spanish, Portuguese, Turkish, Chinese and Danish	Version 4.3a
Panel Optimizer	English	Version 3.7.1.1
Plus 2D for Woodworking	English	Version 5.04
Sheet Layout 9	English	Version 9.07

TABLE 3

Product	System Requirements	Price Information
ACE Cutting Optimizer	<ul style="list-style-type: none"> • Pentium 100 or higher PC • 16 MB RAM • 100 MB free hard disk space • VGA monitor (800 x 600 minimum or higher) • Windows 2000/XP/2003 	\$ 499.95 - \$ 1149.95
Astra R-Nesting	<ul style="list-style-type: none"> • Windows 95 (not less than OSR2) • Windows 98/Me/NT/2000/XP operational systems. 	<i>Light</i> 1 copy \$90 2-3 copies \$75 4 and more copies \$60 <i>Professional</i> 1 copy \$200 2-3 copies \$150 4-5 copies \$120 6 and more copies \$100
Corte Certo	<ul style="list-style-type: none"> • PENTIUM 133 MHz processor (166 MHz for use with Windows NT) • 32 Mb of RAM (64 Mb for use with Windows NT) • Windows compatible printer • Windows 95/ 98/ 2000 or Windows NT 4.0 • 20 Mb free on hard drive. 	MINI \$ 200 STANDARD \$ 550 PLUS \$ 850
Cutlist Plus	<ul style="list-style-type: none"> • Windows XP or later • 24 bit video display with a minimum resolution of 800 x 600. • Display resolution of 1024 x 768 or better is recommended. 	LT Edition \$29.95 Silver Edition \$89 Gold Edition \$249
Merick Calc 3.15	<ul style="list-style-type: none"> • Processor: 486-100MHz and higher (Pentium-Pentium4) • Memory: 530kB free RAM (basic memory) • Hard disk: min. 2MB, opt. 10MB free (after program installation) • Video: colour VGA and better, program works with CGA, Hercules a EGA too • Mouse: Microsoft komp • Printer: Bubble Jet or Laser Printer HP comp. • MS DOS 5.0 and higher, W95, W98, WME, W2000, WXP 	Full program version \$99 Multilicense \$199
Optimik	<ul style="list-style-type: none"> • Windows 98, ME, NT, 2000, XP • Min. resolution; 800 x 600 	MINI 100 €70 MIDI 1000 € 140 MAXI Unlimited € 210
Plan IQ	Fully compatible with both Windows 95/98 and Windows NT/2000 <ul style="list-style-type: none"> • Processor: 100 MHz / 500 MHz • RAM: 16Mb / 32Mb • Hard disk space: 10Mb / 10Mb • Display: 800x600 / 1024x768 • Graphics (colors): 16 bit (65535) 	ATOC \$895 GC \$895 UCGC \$1250
Real Cut 2D	<ul style="list-style-type: none"> • Operating System: Microsoft Windows 98 or higher. Tested on Win NT 4.0, Me and XP. 	€80 / \$100

Product	System Requirements	Price Information
	<ul style="list-style-type: none"> • Disk space for installation: 4 Mb. • RAM: 64 Mb or larger. • Processor Speed: No lower limit, but the speed of the processor will directly affect the speed of the program. 	
Sheet Cutting Suite	<ul style="list-style-type: none"> • Pentium 500 MHz processor • 128 MB of RAM • 40 MB of free hard disk space • Graphic system capable of displaying 800x600 pixels in 256 colors • Windows 95/98/NT/ME/2000/XP 	Lite version €385 Standard version €785 <i>Site License</i> Lite version €1900 Standard version €2900
SmartCUT	<ul style="list-style-type: none"> • Pentium - 233 MHz processor or better • 32 MB of available memory • 10 MB of free hard disk space • Graphic system capable of displaying 800x600 pixels in 256 colors • Microsoft Windows 95/98/NT 4.0/ME/2000/XP 	100 parts €50/\$70 1000 parts €90/ \$120 Unlimited parts €130/ \$170
The Itemizer	<ul style="list-style-type: none"> • IBM® PC or compatible • Windows® operating system • CD ROM drive • Intel® Pentium® class processor • Hard disk with 10 MB free space • 	Complete program \$299 Email program \$279
2D Load Packer	<ul style="list-style-type: none"> • Pentium II or higher. • Graphic system capable of displaying 800x600 pixels or higher resolution SVGA monitor. • Windows 95/98/NT/2000/Me/XP.. 	Standard \$390 Uniform \$290 Single \$190
BestCut	<ul style="list-style-type: none"> • Pentium 166 MHz processor. • 16 MB of RAM • 10 MB of free storage space in hard drive; • Graphic system capable of displaying 800x600 pixels in 265 colours. • Windows 95/98/NT. 	\$195
Cut Master 2D	<ul style="list-style-type: none"> • Pentium 100 MHz processor. • 16 MB of RAM. • 40 MB of free hard disk space. • Graphic system capable of displaying 800x600 pixels in 256 colours. • Windows 95/98/NT 4.0/ME/2000/XP. 	<i>Pro</i> 1 workstation 125\$ 2/9 workstations 80\$ <i>Lite</i> 1 workstation 80\$
Cutlight	<ul style="list-style-type: none"> • PC 486 with 3 ½ inch disk with Windows 3.x™, • 8 Mbyte memory • 4 Mbyte of free hard disk space. You should use Courier New • Font™ and VGA or SVGA • (Minimum 800 x 600). • Windows 95/98/NT 	Small Edition (up to 50 parts) 99\$ Medium Edition (up to 200 parts) 219\$ Premium Edition (up to 2500 parts) 419\$
CutLogic 2D	<ul style="list-style-type: none"> • Pentium processor or compatible • Windows 98 operation system 	\$799

Product	System Requirements	Price Information
	<ul style="list-style-type: none"> • 64 MB RAM • 15 MB of free Hard Disk space • 256 of colours • display 800x600 • Windows 98/NT/Me/2000/XP/2003 	
Cutting 3	Windows 95/98/ME/2000/NT/XP	\$200
GNCutter 32	Microsoft .NET Compact Framework 1.0 installed in Pocket PC	\$297 \$197 for each additional license.
Opticut	-	-
Panel Optimizer	-	R650 (rand)
Plus 2D for Woodworking	<ul style="list-style-type: none"> • Pentium-IV, 1000 MHz (or higher) • 128 MB (or more) of RAM • 40 MB (or more) of free hard disk space • Windows 98/NT/2000/Xp or later 	\$1400
Sheet Layout 9	-	Hobbyist \$34.95 Small Shop \$89.95 Small Shop Plus \$139.95 Commercial \$219.95

TABLE 4

Product	Minimize waste	Minimize cost	Minimize number of different layouts	Best sheet size calculation
ACE Cutting Optimizer	Yes	No	No	No
Astra R-Nesting	Yes	No	No	No
Corte Certo	Yes	No	Yes	Yes
Cutlist Plus	Yes	Yes	No	No
Merick Calc 3.15	Yes	Yes	No	No
Optimik	Yes	No	No	No
Plan IQ	Yes	No	Yes	No
Real Cut 2D	Yes	No	No	No
Sheet Cutting Suite	Yes	Yes	No	No
SmartCUT	Yes	No	No	No
The Itemizer	Yes	No	No	No
2D Load Packer	Yes	No	No	No
BestCut	Yes	No	No	No
Cut Master 2D	Yes	No	Yes	No
Cutlight	Yes	No	No	No
CutLogic 2D	Yes	No	Yes	No
Cutting 3	Yes	No	No	No
GNCutter 32	Yes	No	Yes	-
Opticut	Yes	No	Yes	No
Panel Optimizer	Yes	No	No	No
Plus 2D for Woodworking	Yes	Yes	-	Yes
Sheet Layout 9	Yes	No	No	No

TABLE 5

Product	Guillotine cutting	Free cutting	Rotation of items / Fixed orientation	Maximum cut length
ACE Cutting Optimizer	Yes	No	Yes	Yes
Astra R-Nesting	Yes	No	Yes	Yes
Corte Certo	Yes	No	Yes	Yes
Cutlist Plus	Yes	No	Yes	No
Merick Calc 3.15	Yes	No	Yes	Yes
Optimik	Yes	No	Yes	No
Plan IQ	Yes	Yes	Yes	Yes
Real Cut 2D	Yes	No	Yes	No
Sheet Cutting Suite	Yes	Yes	Yes	No
SmartCUT	Yes	No	Yes	No
The Itemizer	Yes	No	Yes	No
2D Load Packer	No	Yes	No	Yes
BestCut	Yes	Yes	Yes	Yes
Cut Master 2D	Yes	No	No	Yes
Cutlight	Yes	No	No	Yes
CutLogic 2D	Yes	Yes	No	Yes
Cutting 3	Yes	No	No	Yes
GNCutter 32	Yes	Yes	Yes	Yes
Opticut	Yes	No	No	Yes
Panel Optimizer	Yes	Yes	No	Yes
Plus 2D for Woodworking	Yes	No	Yes	Yes
Sheet Layout 9	Yes	No	No	Yes

TABLE 6

Product	Time Limit	Adjustable optimization level
ACE Cutting Optimizer	No	No
Astra R-Nesting	No	Yes <i>Fast or normal nesting</i>
Corte Certo	Yes	Yes <i>Fast, normal, high1 or high2</i>
Cutlist Plus	No	No
Merick Calc 3.15	No	Yes <i>Speed (0-9)</i>
Optimik	No	Yes <i>A, B, C, D, AA, BB, CC, D or choose best variant of calculation</i>
Plan IQ	Yes	Yes <i>Optimization level (1-4)</i>
Real Cut 2D	No	Yes <i>Small time of execution (weak optimization) or Large time of execution (strong optimization)</i>
Sheet Cutting Suite	No	Yes <i>Fastest - Max. Optimization</i>
SmartCUT	No	Yes <i>Quick / Full (slower)</i>
The Itemizer	No	No
2D Load Packer	Yes	Yes <i>Intensity (0-20)</i>
BestCut	No	Yes Minimum optimization - Maximum optimization
Cut Master 2D	No	Yes <i>Minimum (highest speed), Medium (Normal speed) or Maximum (Lowest speed)</i>
Cutlight	No	No
CutLogic 2D	No	No
Cutting 3	No	Yes <i>Fast, Normal or Perfect</i>
GNCutter 32	-	-
Opticut	Yes	Yes <i>Fast, Standard 1, Standard 2, Advanced 1, Advanced 2, Personified or DC Optimized</i>
Panel Optimizer	No	No
Plus 2D for Woodworking	No	Yes <i>Quick results - Optimized results</i>
Sheet Layout 9	No	No

TABLE 7

Product	Kerf width consideration	Reuse of offcuts	Safety margins	Sheets priority
ACE Cutting Optimizer	Yes	Yes	No	No
Astra R-Nesting	Yes	Yes	Yes	No
Corte Certo	Yes	Yes	Yes	Yes
Cutlist Plus	Yes	Yes	Yes	No
Merick Calc 3.15	Yes	Yes	No	No
Optimik	Yes	Yes	Yes	No
Plan IQ	Yes	Yes	Yes	Yes
Real Cut 2D	Yes	Yes	No	No
Sheet Cutting Suite	Yes	Yes	Yes	Yes
SmartCUT	Yes	Yes	Yes	No
The Itemizer	Yes	No	No	No
2D Load Packer	No	No	Yes	No
BestCut	Yes	Yes	Yes	Yes
Cut Master 2D	Yes	Yes	No	No
Cutlight	Yes	No	No	No
CutLogic 2D	Yes	Yes	Yes	No
Cutting 3	Yes	Yes	Yes	No
GNCutter 32	Yes	Yes	Yes	-
Opticut	Yes	Yes	Yes	No
Panel Optimizer	Yes	No	Yes	No
Plus 2D for Woodworking	Yes	Yes	Yes	No
Sheet Layout 9	Yes	No	No	No

TABLE 8

Product	First cut orientation	Sheets of different sizes	Edge banding calculation
ACE Cutting Optimizer	No	Yes	No
Astra R-Nesting	Yes	Yes	Yes
Corte Certo	Yes	Yes	Yes
Cutlist Plus	Yes	Yes	Yes
Merick Calc 3.15	Yes	Yes	Yes
Optimik	Yes	Yes	Yes
Plan IQ	Yes	Yes	Yes
Real Cut 2D	No	Yes	No
Sheet Cutting Suite	No	Yes	Yes
SmartCUT	Yes	Yes	No
The Itemizer	Yes	Yes	No
2D Load Packer	No	Yes	No
BestCut	Yes	Yes	Yes
Cut Master 2D	No	Yes	Yes
Cutlight	Yes	No	No
CutLogic 2D	No	Yes	No
Cutting 3	Yes	Yes	Yes
GNCutter 32	Yes	Yes	-
Opticut	Yes	Yes	Yes
Panel Optimizer	No	No	Yes
Plus 2D for Woodworking	Yes	Yes	Yes
Sheet Layout 9	Yes	Yes	Yes

TABLE 9

Product	Import from	Export to	CNC code for cutting machines
ACE Cutting Optimizer	MS Excel; Lotus Notes; TXT; DXF	TXT; DXF	No
Astra R-Nesting	XML; MS Excel; Astra Exchange File	MS Excel	No
Corte Certo	MS Excel; MS Word; CSV	RTF; CSV; Html; XML; DXF; ERP	Yes (G code)
Cutlist Plus	TXT; CSV	TXT	No
Merick Calc 3.15	-	-	Yes
Optimik	TXT	TXT	No
Plan IQ	CSV	CSV; MS Excel	No
Real Cut 2D	MS Word ; MS Excel	MS Word; MS Excel	No
Sheet Cutting Suite	TXT; MS EXCEL	HTML; DXF(AUTOCAD); CNC G code files	Yes
SmartCUT	CSV	CSV	No
The Itemizer	-	DXF for CAD and CNC purposes	Yes
2D Load Packer	TXT; CSV	-	No
BestCut	MS EXCEL	-	No
Cut Master 2D	MS EXCEL; XML	XML ; AUTOCAD DXF	No
Cutlight	-	-	No
CutLogic 2D	CSV	CSV	No
Cutting 3	AutoCad; TXT; Project Cutting 2	MS Excel; TXT	No
GNCutter 32	-	-	Yes
Opticut	MS Excel; Cabinet design softwares (PolyBoard, TopWood, Obvie, KitchenDraw, ...)	MS Excel; Cabinet design softwares (PolyBoard, TopWood, Obvie, KitchenDraw, ...)	Yes
Panel Optimizer	CSV	-	No
Plus 2D for Woodworking	CSV; TXT; DXF	DXF; CSV; XML	Yes
Sheet Layout 9	ASCII files; File Wizard; CSV	MS Excel; DXF	Yes

TABLE 10

Product	Materials database	Inventory tracking	Customer proposals creation	Pricing tool
ACE Cutting Optimizer	Yes	Yes	No	No
Astra R-Nesting	Yes	Yes	No	Yes
Corte Certo	Yes	Yes	Yes	Yes
Cutlist Plus	Yes	Yes	Yes	Yes
Merick Calc 3.15	Yes	Yes	No	Yes
Optimik	Yes	Yes	No	Yes
Plan IQ	No	Yes	No	Yes
Real Cut 2D	No	Yes	No	Yes
Sheet Cutting Suite	No	Yes	No	No
SmartCUT	Yes	Yes	No	No
The Itemizer	No	No	No	Yes
2D Load Packer	No	No	Yes	Yes
BestCut	Yes	Yes	No	Yes
Cut Master 2D	No	Yes	No	No
Cutlight	No	No	No	No
CutLogic 2D	No	No	No	Yes
Cutting 3	Yes	No	No	No
GNCutter 32	-	-	-	-
Opticut	Yes	Yes	No	Yes
Panel Optimizer	Yes	No	No	Yes
Plus 2D for Woodworking	Yes	Yes	Yes	Yes
Sheet Layout 9	Yes	Yes	No	Yes

TABLE 11

Product	Items position	Items rotation	Items removal	Items insertion	Items size altering
ACE Cutting Optimizer	No	No	No	No	No
Astra R-Nesting	Yes	Yes	Yes	Yes	Yes
Corte Certo	Yes	Yes	Yes	Yes	Yes
Cutlist Plus	No	No	No	No	No
Merick Calc 3.15	No	No	No	No	No
Optimik	No	No	No	No	No
Plan IQ	No	No	No	No	No
Real Cut 2D	No	No	No	No	No
Sheet Cutting Suite	Yes	Yes	No	No	No
SmartCUT	No	No	No	No	No
The Itemizer	Yes	Yes	Yes	Yes	No
2D Load Packer	No	No	No	No	No
BestCut	No	No	No	No	No
Cut Master 2D	No	No	No	No	No
Cutlight	No	No	No	No	No
CutLogic 2D	No	No	No	No	No
Cutting 3	Yes	No	No	Yes	No
GNCutter 32	-	-	-	-	-
Opticut	No	No	No	No	No
Panel Optimizer	No	No	No	No	No
Plus 2D for Woodworking	No	No	No	No	No
Sheet Layout 9	No	No	No	No	No

TABLE 12

Product	Cuts coordinates	Number of cuts	Trajectory of cuts
ACE Cutting Optimizer	Yes	No	No
Astra R-Nesting	No	No	Yes
Corte Certo	Yes	Yes	Yes
Cutlist Plus	No	No	No
Merick Calc 3.15	No	No	No
Optimik	No	No	No
Plan IQ	Yes	No	Yes
Real Cut 2D	No	No	Yes
Sheet Cutting Suite	No	No	Yes
SmartCUT	No	No	No
The Itemizer	No	No	No
2D Load Packer	Yes	No	No
BestCut	Yes	No	Yes
Cut Master 2D	No	No	No
Cutlight	No	No	No
CutLogic 2D	Yes	No	No
Cutting 3	No	No	Yes
GNCutter 32	Yes	Yes	Yes
Opticut	No	No	Yes
Panel Optimizer	No	No	Yes
Plus 2D for Woodworking	Yes	Yes	Yes
Sheet Layout 9	No	No	Yes

3 Conclusions

This may be considered a representative survey, although it is not exhaustive, since there are other software packages on the market.

This software survey highlighted the differences among industry-oriented software packages presently available in the market. While some turned out to be very simple applications, others stood out in terms of variety of features and user-definable parameters specially conceived to meet the furniture industry requirements.

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