Altus Packaging Investigation Report

Executive Summary

Based on the current global logistic situation, it is clear that the price of wood is increasing and that the world is moving towards sustainable options. So multiple avenues of alternative packaging were explored in-depth. The four key factors that the packaging was assessed against were:

1. Ease of use
2. Environmental Impact
3. Protection
4. Price

Due to the nature of Windows & Doors extrusions, packaging becomes very complicated and challenging, each pack is very much unique. The key packaging material that came out on top was Corrugated Cardboard. The Cardboard is very simple to use, recieved good feedback from customers about protecting the metal, and the price compared to wood can be justified.

Particularly, the Corcel cardboard should be used, due to its energy-efficient process, compact machine design that solves the issue of blade tracking. It uses no heat and provides unique features of the end product. One particular feature made from the Coreboard permits vertical load due to the various thicknesses and strengths. The machine allows for the creation of different shapes embodiments made from Kraft paper, recycled in the order of 90 to 150 gsm or virgin e.g Triangular, Saw-tooth, or Trapezoidal. The advantage of forming triangular-shaped flutes has added strength in comparison to other shapes particularly against the compression along the length of a flute. Corcel machine is more environmentally friendly than current cardboard manufacturing practices which use a lot of heat and energy. Corcels machine have a smaller carbon foot print than traditional machines.

It is recommended to only use cardboard on franchises with reports of high damage. Wooden cases and Cardboard cases work hand in hand in the logistic industry currently and are both options suitable for different needs. We can see that Wood and corrugated cardboard both have roles to play in logistics. However, some arguments that cardboard cases are more environmentally friendly, safer or more versatile fall flat.

Packaging Matrix

Packaging	Ease of Use	Environmental Impact	Protection	Price	Total
Wood	Hard	Recyclable	Sufficient	Affordable	Sufficient
Polystyrene	Hard	Non-Recylable	Excellent	Affordable	Worse
Cardboard	Easy	Recyclable	Excellent	Affordable	Best
k-Pak	Easy	Recyclable	Non-Sufficient	Expensive	Worse
Returnable Bases	Hard	Non-Recyclable	Non-sufficient	Expensive	Worse

Method of forming single face corrugated board - CORCEL IP LIMITED (freepatentsonline.com)

Product
High density Polystyrene

Reason
The advantage of using polystyrene packaging is that they are easy to mold into a unique packaging shape and can cater to Altus window systems' various packing heights. Altus Te-Rapa has large variations of height in packaging which means that every case is different. This provides an engineering challenge. Investigating the correct material that can substitute wood in supporting a large amount of weight at any height variation. The conclusion that was drawn was a polystyrene grade that meets the 95 gm/l + density or more. While this makes it a difficult material to recycle, it then gives more incentive to re-use and develop an improved recycling capability. Unfortunately with the density required, recyclers have many stewardship concerns. The polystyrene is very hard and it jams most compression/mulching machines they use. Expol won't take any density higher than 45 gm/l for recycling.

Cost ($46.82 per case)

Current product developments

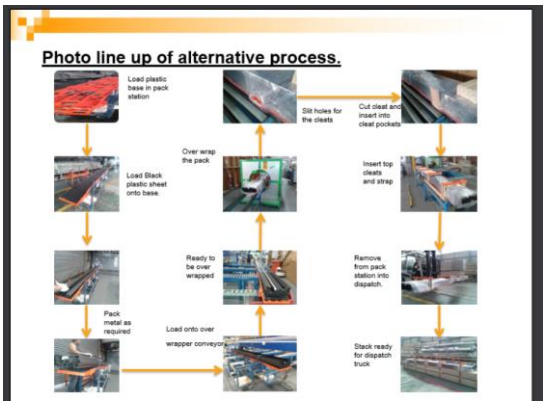
To future proof, this idea, the existing polystyrene molds and the process can be used with EPLA. A company called Zealafoam, based in Rotorua is in the process of scaling to meet production requirements. Zealafoam can make density up to 140 gm/l and provide a bio-degradable, recyclable, and more eco-friendly alternative to polystyrene while meeting similar physical properties. Currently, Zealafoam is still on trial. Part of the process requires pre-impregnation with Co2, and the total capacity for this is 76kg/hr that wouldn't even come close to being able to service Altus, even if Altus was at the front of the queue. The outlay for the pre-impregnation is in the range of NZD 750k ~1mil and will need 12 ~18months to get up in running, with some luck.

Product
Plastic/Aluminium bases

Reason
The plastic base is a good middle-ground for re-usability. The base is to be sent back while the wooden cleats are left to the customer to dispose of. We packed up a trial case to 130kg's. We found it to work but had some difficulties moving it on the conveyor belt. The wooden cleats had to be trimmed to fit in the slots. Some modifications would need to be made to the mold for it to work on our current system if we were to go down this path. The mold is currently located in New Zealand and is owned by Outwork Services. The idea was developed with Ulrich but was scrapped a year ago and the idea hasn't been developed further.

Cost ($59.75 for 4 plastic bases not including wood or aluminium)

Plastic bases with wooden cleats were done in 2014 specifically for Christchurch. This had a 2 year ROI. The bases lasted the required ROI duration but were not useable after 2 years due to the damage caused by transport. The plastic bases still used wooden cleats. The design of the bases meant that they were easily damaged. This idea hasn't been developed any further.



Cost ($116 base + $25.12 PP sheet not including wood).

Re-useable bases provide an advantage during the logistic route. The bases can easily be stacked in the mix of cases on the truck. This provides easy access.

Current Developments

According to Warren Tosse, Outworks have been approached by 2 other companies concerning reusable packaging. Currently, he is working on developing his current design and making improvements. The plastic base will be redesigned to be flat to work on the roller conveyor system. They are in the works to make adjustable telescopic side cleats using square/triangular pins that collapse down to keep everything together as one unit instead of pieces to make it more cost-effective to bring back.

An advantage of using re-usable bases in low-volume places, they can seamlessly fit in with the other packs in the trucks without being a hindrance. The final product has cardboard, overwrap, and a strap.

Conclusion

Re-usable bases are very prone to damage. With consistent logistic handling, a large number of bases will be damaged/unusable. The money would still have to be invested in cardboard and polystyrene to protect the metal from impact & vibrations.

Product

Reducing the Cost of wooden cleats

1. Reduce the length of the wooden base.

Trial 1

Conveyor Travel

To reduce the length of the runners and replace the strength with the over wrap. What we found was that during the stages of assembly an excess of tape had to be used to hold the metal onto the base cleat. While traveling along the conveyor, the weight of the metal would slide the cleat out of position. Previously the runners would keep the cleats in location during transport along the conveyor belt. This was a challenge aligning the cleat.

Over Wrapper

When the unsupported side cleat went into the over wrapper it slightly dropped before being caught by the wrap. This confirms that we need the runners in order to be assured that the cleat aligns in the correct place each time.

Storage

The over wrap seemed to act as a moisture barrier. This is found to be helpful by prolonging the cardboards life and exposure to the elements. My suggestion is to use a thicker over wrap perhaps with the company's logo.

Forklift handling

The forklift needed the middle runners to protect the metal from the forks. The ends of the runners were removed and the over wrap provided adequate strength holding the metal together.

Wrapping

2 cleats had strapping and the other two had screws and no strapping. The wrapping provided sufficient tension on the two cleats without strapping. Different thickness over wrap provide different weight load capability's and even more so when it's over wrapped. However one of the cleats was not stable and provided a lot of movement.

Thickness	2"-5" Banding	12"-20" Hand Grade	20" Machine Grade
37 Gauge	A pre-stretched eighty gauge film. Great for bundling two light uniform objects together. Users can easily apply the film with minimal exertion	A pre-stretched eighty gauge film. Great for wrapping light, uniform loads less than 800 lbs.	Due to the film being pre-stretched, pre-stretched rollers on a machine are not necessary. Excellent cost saver when wrapping light loads less than 800 lbs.
47 Gauge	Often referred to as a hybrid or equivalent bundling film. An excellent option for bundling heavier uniform objects. No products with sharp edges or corners	Often referred to as a hybrid or equivalent hand film. The film is stiffer and does not require much stretch from users. Excellent for box and case wrapping up to 1800 lbs.	Often referred to as a hybrid or equivalent machine film. A stiffer machine film that works great with most machines. Great for lighter boxes and loads less than 1800 lbs.
60 Gauge	Ideal for lighter, smaller objects, small boxes, and banding light items together. Many moving companies use light gauged banding stretch film in place of tape.	Ideal for loads up to approx. 1800 lbs. 12", 15", and 18" widths are ideal for shorter loads or loads where the bottom and top only need to be wrapped.	Same strength as 12"-20" hand Stretch wrap. Machines promote more efficient wrapping and reduce waste. The true gauged 60 gauge film offers excellent stretch during machine application.
63 Gauge	Often measured in microns, a 63 ga film is 16 microns. Thicker and better puncture resistance than 47 ga. Film. Bundle and wrap heavier products with minimal sharp edges.	Often measured in microns, a 63 ga film is 16 microns. Thicker and better puncture resistance than 47 ga wrap heavy loads of products up to 2200 lbs with minimal sharp edges.	Often measured in microns, a 63 ga film is 16 microns. Thicker and better puncture resistance than 47 ga. Most popular machine film for standard boxed pallets ranging up to 2200 lbs.
70 Gauge	The same uses as the 60 gauge but enables slightly stronger holding strength. Often used to bundle multiple long cylindrical products.	Ideal for loads up to approx. 2200-2400 lbs.12", 15", and 18" widths are ideal for shorter loads or loads where the bottom and top only need to be wrapped.	Same strength as 12"-20" hand Stretch wrap. Machines promote more efficient wrapping and reduce waste with premium stretch.
80 Gauge	The most common gauge in all stretch wrap. Known to be very versatile and handle a variety of applications.	Ideal for loads up to approx. 2200-2400 lbs. 80 gauge is the most common stretch film thickness and suitable for a variety of applications	Same strength as 12"-20" hand Stretch wrap. Machines promote more efficient wrapping and reduce waste.
90 Gauge	Better durability and stretch than a standard 80 gauge film. Used to wrap bundle firewood, angle iron, and a variety of other heavier objects	Ideal for loads up to approx. 2400-2600 lbs. 90 gauge is a starting thickness for a larger and heavier product wrapping. The 18" and 20" 90 gauge and above is ideal for taller or heavier loads.	Same strength as 12"-20" hand Stretch wrap. The ability to run with a higher tension with fewer tears. Excellent stretch rate and memory.
100 Gauge	Commonly used for larger boxes and products to bundle together. Medium-heavy boxes and medium-heavy items such as light lumber are ideal.	Ideal for loads up to approx 2800-3000 lbs. The 18" and 20" 100 gauge requires maximum exertion during hand application to achieve the proper stretch rate.	Same strength as 12"-20" hand Stretch wrap. The machine 100 gauge stretch film is often used to wrap pallets of 55-gallon drums, steel beams, and other heavy objects.
115 Gauge	Used for smaller heavy objects, commonly used for banding sets of heavy products together.	Ideal for loads up to approx. 3000-200 lbs. The 18" and 20" 115 gauge and above is ideal for taller or heavier loads	Same strength as 12"-20" hand Stretch wrap. The 115 gauge provides excellent stretch with limited tears.
150 Gauge	Greater strength and puncture resistance, great for regular and irregular shaped boxes. Ideal for securing steel, metal, and other heavy-duty items.	Not typically offered in a hand stretch film.	The heaviest cast machine stretch film offered. They are meant for heavy-duty pallet loads.

Conclusion

We found that the runners were necessary to provide accurate cleat placement during the assembly process and are necessary for making the assembly process consistent and efficient. The wrapping adds adequate support for the metal when wrapped even more so when wrapped more than once. From this trial we found that a base is necessary to make an efficient assembly & wrapping process.

Product

K-Pak reusable cleats

Advantage of reusable plastic

Altus Te-Rapa has many variations of height in packaging which means that every case is different. The advantage of using Plastic adjustable cleats is that they are strong, durable, sustainable, easy to assemble, and can cater to Altus Windows' various packaging heights. A company called Ozkor has developed a system called K-Pak where it is currently being implemented at Capral, Australia. A proposition is to work with Ozkor to fine-tune the operational model to accommodate Altus height variations. With an expected Australasian bubble, we can assume that supplies to meet Altus demand will be reliable and consistent in the foreseeable future.

The K-Pak solution is made out of PP (grade 5 resin). Due to the strength and durability of PP, the k-pak solution can hold 150kg-350kg of aluminum per case and is rated up to 1750 kg static load on the bottom case. They are easily stackable for transport when assembled. The base cleats come with a forklift lifting flange to protect the aluminum extrusion and bottom stacking location housings for the top stacking location points. The top and bottom both have a strapping channel, and the top has top stacking location points that are easily visible. The side cleats have a ratchet wall system that can be adjusted to suit the height required and location lugs for ease of assembly. They can be disassembled for ease of transport.

Logistics

It's important to provide a cost-efficient way of sending what is usable back to Altus using a robust, reliable product to transport the k-pak assemblies in. The Ozkor bins called Ozbins are collapsible bins are made out of PP (grade 5 resin). This density ensures the longevity of the products. The best Logistics solution will be to incorporate a closed-loop system with the customers. Smaller customers in the South Island, don't have much storage capacity. Using plastic collapsible bins means that they can be unassembled and stored using minimal space. They are stackable and can be moved using Forklifts. If customers send back k-Paks in collapsible for convenience to an Altus site, reusable packing becomes extremely cost-effective, while providing adequate protection. A door flap can be added for customers to bend over into the bin to collect them. 45 K-pak sets can fit into 1 Ozbin.

Cost - $33.5 AUD per assembly unit (400mm-240mm) Green = $134 per case

Cost - $AUD per assembly unit (240mm-144mm) Red

Cost - $ AUD per assembly unit (144mm-86.4mm) Blue

Cost - $468 AUD per Collapsible bins (45 K-Pak Assembly units a bin)
Int(1090mm x 1080mm x 635mm)
ext (1162mmx 1162mm x 780mm)

Heights

The immense height variations can be standardized using the K-Pak System. We have found the height variation of (240mm-400mm) to not meet a significant amount of the packaged height requirements due to the small job bundles. This happens to fall under the 240mm minimum height. According to the ratio (240/400=0.6) of 0.6, the height variation that is possible to make, fall between (86.4mm-144mm) and (144mm - 240mm). Combined, this would cover a significant amount of our package heights up to 96.67%% (table 2). On 8/04/2021 a random sample of packs addressed to the south island was measured. According to Figure 1. We found that about 1/3 of heights fell between 400mm-240mm, 1/3 of heights fell between 240mm-144mm and 1/3 of heights fell between 144mm-86.4mm (Table 1.). By having three different height variations, we can standardize our pack height variation.

Sizes	**Height Variation(mm)**	**Frequency (%) (South Island)**
1 = Large	(400-240)	35.83%
2 = Medium	(240-144)	32.50%
3 = Small	(144-86.4)	28.33%
NA	(0>86.4) or (400<∞)	3.33%

Table 1. Frequency of North and South island Height Variation in Te Rapa wooden packaging

Customer Driven

- Reduction in waste.

- Savings from reduced waste. Bradnams, Highbrook are paying $250 per tonne to get rid of - wood.

- Increase in storage space which means they will be able to organize and utilize all of the job sites.

- Improved usability, reducing the complexity of disassembly, making it simple for customers to take apart.

- The Ozbin solution can be folded reducing the transport cost for customers and increases storage efficiency.

Future Applications

Automation

With the advancement of automation and the reduced assembly complexity, the assembly process has the potential to be automated. Firstly, the cleats can be sorted from the different colors/labels using machine vision/color sensors. The colors help identify the correct sized cleat size for the bundle it assembles. The cleat can be inserted into the base with the use of a jig system since they are always the same. Due to the adjustability of the ratchet system on the cleat sidewalls, the cleat height can be adjusted using linear pneumatics on a jig with sensors.

Financial Justification

Speed

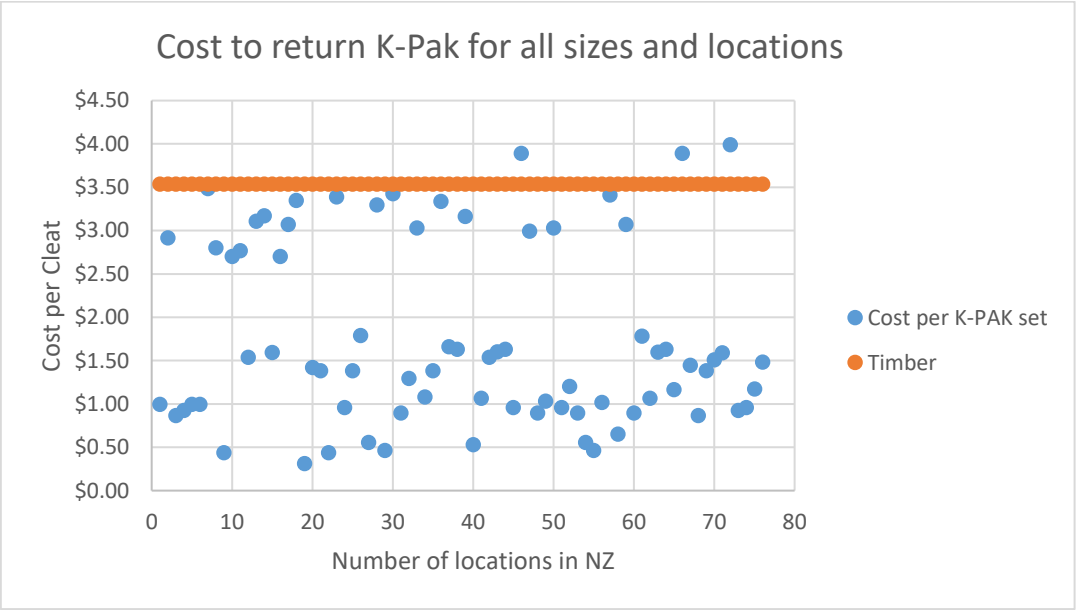
One of the advantages that can be realized is the increased speeds of packaging. With easier assembly, it is estimated that we can go higher than the current hourly rate of packages produced.

Durable

The benefit of using plastic is that it is long-lasting, strong, and very durable. Plastic also happens to be easily recyclable. This gives them the ability to re-use them for the foreseeable future which gives them enough time to be financially beneficial.

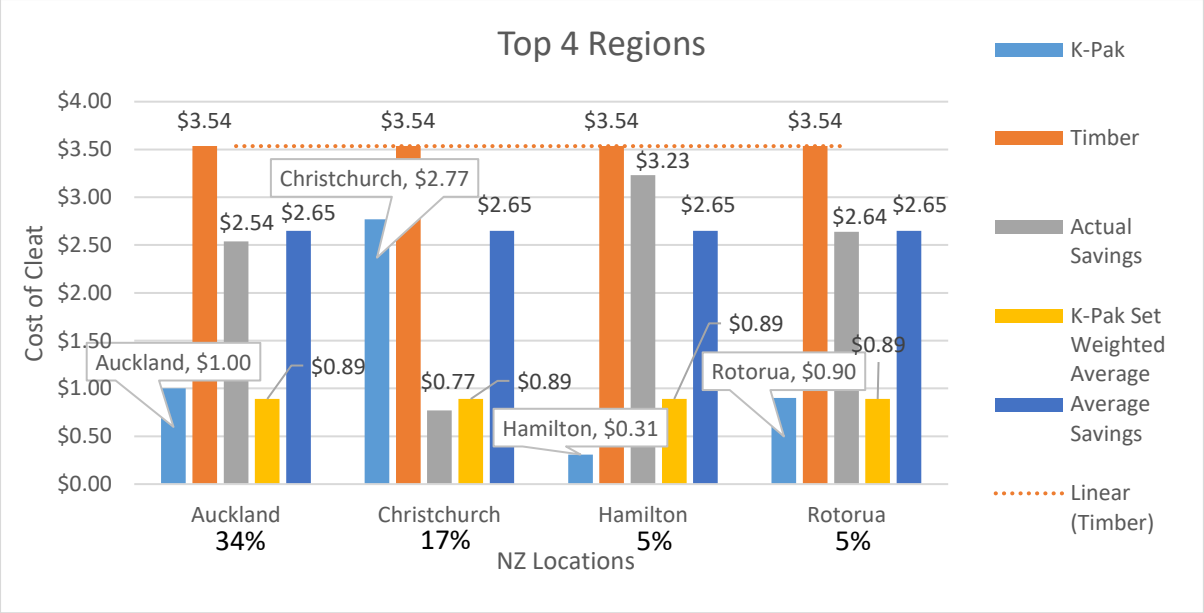
Cost effective

The cost of returning the K-Pak System is depended on the location it is in NZ. The majority of places in New Zealand make it extremely financially viable to use reusable packaging. The graph below shows the cost to return all K-Pak solutions. The orange line represents the cost of a wooden cleat. The blue dots represent the cost of each location to return the K-Pak. As you can see, there is a significant amount below the orange line ($3.54) making reusable packaging an extremely cost-effective practice.



Savings

Altus spent $509,000 on wood during the 2020 financial year. Altus could spend that investing in K-Paks and Ozbins to transition into reusable packaging. This will then eliminate the need to purchase timber entirely. The financial benefit of moving to re-usable cases makes it cheaper to pay the cost to ship back plastic cleats from franchises to Hamilton than buying wood over the long term. The graph below shows the cost of returning the K-Paks and using case wrapping compared to purchasing brand new wooden cleats each time.



When analyzing the top 4 regions in New Zealand with the highest tonnage allocation, we can see several things. Firstly each place has a large mixture of windows and doors and industrial. This graph is assuming that metal and metal merit skips were replaced with K-Pak.

Other savings

- Reduce the amount of labor required to assemble K-Pak.
- Reduced safety risk from the elimination of saw.
- Savings from disposal cost for Te-Rapa.
- Savings from disposal cost of franchises
- Work Towards ISO 14000 (Environmental Management System)

Operational Justification

K-Pak Roll out

By making rollouts for each city/fabricator at a time, we reduce the chance of K-paks going missing, educate our fabricators and reap the rewards as we roll out this system. Each city must roll out one at a time, firstly, Hamilton being most profitable being at 0.31 cents a pack. This method of rollout allows Altus to gradually move the K-Pak to customers with enough bins & K-Pak supplies to meet their demand. The roll-out process can be fine-tuned to work for each fabricator. Year after year Altus and fabricators can accumulate yearly savings from the K-Pak solution when this closed-loop process becomes efficient and optimized.

Training

Create assembly and disassembly instructions to make each fabricator aware of the change. This will guarantee that each fabricator and Te-Rapa packing team has the training and knowledge to gain all the benefits that reusable packaging provides. The key points that need to be taught are:

- Adjusting the side cleats correctly. (Pins)
- Assemble the K-Pak and packing it. (Strapping pressure)
- Disassembling the k-Pak.

- Storage.
- Shipping. (3PL)
- Arranging the K-Pak to optimize profits per unit for Altus.

Simplicity
Since the only moving part is the ratchet system, it speeds up the assembly process compared to wood. The system is less labor-intensive and tools don't need to be used. Jigs can be created to assist the assembly process which can be later automated.

Process
The stretch wrapper will need to be fully functional and operational in Te-Rapa. The case needs to be overwrapped with 50% overlap on the whole final assembly. This adds a lot of strength which helps support the aluminum while being lifted. This has been included in the cost of the K-Pak System.

Continuous improvement
With the trials, we will be able to see how the assembly behaves and how franchises react to it. We can test it by sending it down to each fabricator and back. This will indicate to us if plastic cleats protect the aluminum during transport and introduce the idea of re-usable packaging to each franchise. It is important to start the trials and get feedback from the packing teams and customers.

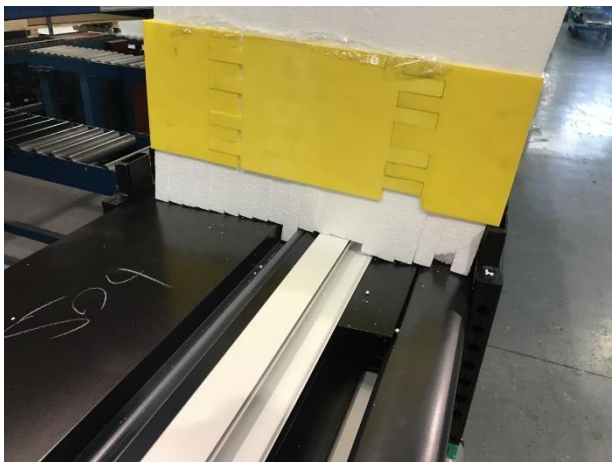
The customers have to be on board with this idea as this can only work if they are willing to send it back.

K-Pak Trial
Trial 1
Levelling the Top Cleat-
We have found that with our variations of Window & Door extrusions, it was difficult to adjust the side cleats all to the same height (getting it square). Under strapping pressure, the ratchet wall system gives way causing the top cleat to be on an angle. We also found that with a strike of a soft-headed hammer the side cleats give way.

Solution 1: Steel pins-
We have solved this problem of the ratchet wall collapsing by using 10mm steel/aluminium pins through the through holes in the ratchet wall system. The pin system levels out the top cleat and stops the side cleats from potentially collapsing. But, we don't want to be using pins as this becomes ineffective and costly since we are paying a premium for a ratchet wall system. We would much rather rely on the ratchet wall.

Solution 2: Polystyrene packing-

Mana from packing has developed a way to pack polystyrene more effectively. Instead of vertically packing the extrusions, mana developed the idea of packing the polystyrene vertically. Packing the polystyrene vertically means that each piece can fall in between the extrusions securing the variations of profile heights.



The polystyrene can be taped and cut using a hot knife on a jig the width & length of the extrusions.

Solution 3: Side cleat ratchet wall deeper Teeth & Groove-

For the K-Pak solutions to be viable, the ratchet wall system needs to be able to withstand 3500N of strapping pressure without collapsing. Currently, the ratchet wall is too shallow and is snapping out of position under the pressure of the strap. Is it possible to make the ratchet wall profile grooves deeper? This will ensure that we don't get any unevenness. This would also mean the teeth on the opposite would also have to be made bigger as well.

Side cleat clip tabs-

When the wrap covers the case, the side cleat clip tabs have a lot of pressure on them that they break through the wrap. Also, during the assembly process, they were dropped, and the side cleat clip tabs broke off. Perhaps this can be designed with the bottom cleat as a square button tab mechanism?

Overall the K-Pak packaging was easy to assemble but with these changes, it would work better for our windows & Doors packaging which is our main focus. We want the confidence that the

ratchet wall can hold up and withstand the strapper load and the large dynamic forces during the long truck drive to the south island.

Results

The current solution needs to be developed to have deeper teeth & grooves on the ratchet wall to provide Altus the confidence that the ratchet system can withstand the large forces from strapping. I also suggest the development of a hot knife jig for polystyrene and a pin system to provide confidence that the top cleat remains level. The issue of the ratchet wall collapsing is concerning and the only solution is a pin mechanism. The pin mechanism makes it possible to align the top cleat efficiently enough and provides adequate confidence that the side cleats will withstand the large dynamic and static forces. Extra money on the packaging would have to be spent to protect the packaging. The Windows & Doors extrusions couldn't be used on this solution because the ratchet wall doesn't provide sufficient amount of support to protect the metal.

Conclusion

There are two options with going forward with this idea:

1. Developing the K-pak system further with Ozkor in hopes that the ratchet wall system will work with the required strapping forces. This is costly, time-consuming and there are no guarantees. Nevertheless, we still have to spend money on cardboard, plastic overwrap, and polystyrene to protect the metal.

2. Removing the ratchet wall system entirely and developing our own telescopic pin side cleats that are collapsible and can be replaced with wood in case necessary. We still have to spend money on cardboard, plastic overwrap, and polystyrene to protect the metal. (Working with Warren Tosse from Outworks Central).

The common theme between the two solutions is that cardboard and overwrap are used. This means that Cardboard & polystyrene is protecting the Windows & Doors metal. I don't believe that the K-Pak solution will protect the metal adequately enough. There are only two strips of rubber on the base cleat which won't provide adequate protection of the metal extrusions. For uniform aluminium extrusions, K-Pak is adequate enough. It is about as equivalent as the current wood solution. The K-Pak solution, once modified, would work for places with low damage if a logistics chain solution was set up.

Other options considered that did not progress further:

Waste Powder Cleats:

The waste powder is currently being disposed of by the tonnage at Altus Te-Rapa VPL. After doing some Trials with an aluminum mold, baking it, and heating it into a brick. Tests have shown that it is very brittle and breaks very easily. I think there should be an investigation into using the waste powder for a similar application like this. There needs to be some sort of chemical process to make it denser and less brittle. This should still be investigated.

Cost (R&D+Mould+Process)

Corflute:

At the time, the core flute was potentially a substitute for cardboard. Corflute is water-resistant, durable in the weather, and could be potentially as strong as cardboard if the correct thickness could be met. Unfortunately after contacting modern plastics, 8mm is the thickest in stock which will not meet the strength requirements. For research purposes, 11x3mm sheets were glued together with PVA to mimic the 33mm sheet. Corflute turned out to be very oily and resulted in the bonds not sticking well. The corflute was not rigid enough and would bend under little pressure.

Cost ($9.63 for 900mmx600mmx3mm) - $317.79 for 900x600x33mm thick sheet not including glue or fabrication.

Aluminium:

While costs are low for aluminum as Altus extrudes it, fabrication costs aren't. There will need additional people to cut the cleats to size, more labor, and tooling costs. The metal case doesn't provide any absorption or protection without expensive polystyrene pads. The cost to repair them makes them expensive, overly complicated, and time-consuming. There is a lot of work required to design them to be collapsible.

Cost ($42.83 per case not including labour)

Product

Corcel corrugated cardboard + Machine

Reason

The current timber construction method of non-returnable or reusable / cases would rate very low in any review of Altus sustainability measures. The current timber construction method is unreliable in terms of its ability to withstand forklift handling, albeit with some improvement made since the shift to regional pallets and bulk transport. Customers have reported received broken packages from the wooden cleats collapsing under high load during logistic handling. There have also been reports of an excess build-up of wood and cardboard waste from Altus packaging causing storage issues at customer sites throughout the country. Potentially, timber is going to increase in price due to demand and influenced further by china raising tariffs on various supplies. H&S risks do exist in the current timber construction method due to the involvement of various tools.

Advantage of corrugated cardboard

Altus Te-Rapa has many variations of height in packaging which means that every case is different. The advantage of using Cardboard cleats & bases is that they are strong, durable, sustainable, easy to assemble, protect the metal during transport, and can cater to Altus Windows' various packaging heights. Corrugated cardboard acts as a structural cleat member and supplies adequate vibration absorption on the metal.

Ease of use

With a sticker adhesive on the sides, the cardboard side cleats can be placed on the cardboard base easily. This reduces the amount of handling time required to assemble the cleats compared to wood. Forklift drivers have reported that they can easily see the extrusions and damage has been reduced.

Environmental Impact

The advantage of cardboard is that we can use recycled Kraft Paper if it falls within the order of 90 to 150 - gsm. Cardboard is very environmentally friendly, safe for our environment, and is easily recycled. While the fabricators have to still pay rubbish removal costs, it is much easier to process than wood as there are no nails or strapping.

Protection

Fabricators have responded very positively towards cardboard. When dealing with customers in the south Island the extrusions must get protected during freight as it is very costly to replace damaged metal. Fabricators have reported that they have dropped the cardboard cases and that it protected the extrusions. During transport, cardboard seems to absorb vibrations.

Price

With the cost of wood going up, the cost of cardboard will indirectly go up to but this can be countered by purchasing the machine. If we can source a corrugated cardboard machine from Corcel, we will directly be able to keep costs down.

Advantages of corrugated cardboard machine from Corcel

A Company called Corcel have developed a special machine for forming single face corrugated board. To summarise the Corcel invention in simple terms, it provides a method of bonding sheet material to a corrugated sheet material using an automated process the method characterized by the steps of:

a) Applying adhesive in discrete amounts (droplets) to contact points of the corrugated sheet material

b) Holding the sheet materials until a bond is formed (Tension endless belt)

There are many reasons that the Corcel machine is beneficial:

- Saving in energy cost & lower carbon footprint compared to conventional corrugated cardboard machines
- Saving in costs of machinery (no boiler)
- Saving in space
- Improved safety
- Saving in consumption of adhesive

The size of the machine is scalable mainly because no heating apparatus is required. This allows the machine to be of a size suitable for installation and operation on the site. It also allows Altus to make packaging on Site. This provides savings to Altus as supply is controlled and there are no transport and handling costs from off-site production.

Waterproofing

With the spiral wrapper at Te Rapa, Hamilton, the whole assembly is covered in plastic making it a lot harder for water to get through. This has been tried and tested and has worked with trial packs to a customer in New Plymouth. Over wrapping is used in food packaging to keep moisture out.

Cardboard Height variation

Because of the immense height variation, a suggested solution is to standardize cardboard cleat heights.

Final Justification – Cardboard vs Re-usable Cleats

Re-Usable Cleats		***Corrugated Cardboard***	
Advantages	Disadvantages	Advantages	Disadvantages
Savings from Reducing waste	High initial Cost	Protects the Aluminium	High Cost than wood
Increase storage space & efficiency	Doesn't protect the Aluminium unless packed with cardboard	Improved assembly	Decrease Storage space
Improved assembly		No strap	Unusable after it gets wet
Future application for automation		Future application for automation	

Pay itself off		Reduction in labour	
Reduction of labour			

In conclusion, the re-usable cleats such as the K-Pak system would theoretically be a saving in the long run when looking at the individual costs of wood vs plastic but doesn't protect the metal as well as what the cardboard does.

The risk of delivering the aluminum extrusion without damage significantly outweighs any advantage the re-usable cleats may have. The consequence of delivering damaged metal has significant consequences in the production and supply chain. The cost to re-do the metal for our customers is expensive not just for Altus but it effects the customers, builders, fabricators, builders and contractors. The aim is to achieve a high quality of extrusion that is delivered on time, undamaged.

The current focus of Altus extrusion is to pack and deliver the Windows & Doors extrusion consistently and with the highest quality possible and corrugated cardboard meets these requirements. It is strong, protective, and easy to assemble.

There is a huge reliance on receiving the reusable packaging back from customers and after doing rough estimates, a lot of customers in the south island have such a low volume that they would most likely have too much or too little K-Paks to full an entire Ozbin. The time of accumulation does not meet the time deadline that we would need to get the cleats back by. This would mean we would be replenishing more K-Paks than we need to counter this issue. This would be disadvantageous towards cost savings. A solution with re-usable long bases with runners that could be back loaded, would work better in the South -Island instance. The long base runners could seamlessly go back into the truck on the trucking route where they would get dropped of and picked up at the same time due to the low volumes.

A separate contract would have to be made for the 3PL which means a heavy reliance on the logistics companies and the fabricators servicing us. The increase in costs could change the contract dynamics of freight causing delays and logistic issues. Because most of the volume is Auckland, we don't see the full benefits of a re-usable packaging system as most of the volume is transferred on merit skips which is a proven working system anyway. Changing to the K-Pak would mean an increase in cost due to the labor increase of assembly/disassembly, and packaging the Ozbin. While we eliminate the cost of purchasing wood, we bring in a bunch of unforeseen costs that are hard to measure and a heavy reliance on the customers to do our job to bring it back.

Import Cardboard vs Cardboard Machine

Cardboard machine		***Cardboard Import***	
Advantages	Disadvantages	Advantages	Disadvantages
Control Supply	High initial Cost	Cheap Prices	Uncontrolled Supply
No Transport & Handling costs	Responsible for Maintenance & Repair	No overhead costs	Transport & Handling Costs
Create to our own needs	Labour costs	No labour costs	Reliant on logistics
Competitive advantage			Unreliable quality

Will pay less in long run			Gets wet

Corrugated structure

Architects discovered the arch with the proper curve is the strongest way to span a given space with the most strength. The most common flute structures are C and B flute, 4.0mm and 3.2mm flute thickness respectively. Corrugated fiberboard is anisotropic; many of its properties are highly directional. For example, edge crush, bending stiffness, tensile, and surface characteristics are different, depending on the orientation to the flutes and the machine direction of manufacture.

The argument between purchasing a corrugated cardboard machine vs buying imported cardboard quickly comes into play since cardboard has been a proven solution. While purchasing a machine provides savings to Altus as supply is controlled and there are no transport and handling costs from off-site production. With the foreseen demand increasing it's expected that there might need to be an additional machinery. Implementing a machine in Te-Rapa would be a complicated task and leaves the Extrusion plant starved of space. In the case of Altus leasing a building, Altus would need most likely need more than one of the Corcel Machines in a building that can be run by a sole entity. This way it can run parallel to production and be an individual operation altogether. In case problems or maintenance happens imported cardboard can be kept as a backup supply at this site. Since we would be buying raw materials such as Kraft paper, we can adjust the final product to suit Altus and its unique packaging process. Additional features might have to be added such as lamination or waxing for waterproofing.

Recommendation

It is recommended to experiment with thick corrugated cardboard. Trials should be specifically targeted to places that have reported high rates of transport damage. The imported cardboard and trials should give us an indication if corrugated cardboard can be a long-term solution.

- Proven solution
- Strong
- Reduces freight damage according to shipments sent to Palmerston North ran by Evan

Hastings

- Easy to assemble/dispose
- Fully recyclable

Evan & Andrew found was that Cardboard works for New Plymouth that has reports of high damage.

Cardboard vs Wood Comparison

Cardboard		***Wood***	
Advantages	Disadvantages	Advantages	Disadvantages
Lighter	High Carbon Foot print	Last longer when exposed to elements	Complicated Construction process.
Prevents damage in targeted areas (New Plymouth)	Chemicals	Reused	

	Loose strength when exposed to moisture – Worker safety?	Handle complex shapes	
		Handle Stacking	

Environmental Impact wood vs corrugated cardboard

- Wooden cases are the best option environmentally. It's true that cardboard cases are lighter than wooden cases. But the life-cycle carbon footprint of a case is about a lot more than weight.

- The carbon footprint of manufacturing a cardboard case can be five times larger than manufacturing a comparable wooden case. Over the course of its life cycle, one ton of corrugated cardboard causes emissions amounting to 538 kg of CO2 equivalent, as a result of the efforts made by manufacturers of corrugated cardboard to minimize its environmental impact.

- A wooden case requires fewer chemicals to produce than a cardboard case.

- Wooden cases last longer than cardboard cases, especially when exposed to the elements. That means fewer of them need to be manufactured, saving energy.

- And the vast majority of wooden cases are reused or recycled.

Particularly, the Corcel cardboard stands good environmentally. It has a less environmental impact due to its energy-efficient process, compact machine design and ability to use recycled Kraft paper.

Versatility & Safety

- Wooden cases are used for a wide range of products. They're a flexible option that can handle complex needs, such as very heavy or irregularly shaped shipments.

- Wooden cases are suitable for a wide range of New Zealand's environmental conditions. In contrast, cardboard cases lose strength when exposed to moisture, and naturally lose strength over time. This can raise questions for worker safety.

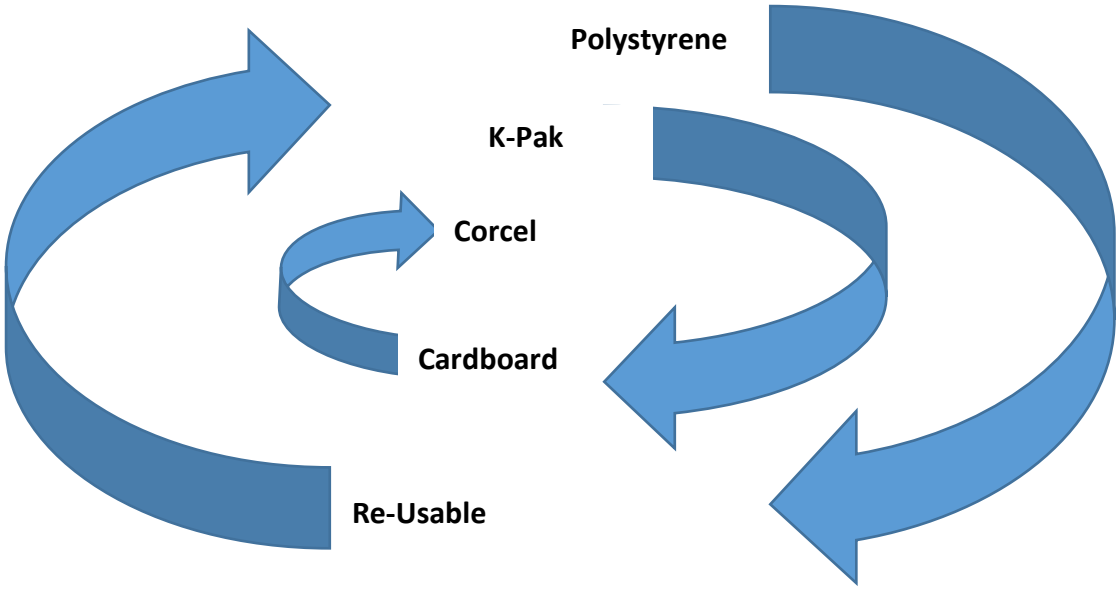
- Wooden cases can handle a wide range of support and racking conditions. Wooden cases can handle stacking; cardboard cases often cannot.

- Supply Chain Logistics is a complicated and intricate national web of distribution centres, trucking and warehouse hubs that span the country. Even a small untested change could be disastrous to human life and safety at the speed of movement of goods from manufacturer to retailer to customer.

Conclusion

Wooden cases and Cardboard cases work hand in hand in the logistic industry currently and are both options suitable for different needs. No one option is a one-fix-solution. Logistic damage mainly occurs when cases are not packed correctly rather than from the material itself. Education on how to pack and what to pack with is the key answer:
Altus needs to listen to the customers with high complaints and pack the cases to offer more protection for those that suffer high logistic damage. While cardboard might be the answer for everything, it currently works in New Plymouth but might not necessary be the answer for another city with high damage. Fully transitioning to cardboard poses a greater environmental impact than wood and also poses logistic & health and safety challenges. It is recommended to only target franchises with high damage rates.

Analysis Cycle



Cardboard packaging trials

To reduce packaging and transport damage, decrease cost of packaging materials.

Aim:

To pack two cases using cardboard style packaging using our standard pack line and dispatch the cases on a round trip to a customer's location which are prone to scratches/scuffs/transport damage. Inspecting these on return we would hope to see a decrease in all round damage and integrity of the pack style itself.

Method:

Find the top 8 franchises that have recorded the most amount of NCR's. Replace the wood cases with the cardboard cases and wrap.

Document Date (Year)	Document Date (Month)	Bradnams Wellington	Bradnams CHCH	Nulook Solutions Nelson	Nulook New Plymouth	Nu-Look Wanganui Ltd	Stellar Doors - Altus NZ	Bradnams Rotorua	Windows 2000 Mangere	Nulook Cambridge	Rylock Auckland	Nulook Tasman Bay	Gateway Glass & Aluminium Ltd	Nulook North Harbour	Nebulite Auckland	Nulook North	Nulook East
2020	Jul	7	5	4	2	5	12	5		4		6	4			2	3
	Aug	15	6	1	3	3	3	4		1		2		1		2	1
	Sep	7	6	2	6		2		3	2			1	3		2	5
	Oct	7	6	7	9	2	2	5	4	4		2	4	1		2	2
	Nov	14	4	7	7	8	3	4	9	1		2	6	5		1	6
	Dec	10	11	7	2	3	1	2	4	3		6	1	3		2	1
2021	Jan	3	8	3	5	4	3	1	1	5			7	5		2	
	Feb	3	8	6	4	1		7	5	9	3	2	1	3		1	1
	Mar	5	10	6	3	6	7	4	4	3	7	4	2	3		3	
	Apr	4	8	5	3	7	7	5	2	2	11					2	1
	May	5	8	4	6	4	4	2	5	2	11	7	4	4	23	3	2
	Jun			3	1	1			1		2				1		
Grand Total		80	80	55	51	44	44	39	38	36	34	31	30	28	24	22	22

Based on the NCR's we can see that generally the further the aluminium travels the greater the defects that occur. What's an outlier is Bradnams Rotorua receiving a high number of defects. Bradnams Rotorua focus on high-spec homes. This would be a good indication to see if using corrugated cardboard reduces the amount of NCR's.

Cardboard Trials

Send 5 packs to Rotorua Bradnams, document the whole process.

Packaging

The pack located on the top has been outside in the rain exposed to the elements for 5 months. The rain has found gaps in the cardboard causing some areas to get wet. The case below it was left in the rain for 1 week and was completely unaffected from the elements. The cases below it were made the previous day and had been sitting outside for a little over a day.

Loading the truck was found to be simple and easy for the forklift driver. The cases were rigid, strong and supported its own weight.

Delivery Rotorua

On delivery, the cardboard cases held up sufficiently with minimal movement. Due to the over wrap plastic providing sufficient grip during transport the cases did not move from its initial position. Bradnams Rotorua took positively to the cardboard case trials and encouraged the idea. They found that the wooden bases took up too much room and when asked the question to Bradnams Rotorua about reusable bases they said they had no space to put them and preferred if they could bin the cardboard. The bases are left on the street in hopes people pick them up as firewood or are cleared out weekly. In regards to backloading- the truck driver said that he didn't have any space and is giving him extra handling work when he already drives the forklift to unload himself.

Inspection upon arrival

Damage

The places that seemed to take the most damage were the underside of the bases and the side cleats.

The most places that water absorption occurs seems to be the corners of the bases and where the forks press against on the underside. It was found that the cardboard cases worked with a positive results.

Compared to the wood cases

According to the truck driver, large cases like this are incredibly hard to unload at some franchises that don't have forklifts. In one particular situation he said they had to unload it by hand and so used straps to lower the large case from the top shelf. This is extremely dangerous especially for the

Mainfreight driver. When the larger case is at the top it cases extreme pressure on the runners causing flex. Bradnmas Rotorua have said they have a large amount of reports of twist on the mullion fins and other extrusions.

When packing larger cases in the middle, flex on the bottom runners occur. Each case contains different extrusions, the case height does not relate to the weight. Just because one case is bigger does not mean it weighs more and so stacking from largest to smallest isn't necessary correct.

The flex on the bottom runners was caused by an excess of weight from an overweight case packed at the top. The case that was larger had a large amount of polystyrene in it in order to keep it rigid. It also started falling sideways as he started lifting the cases. The truck driver said taller cases are more likely to tip regardless of wood or cardboard.

Wooden cases on top of skips

When the correct wooden jigs aren't used, the cases tend to fall onto the metal in the metal skip. The bases usually go on top upside down but since most aren't straight they don't use them so a jig either has to be cut or supplied. In this case the truck driver only used one jig and was just balancing on the skip.

Cardboard Arrival back to Te Rapa

Upon arrival, the cases were all in one piece, with the biggest damage occurring on the side cleat. The cardboard on the side cleat

Results

Wood vs Cardboard

- Due to the over wrap, the rigidity of the cardboard bases improve.
- The cardboard protects the sides of the metal and prevents damage.
- The cases tend to be smaller which is safer for forklift operators and franchises to handle.
- Smaller cases are less likely to tip while forklift drivers are unloading.
- Cardboard can be disposed of at franchise sites improving available space on site.
- Cardboard cases don't require any polystyrene for support.
- Pyramid style packing is easier for beginner packers to pack in the pyramid style packing.
- Cardboard cases can be mixed with wooden cases and implemented on the current VPL packaging line.
- Cardboard bases can fit on top of metal skips so there is no need for a jig.
- Absorbs road vibrations in rural NZ roads.

Previous Trials

Document Date (Year)	Document Date (Month)	07 Dents / scratches	08 Paint inclusions / Grit	Defective finish Paint	08 Poor coverage	Wrong Section	08 Orange peel	Poor Packaging	08 Die lines	06 Goods invoiced not received	Inclusion Swarf	Shape defect	08 Contamination	Forklift Damage	06 Rib marks	Dimensional defect	08 Jig/Rack marks	07 Ripples	Anodising Fault	Wrong Length	Defective finish Anodising	Lost Metal	08 Colour variation	07 Twist	03 Incorrect Order Entry	08 Water marks	06 Incorrect count / Short delivery	07 Dimensional	Total
2020	Jul	2	5		1				1															1					10
	Aug	3	7				1																		1				12
	Sep	6	9		1		4	1		2																	1		24
	Oct	9	6			3			1								2			1			1						23
	Nov	7	2		1				2	1												1							14
	Dec	2	1															1										1	5
2021	Jan	5	1		3							1		2	1				1										14
	Feb	4	2		1						2		1		1														11
	Mar	3		2		1		1			1	1	1																10
	Apr	3	1	4	1			1																		1			11
	May	6		6	1	1		1				1				2					1								19
	Jun	4		2	1																								7
Grand Total		54	34	14	10	5	5	4	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	160

Evan and Andrew have been sending down cardboard cases to New Plymouth for the duration of 1 month (May 17 – June 17).

What's next?

- Establish 4.5m bases with double sided taped already applied along the base of the cardboard bases.
- Trial out Cardboard at Bradnam's Rotorua for 1 month. On average there are 3.25 NCR's per month. To reduce the amount of NCR'S in Bradnams' Rotorura.