

# SMARTPACKER V2.9 TUTORIAL

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ZHIHUO SOFTWARE

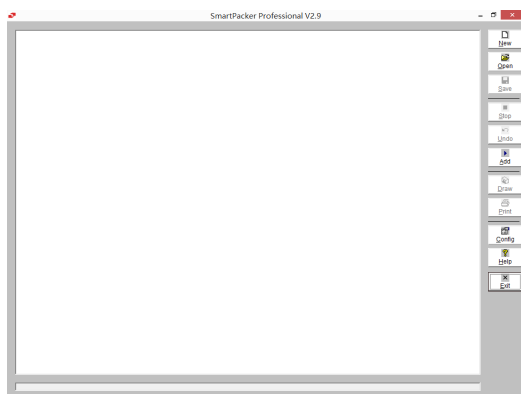
MARCH, 2015

# 1 BASICS

SmartPacker computes container loading plans for space efficiency. The use of the Professional, Standard and Free Edition are the same, when the compute results may vary. The compute results and screenshots in this document are of Professional Edition.

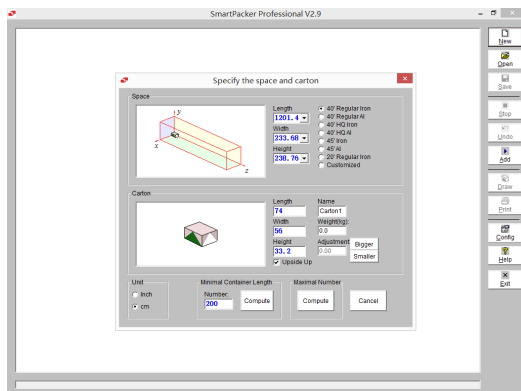
Suppose we are using a 40' container to load the following:

Cargo	Length/cm	Width/cm	Height/cm	Note	Quantity
Carton1	74	56	33.2	Up	200
Carton2	54.7	43	31.2		280
Carton3	47.1	37	30.8		to maximize



## 1 User interface:

- A toolbar in the right
- A progressbar at bottom
- White space for illustration

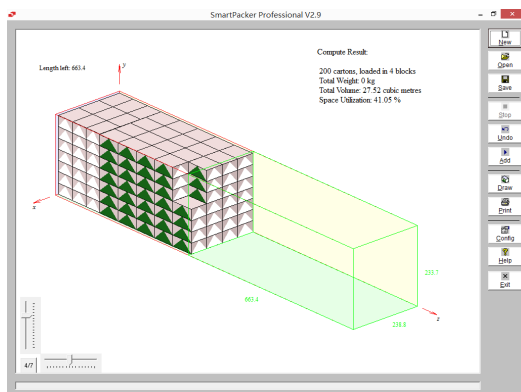


## 2 Click “New” to start a compute case

- Use “40’ Regular Iron”
- Input the dimensions of Carton1, and get “Upside Up” checked
- Input 200 the carton number, then click “Compute”

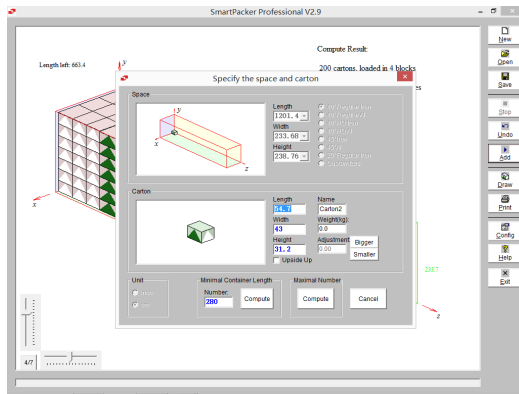
Note:

- First load named “Carton1” by default
- If you won’t bother weight, leave it as 0.



## 3 See the loading plan for 200 Carton1

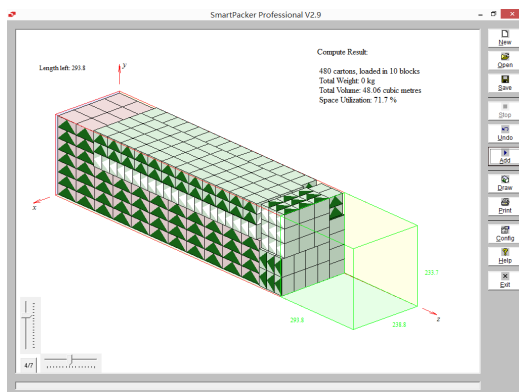
- Remained space is 663.4 cm long, and is marked by green framework
- Cartons loaded with 2 orientations
  - Length-height face is marked with green triangle
  - Width-height face with white triangle
- 3 removed to make the 200 carton number
- Total weight is 0, since carton weight was left 0 in previous step.



- 4 Click “Add” to load Carton2
  - Input Carton2 length, width and height
  - Uncheck “Upside Up”
  - Input 280 the carton number, click “Compute”

Note:

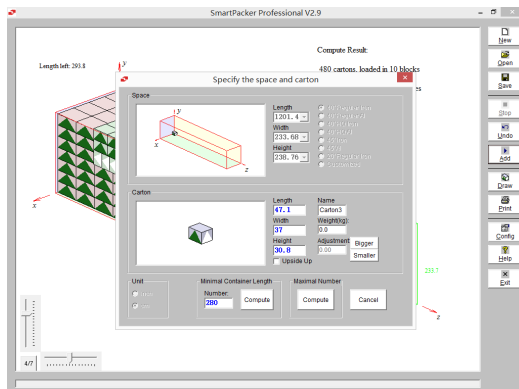
- 2<sup>nd</sup> load named “Carton2” by default
- 2<sup>nd</sup> carton colored differently



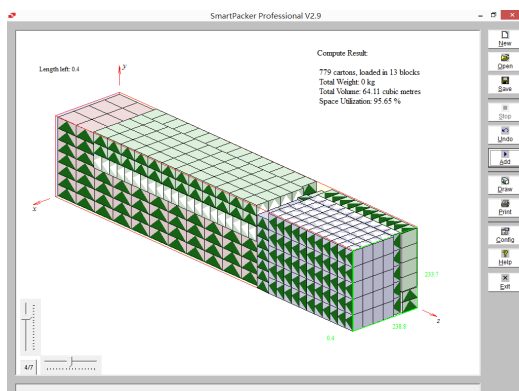
- 5 See the loading plan with 280 Carton2 added
  - In general, load from front to back
  - In between, there are some Carton2 and Carton1 loaded upside by downside

Note:

- The juxtaposition in between is to make better use of space
- Without “Upside Up” limit, load Carton2 with 4 orientations.



- 6 Click “Add” to load Carton3
  - Input the dimensions
  - Click the “Compute” button for “Maximal Number”

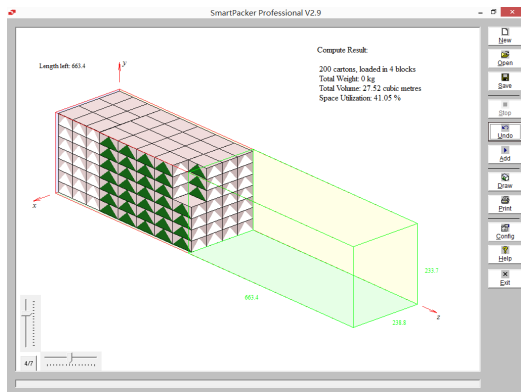


- 7 See the loading plan with Carton3 added for maximal number, the container gets full now.
  - For the 3 carton types, there are 779 cartons in total: the number of Carton3 is 399 (779 – 200 – 280)
  - Remained space is 0.4 cm long, the space utilization of container is 95.65%

## 2 ILLUSTRATION

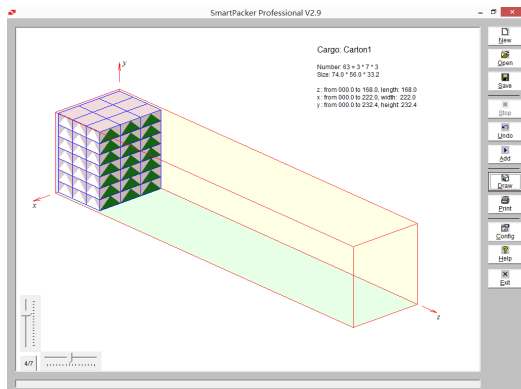
Let's investigate the loading plan from different angle, as a whole or block by block.

For the coordinate system of the inner 3-dimensional space of container, the original point is the front-right-bottom corner, x axis is to left, y axis up, and z axis backward.



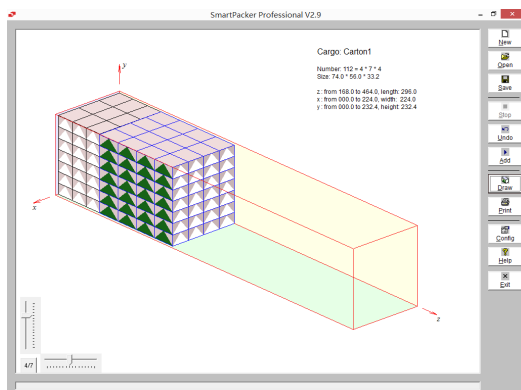
- 8 From Step 7, click “Undo” twice to undo the Carton2 and Carton3 loading, then the loading plan is back to Step 3 with only Carton1.

The cartons are loaded with 2 piles of distinct orientation, why does SmartPacker say the 200 cartons are “loaded in 4 blocks”?

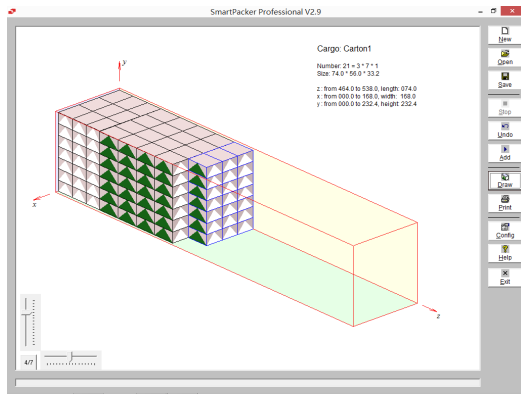


- 9 Click “Draw” to review the plan starting from the 1<sup>st</sup> block. SmartPacker calls a group of cartons of a same orientation, and same numbers of layers in 3 directions so as to make a cube, a block.

- “Cargo: Carton1” tells the cargo name
- “Number: 63 = 3 \* 7 \* 3”, tells
  - There are 63 cartons in this block
  - 3 layers from left to right
  - 7 layers bottom up
  - 3 rows from front to back
  - Times 3, 7 and 3, you got 63.

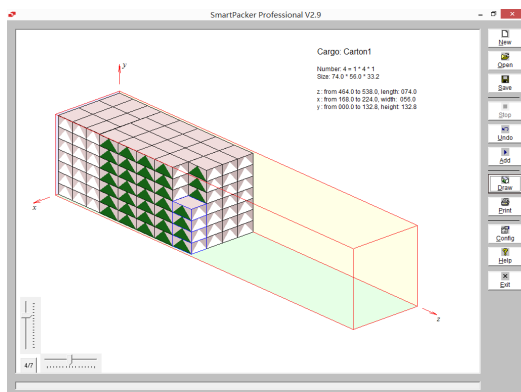


- 10 Click “Draw” again, add the 2<sup>nd</sup> block in the illustration
  - In comparison with Step 8, you only see 4 rows from front to back in this 2<sup>nd</sup> block.



11 Click “Draw” again, add the 3<sup>rd</sup> block in the illustration

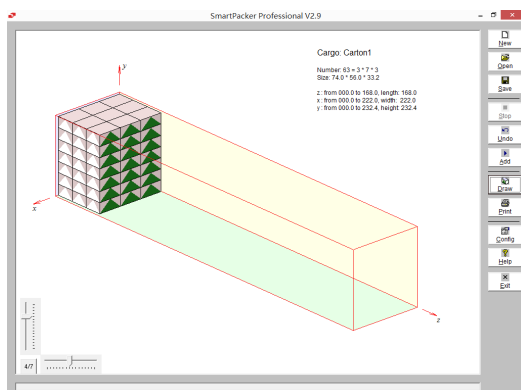
- In comparison with Step8, as of the last row, you only see the 3 layers from right to left.



12 Click “Draw” again, add the 4<sup>th</sup> block

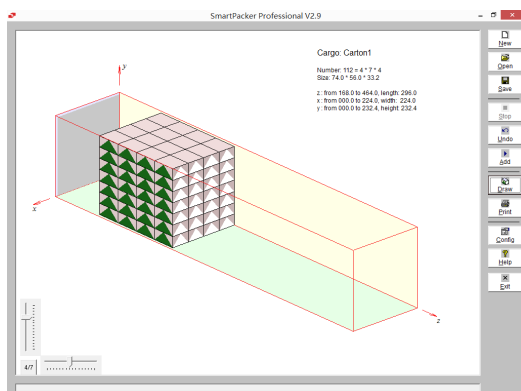
- In comparison with Step8, the 4<sup>th</sup> block is the left most layer of the back most row.

To address the question in Step 8: In terms of blocks, the back pile of cartons was of 3 blocks.

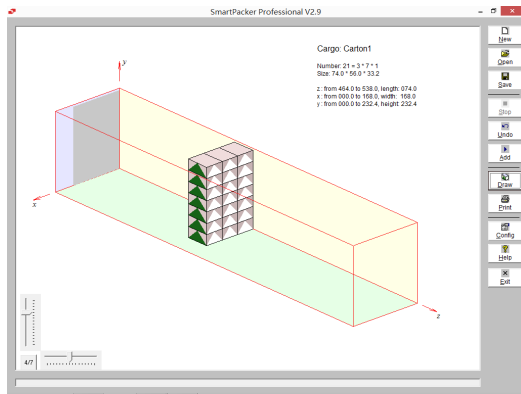


13 The Step 12 illustration has drawn all the cartons in the loading plan. At this time, if you continue click “Draw”, cartons are drawn block by block again, but switch from accumulatively to individually.

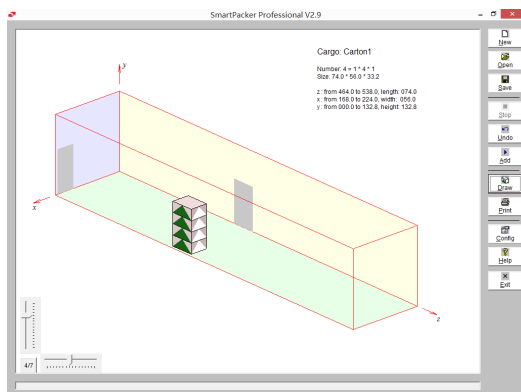
Now see the 1<sup>st</sup> block individually.



14 Click “Draw”, see the 2<sup>nd</sup> block individually



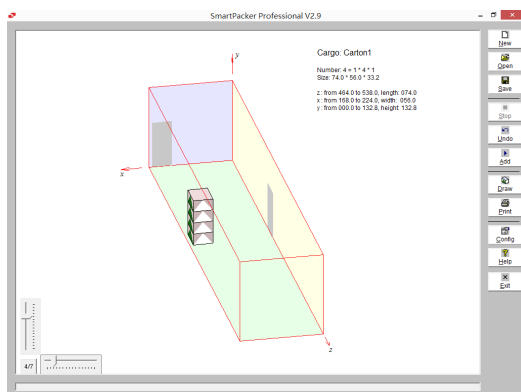
15 Click “Draw”, see the 3<sup>rd</sup> block individually



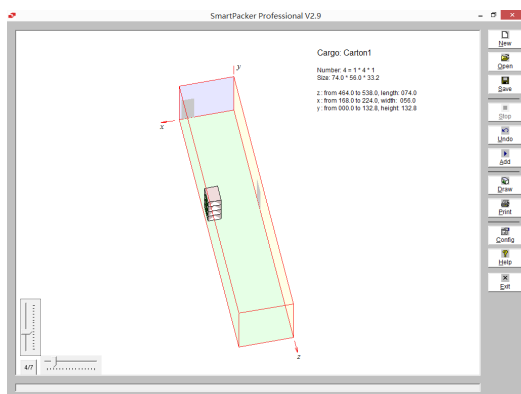
16 Click “Draw”, see the 4<sup>th</sup> block individually

Block throws shadow along axis directions on the container wall, for better understanding of the 3-dimensional space.

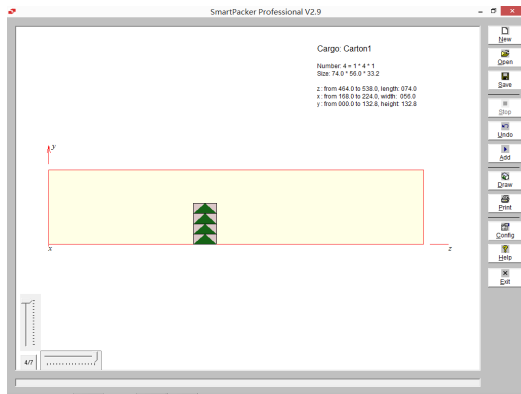
Now if you click “Draw”, the illustration starts over, and is switched from individually back to accumulatively.



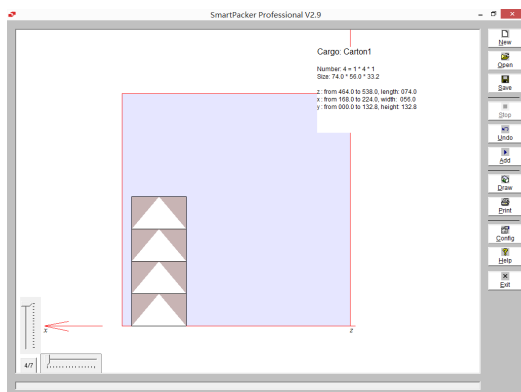
17 Use the sliders in the left-down corner to rotate the view. Drag horizontal slider to left, then the illustrated container turns clock-wise.



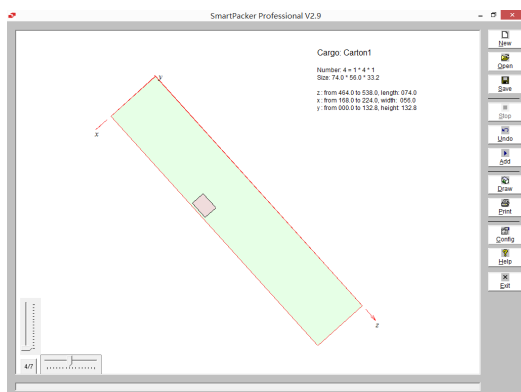
18 Drag the vertical slider downward, then you see the container from above.



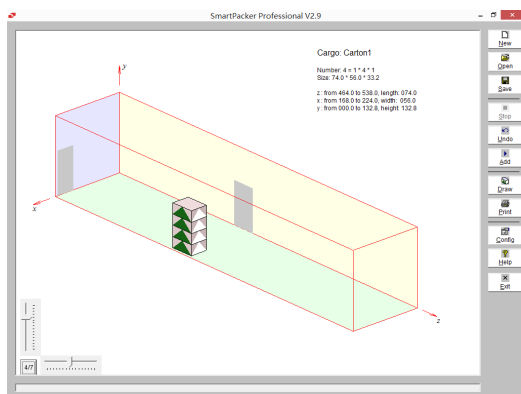
- 19 Drag the horizontal slider to the right most, and vertical slider to the up most, view the container from left.



- 20 Drag the horizontal slider to the left most, when the vertical slider is at the up most, you view the container from back.



- 21 Drage the vertical slider to the down most, you view the container from above.



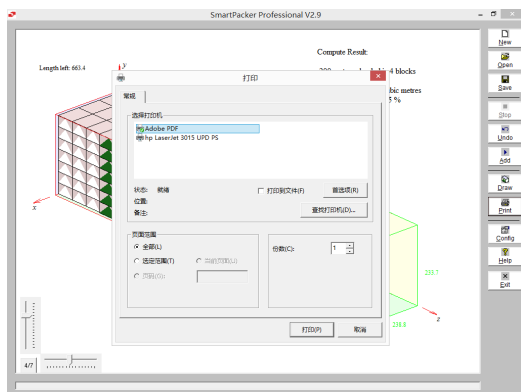
- 22 Click the “4/7” button, then you are back to the default angle of view.

The software makes 90 degree 15 steps tunable, then 4/7 means tuning the angle of view at step 4 vertically and step 7 horizontally, which works well in most cases.

### 3 PRINT/EXPORT

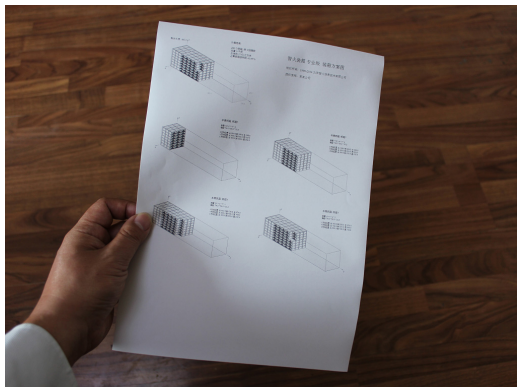
To get a copy of the compute result of SmartPacker

- Use “Print” to print a hard-copy
- Use “Print” to get a soft-copy, e.g. a PDF formate file
- Use “Save” to save to a .ptn loading pattern file



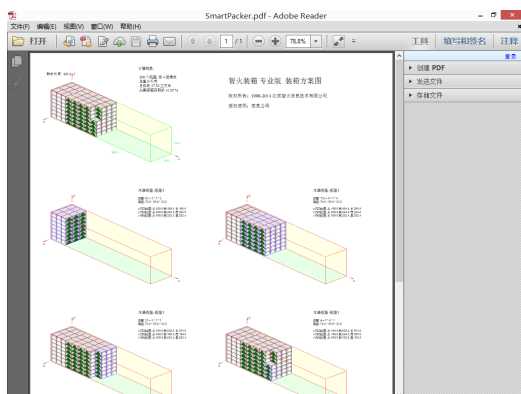
23 Click “Print” to see the print dialog.

You would see different printers listed in the dialog using your computer.



24 Pick a printer, e.g. a HP laserjet, go ahead and get a hard-copy.

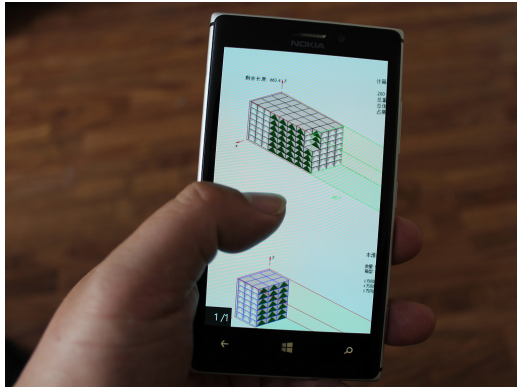
You may write notes on the print-out, then hand-over or fax it to your suppliers, buyers, carriers, or those who load the cartons using a forklift or by hands.



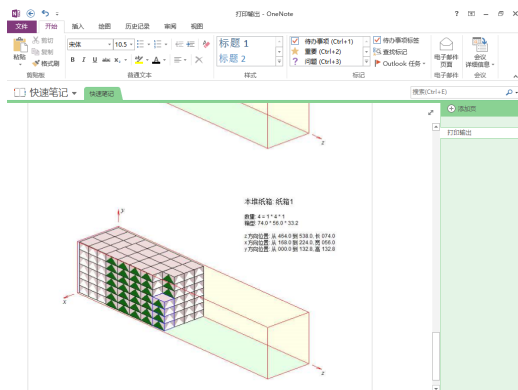
25 You may choose “Adobe PDF”, to get a PDF loading plan.

PDF can be sent as email attachment to others, and can be read by free software like Adobe Reader, as shown in the left.



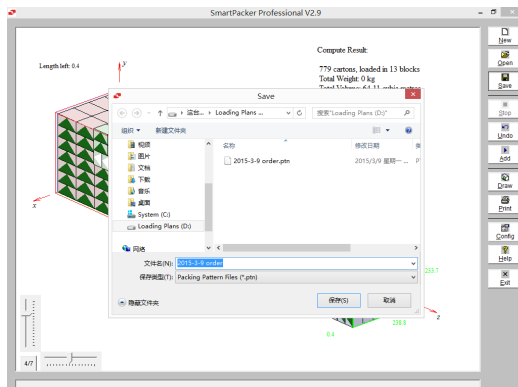


26 They can also use smartphone to receive email and read PDF loading plan.



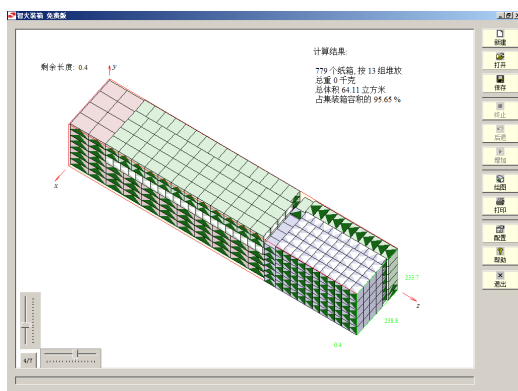
27 Depending on what softwares installed on your computer, you may use “Print” to export a loading plan to other formats, for example:

- Use “Microsoft XPS Document Writer” printer, to generate XPS format file
- For a computer with Microsoft Office suit, you can “Print” to OneNote, as shown in the left.



28 The proprietary file format of SmartPacker 2.9 is .ptn.

For example, you use SmartPacker 2.9 Professional and get 779 cartons loaded in Step 7, save the loading plan as a ptn file.



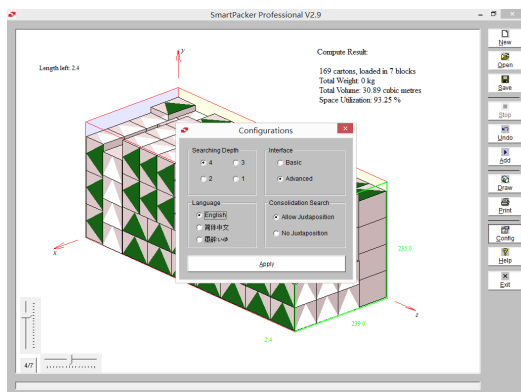
29 .ptn files can be open by Professional, Standard and Free Edition of SmartPacker 2.9.

You may compute and save using SmartPacker 2.9 Professional, then send ptn file to your supplier in China. She then open the loading plan using SmartPacker 2.9 Free, review the plan block by block ... in the end, you pay less and emit less in shipping.

## 4 CONFIG COMPUTE

Search depth, and whether juxtaposition can be configured.

The Professional, Standard and Free Edition of SmartPacker 2.9 are different by the maximum of search depth configurable.

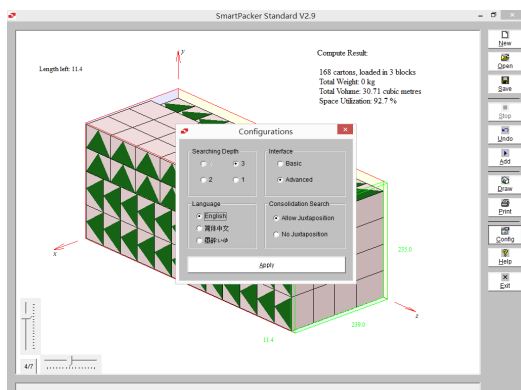


30 Open SmartPacker 2.9 Professional

- Click “New”
- Click “Compute” for “Maximal Number”
- Then Click “Config”

Regarding loading ( $69.2 \times 54.3 \times 48.2$ ) carton into 20' container, V2.9 Professional Edition

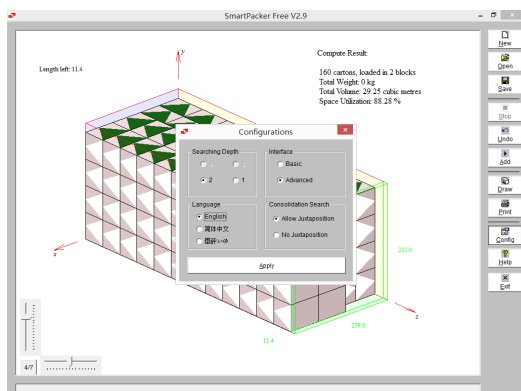
- Made 169 cartons in 7 blocks
- The maximal and default search depth is 4, which can be reduced to 3, 2, and 1



31 Using SmartPacker 2.9 Standard, do the same as in Step 30.

For the same compute case, V2.9 Standard Edition

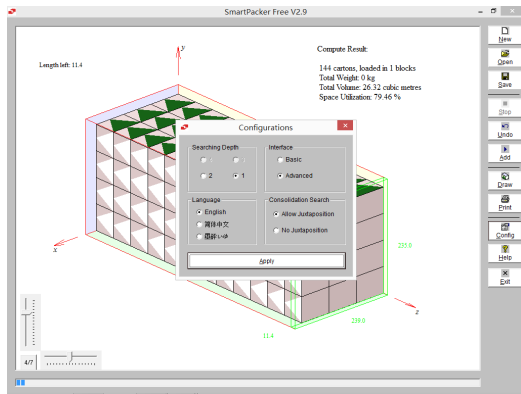
- Made 168 cartons, in 3 blocks
- The maximal and default search depth is 3, which can be reduced to 2 and 1



32 Using SmartPacker 2.9 Free Edition, do the same as in Step 30

For the same compute case, the V2.9 Free Edition

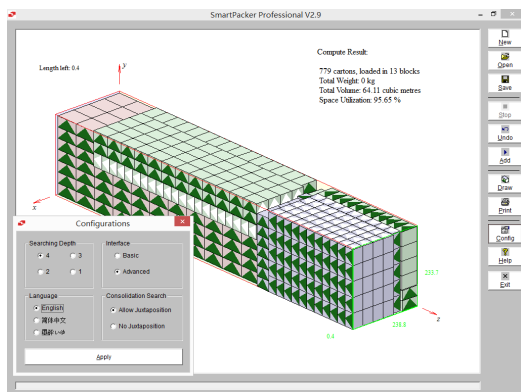
- Made 160 cartons, in 2 blocks
- The maximal and default search depth is 2, which can be reduced to 1



- 33 Using the Free Edition and 1 as search depth, compute the same case as in Step 30
- Made 144 cartons, in 1 block

Comparing the above 4 results:

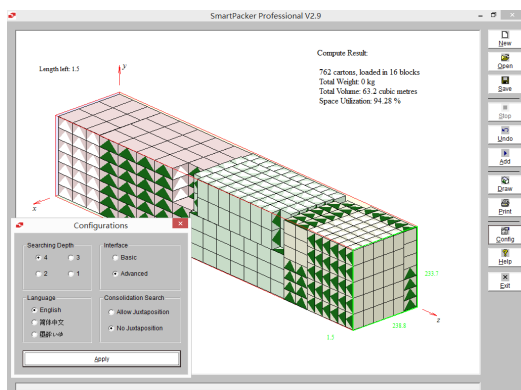
- To make better use of space, SmartPacker combines cartons of different orientation
- The deeper the search, the more combinations are checked, and the better space utilization may be achieved.



- 34 The other compute configuration is whether to juxtaposition: for neighbouring two carton types, in between some be placed up-down or left-right side by side.

Step 7 is computed allowing juxtaposition:

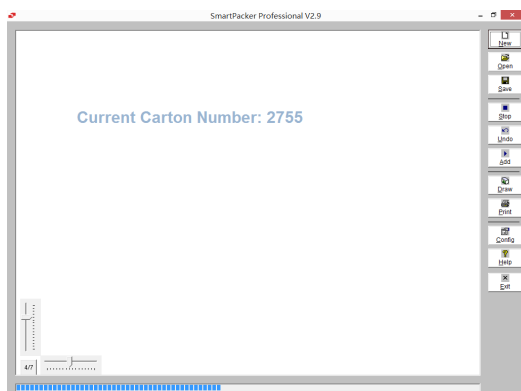
- Made 779 cartons, by 13 blocks
- Space utilization: 95.65%



- 35 The same compute case, same search depth, but not allowing juxtaposition, ends up:

- Made 762 cartons, by 17 blocks
- Space utilization: 94.28%

As you can see, allowing juxtaposition helps on space efficiency.



- 36 The compute time can be long, when

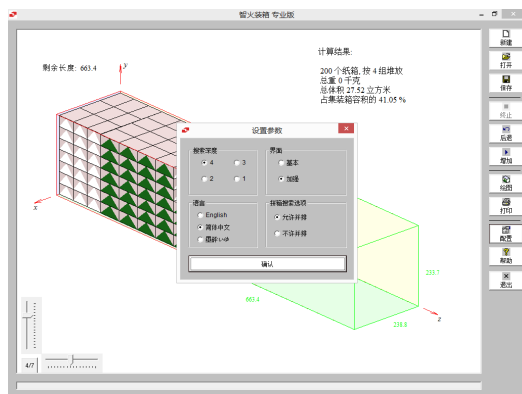
- Carton is small
- Deeper search, allowing juxtaposition
- Dated computer hardware

When compute speed became a priority

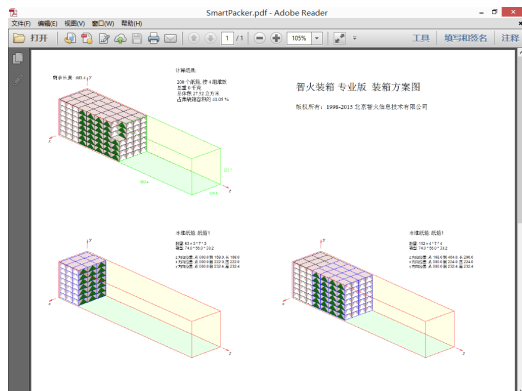
- Click “Stop” during compute, then you got the best solution so far searched
- Config compute, e.g. reduce search depth

## 5 CONFIG USER INTERFACE

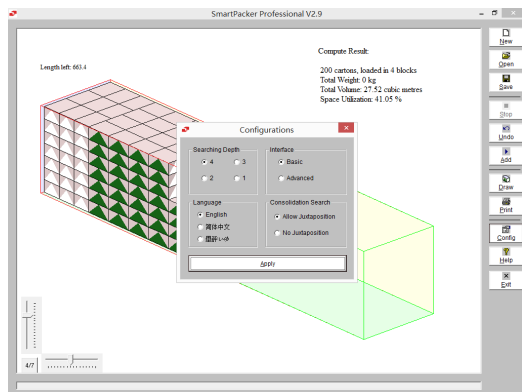
You can switch the language of user interface between: English, Simplified Chinese (used in mainland China) and Traditional Chinese (used in Taiwan and Hong Kong).



- 37 Click “Config”, make a choice in “Language”, then the user interface switch to that language, e.g. Simplified Chinese.



- 38 Then if you print the loading plan, the language of the text on the print-out changed.



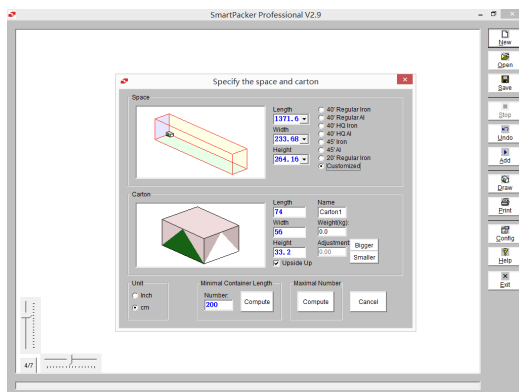
- 39 The last config setting is between “Basic” and “Enhanced” illustration, when the “Enhanced” is the default choice.

If you switch to “Basic”, the illustration will be simpler: no x, y, z axes.

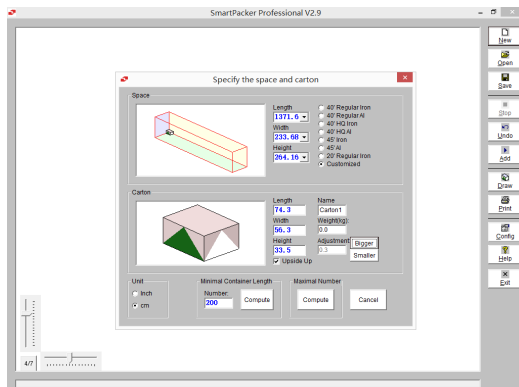
## 6 MAKE ALLOWANCE

Though a carton is long, wide and high by its own design and made, it deforms when being overfilled. Making allowance by using slightly larger dimensions in compute can ensure the computed plan is doable.

But how much allowance to make? Allowing more than necessary waste space and make the loaded cartons loose and unstable, while no allowance or too mean then you may simply unable to push in. To get it right, software computing and cargo loading shall check against each other, try and fine tune, and setup guidelines for each container type and cargo type on: 1) usual allowance, doable and efficient; 2) minimum allowance, tight to load, but can save the day in critical cases.



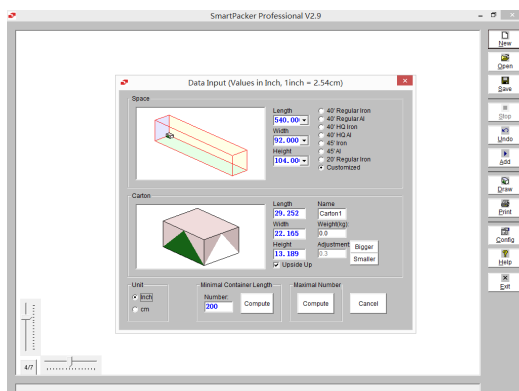
- 40 Even for standard containers, their actual length, width and height of inner space may vary to some extent. Verify the numbers, you may also need to make allowance for doorframe and corner parts.



- 41 To adjust allowance for carton size, you can use the “Bigger” and “Smaller” button to increase or decrease the length, width and height of carton, 0.1cm per click.

Click “Bigger” 3 times

- “Adjustment” became 0.3
- The length, width and height of carton are increased by 0.3 than in Step 41

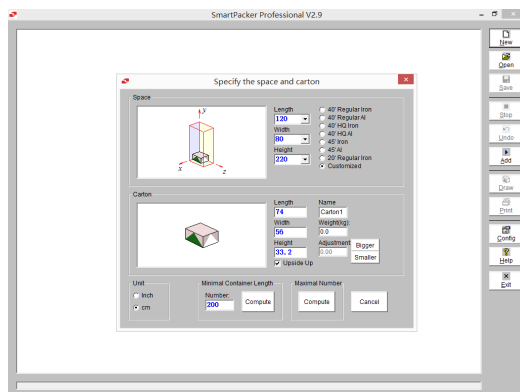


- 42 You can switch the unit of length between “Inch” and “cm” at the left-bottom corner, and the length values will convert automatically.

## 7 PALLET

For cartons to be palletized and containerized, you can use SmartPacker 2.9 through two steps with some back and forth to optimize. Let's still load the below cartons to a 40' container, using 1210 (120×100×16) or 1208 (120×80×16) pallets.

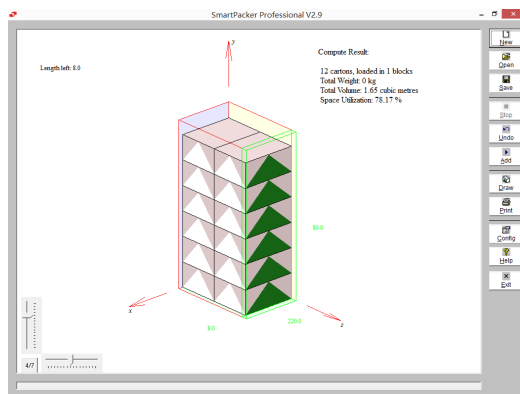
Cargo	Length/cm	Width/cm	Height/cm	Note	Quantity
Carton1	74	56	33.2	Up	200
Carton2	54.7	43	31.2		280
Carton3	47.1	37	30.8		to maximize



43 Firstly, check palletization on each carton type  
For space:

- Input pallet length and width
- You may use 220 as space height (container space height 238 – pallet height 16 – allowance 2)

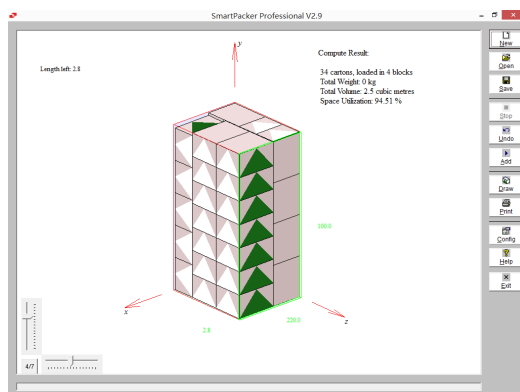
Then you input carton dimensions, click “Compute” for ”Maximal Number”



44 How many pallets to load 200 Carton1?  
 $200 / 12 = 16$  pallets with 8 cartons left:

Pallet	1210	1208
Carton number per pallet	12	12
Space utilization	62.54%	78.17%
Pallet number	16	16
Carton number left	8	8

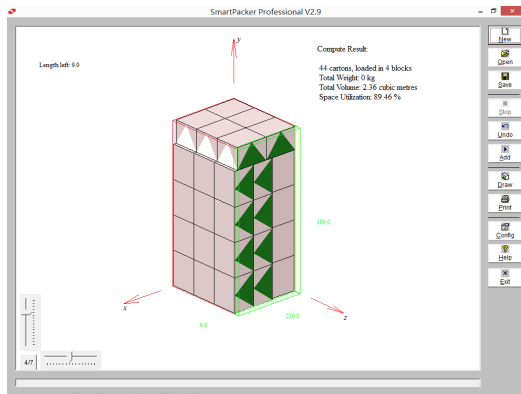
So, 1208 is better for Carton1



45 Similarly, for 280 Carton2

Pallet	1210	1208
Carton number per pallet	34	25
Space utilization	94.51%	86.87%
Pallet number	8	11
Carton number left	8	5

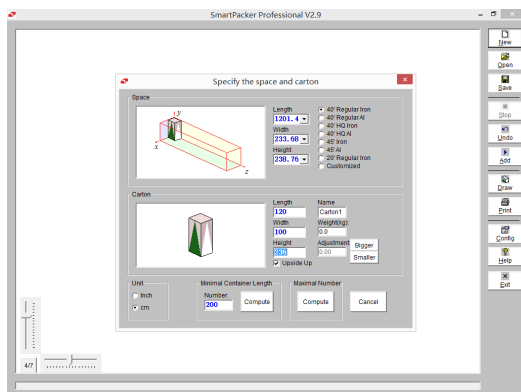
1210 is better for Caron2



#### 46 On palletizing Carton3

Pallet	1210	1208
Carton number per pallet	44	34
Space utilization	89.46%	86.41%

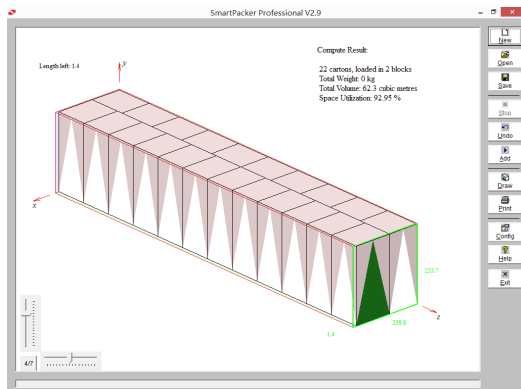
1210 is better for Carton3



#### 47 To containerize loaded pallets

- Input the size of inner space of container, as the space for loading
- Input the dimensions of loaded pallet, as the dimensions of carton to load.

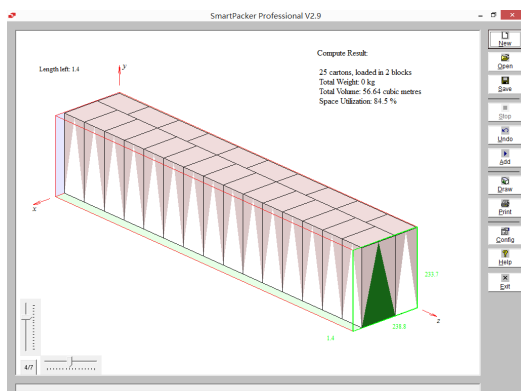
For example, use 120×100×236 for loaded 1210 as carton to load, and make “Upside Up” checked.



#### 48 If use 1210 alone, to load into container

Number of 1210 pallet	Space utilization
22	92.95%

Referring to the pallet capacity in Step 44, 45 and calculate: 22 1210 fall short for 200 Carton1 and 280 Carton2.

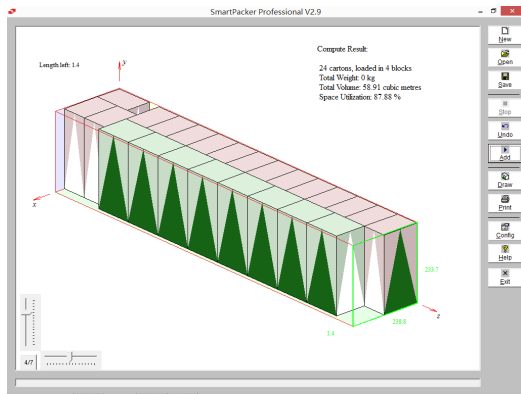


#### 49 If use 1208 alone, to load into container

Number of 1208 pallet	Space utilization
25	84.5%

Referring to Step 44, 45: 25 1208 also fall short for 200 Carton 1 and 280 Carton2.

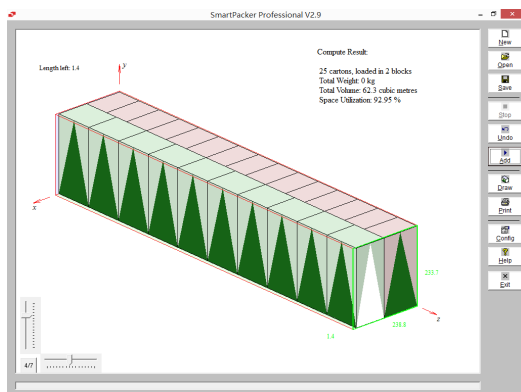
How about do containerization and palletization using combinatorial optimization?



- 50 On containerizing pallets, try various 1208 and 1210 combinations, e.g. try load 16 1208, then 1210 for maximal number

1208	1210	Space utilization
16	8	87.88%

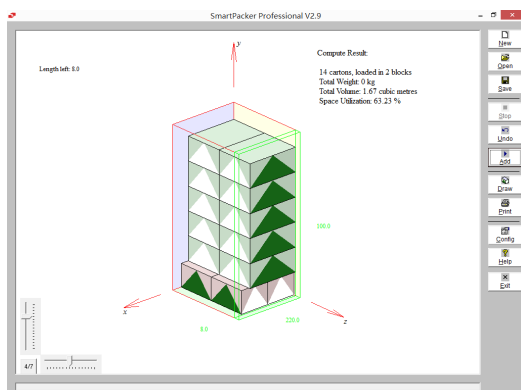
Referring to of Step 44, 45: there are still 8 Carton1 and 8 Carton2 outstanding.



- 51 But if load 15 1208 then 1210 for max number

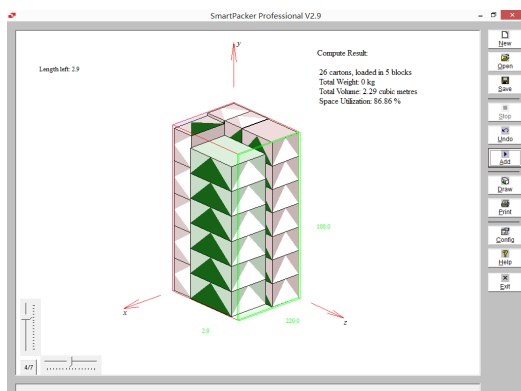
1208	1210	Space utilization
15	10	92.95%

- better than Step 48: more space in 1208 format for accommodating Carton1
- better than Step 49: swap 10 1208 for 10 1210, good for accommodating Carton2



- 52 Check Step 51 on 200 Carton1 & 280 Carton2
- 15 1208 by Step 44, and 8 1210 by Step 45
  - 2 1210 solved the remained as shown left.

Pallet #	Pallet type	Carton1 #/Pallet	Carton2 #/Pallet	Carton1 Total #	Carton2 Total #
15	1208	12	0	180	0
8	1210	0	34	0	272
2	1210	10	4	20	8
Total #:				200	280

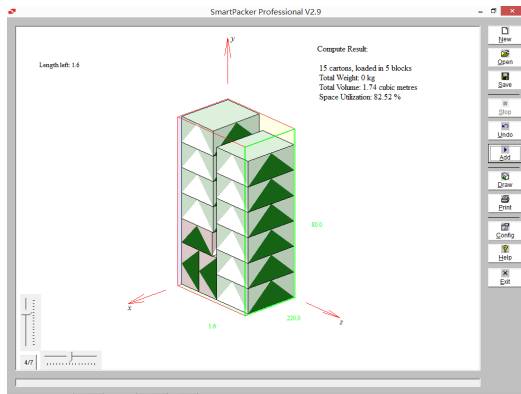


- 53 Can we do better? The space utilization of Step 44 and 52 are below 80%.

Step 52 is one Carton1–Carton2 combination for 1210, try more and find:

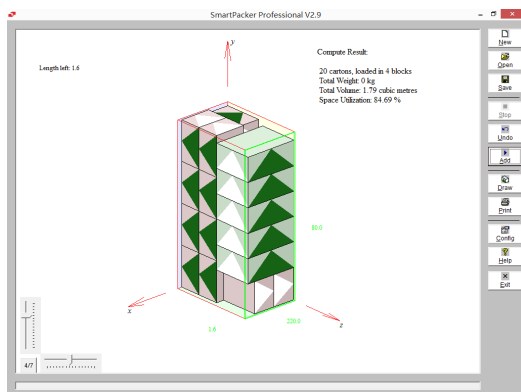
	Carton1 #	Carton2 #	Space utilization
Pallet 1210	6	20	86.86%





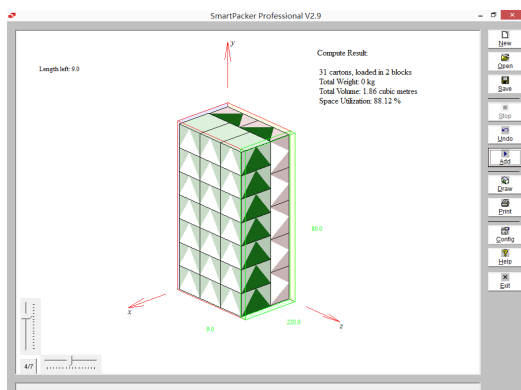
54 Also try various Carton1–Carton2 combination for 1208, and find

	Carton1 #	Carton2 #	Space utilization
Pallet 1208	10	5	82.52%



55 another good one for 1208

	Carton1 #	Carton2 #	Space utilization
Pallet 1208	5	15	84.69%



56 By Step 51 containerization, Step 53, 54 palletization, not only 200 Carton1 and 280 Carton2, but also 21 Carton3 can be loaded

- 10 1210 by Step 53, 14 1208 by Step 54
- 1 1208 solved 10 remained Carton2 plus 21 Carton3 as show left

Pallet #	Pallet type	Carton # / Pallet			Carton Total #		
		1	2	3	1	2	3
10	1210	6	20		60	200	0
14	1208	10	5		140	70	0
1	1208		10	21		10	21
Total:					200	280	21

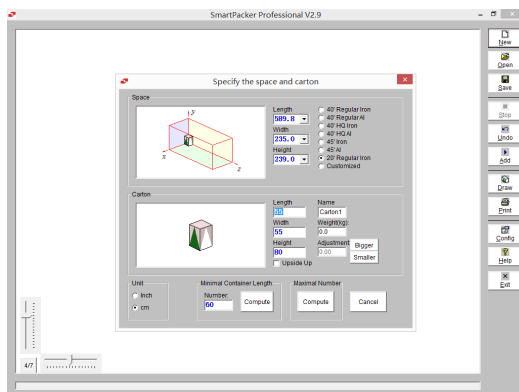
On palletization & containerization, you may also consider:

- Cartons loaded on pallet can be slightly wider than pallet
- Issues like stability of pallet loading and weight balance

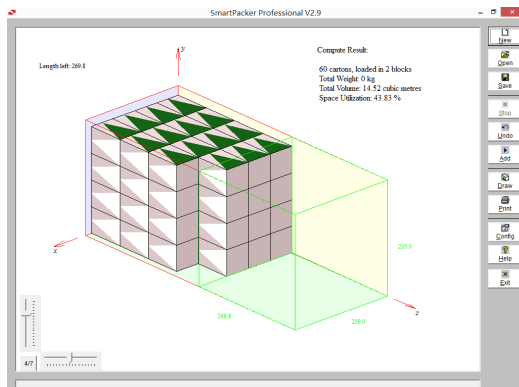
# 8 BARRELS

You may treat barrels as cartons of equal length and width in SmartPacker compute.

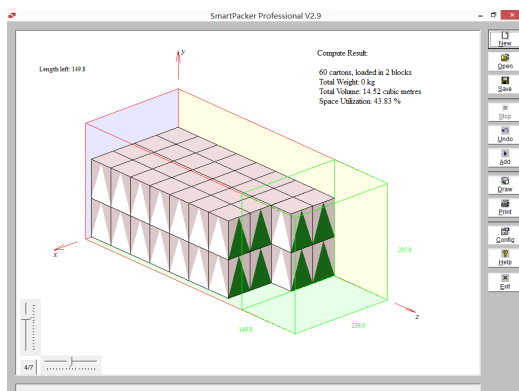
For example, for a barrel with 55 cm in diameter and 80 cm in height, you compute it as a carton which is 55 cm long, 55 cm wide and 80 cm high.



57 Input the barrel size as a carton.



58 In illustration, a face without a triangle marker is the bottom (or top) of a barrel.

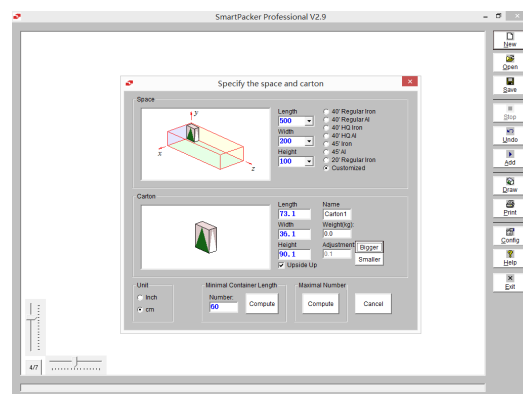


59 If the barrel can not be lie-down placed, check “Upside Up” in Step 57 before compute.

## 9 TWO-DIMENSIONAL MATERIAL CUT

SmartPacker 2.9 can be used to solve two-dimensional cutting problem, though it is developed for three dimensional packing.

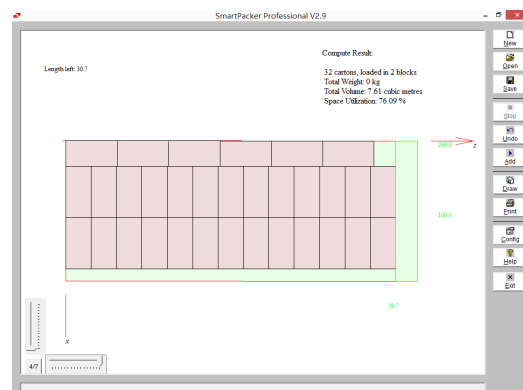
If you are in manufacturing, for example, you may want to make maximum use of a  $500 \times 200$  plate glass, by cutting it into as many as  $73 \times 36$  pieces, then as many as  $42 \times 17$  pieces.



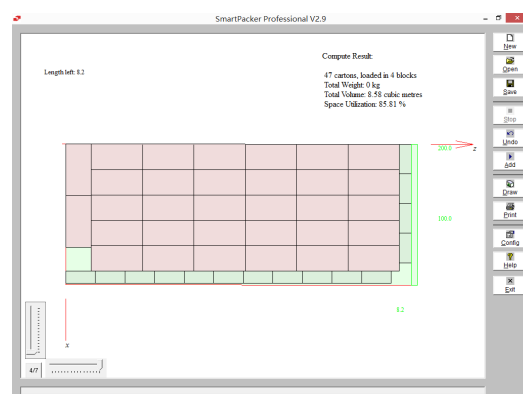
60 Input data like below:

- Set the space as 500 long and 200 wide to represent the material. Set an arbitrary number as space height, e.g. 100.
- Use  $73 \times 36$  for carton length & width, use 90 as carton height (less than space height), and get “Upside Up” checked.
- You may click “Bigger” to allow for materials loss in cutting.

Click “Compute” for “Maximum Number”



61 Rotate the illustration by drag the horizontal slider to the right most and vertical slider to the bottom most, and see how you can cut 32 pieces of  $73 \times 36$ .



62 Click “Add”, input  $42 \times 17 \times 90$  as carton size with “Upside Up” checked, set allowance as needed, and click “Compute” for “Maximum Number”: You can cut 15 pieces of  $42 \times 17$  after 32  $73 \times 36$ .

Comparing Step 62 and 61, you see SmartPacker adapted the layout of the 32  $73 \times 36$ , for cutting more  $42 \times 17$  pieces.