

TECHNOLOGICAL PRACTICE CASE STUDY

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HARD MATERIALS TECHNOLOGY

YEARS

1-6

7-10

11-13


CUSTOM CLASSROOM FURNITURE

In 2005, Hawke's Bay classroom furniture manufacturer Furnware introduced a new Bodyfurn range which included a new student desk and the dynamic chair in a range of sizes. The increased size of the desktop opened the opportunity to later develop a clip-on side storage unit for the desk. The new range was developed through extensive initial market and end-user research and ongoing stakeholder consultation and testing and trialling. Because of this direct relationship with their customer base, marketing of new products began at the early development stage. After a look at the initial concept development of the range, this case study focuses on the development, manufacture and marketing of the side storage unit. It also looks briefly at the changes that Furnware have made to implement their core values in terms of environmental sustainability.

DISCUSSION POINTS INCLUDE:
Outcome development and evaluation:

The creative generation of design ideas and the refinement of potential outcomes through ongoing research, experimentation, analysis, testing, and evaluation.

Technological modelling:

Developments based on evaluation of functional modelling undertaken during practice, and prior to the realisation of the outcome. Refinement of realised technological outcome informed by evaluations from prototype testing in situ, to optimise its fitness for purpose.

Technological Products:

Properties of materials and performance attributes

Characteristics of technological outcomes:

Fitness for purpose in its broadest sense

ADDITIONAL LINKS

www.bodyfurn.co.nz

www.furnware.co.nz

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CUSTOM CLASSROOM FURNITURE

Identifying a need

In the early 2000s, Massey University released a study on classroom furniture that showed that the desks and chairs used by New Zealand school students didn't suit their needs – 96% were the wrong height and 56% the wrong depth. Already well aware of the issues, Hawke's Bay classroom furniture manufacturer Furnware were doing their own research, both in New Zealand and overseas.

"We looked around the world to see what was happening," said then Furnware Ambassador Pat Kane. "There were draft standards at that time and a system for getting kids into the right sized furniture, but nobody used it because of the preference of schools that everything be of a standard size."

Worldwide, as in New Zealand, the main criteria for classroom furniture were price, durability and stackability. Some suppliers were, for example, reducing the gauge of the metal to make the chairs lighter, but of a lesser quality – because they looked the same to the schools the cheapest quote would win, said Pat.

"At Furnware, we were asking: Was this being fair to the kids, to have them sit for 13 years on furniture that cost \$35? Would adults, for example, be prepared to sit on such low quality furniture for such a long time?"

Furnware decided to put together a series of focus groups of school managers and teachers, to see if they thought it feasible to have different sized furniture in their classrooms, and trialled such furniture in some classrooms.

The results were immediate and profound – with a marked improvement in class behaviour and far fewer interruptions. "The schools were absolutely staggered at the difference that having kids in the right-sized furniture made. What had been interpreted as behaviour issues were suddenly understood for what they were – comfort issues."

Students engaged immediately because they were being listened to and their needs respected, said Pat. "When we gave the kids the

background and explained all the research, they bought into it right away. They just loved it – someone's really been thinking about *them*. And this improved the relationship between the teacher and the students – there was a feeling of greater mutual respect."

Furnware's research uncovered an interesting study being done by Dieter Breithecker which involved two similar schools – one in Germany and one in Belgium – and demonstrated that if you could get students moving more, their productivity improved.

So the challenge was there for the Furnware designers – could they come up with different sized desks and a 'dynamic chair', one with a pivoted seat and back so the student could move comfortably without having to lean back dangerously on the chair. The new designs were to solve as many other shortcomings of the current desk and chair designs as possible, informed by feedback from focus groups of property managers and caretakers.

Furnware then undertook a massive data-gathering programme. They measured about 19,000 students, aiming to get a representative sample of 50 in each 'cell' from Year 0 through to Year 13 – a cell being, for example, Samoan boys in Year 4, or Maori girls in Year 8. The data gave the company a profile for every classroom in the country, based on the year level and the ethnic/gender mix of the students. They then worked out the product mix that suited a specific classroom.

Principals appreciated what Furnware were trying to do and how helpful it could be to them, and were very quick to offer to participate in the research, said Pat. "They were really very helpful in allowing us into their schools to measure the students. In the end we were able to measure one student in seven seconds. There were two of us moving around the country doing it, so it was quite an involved process."

In 2005, Furnware introduced their new range called Bodyfurn, which included a new student desk and the dynamic chair, in a range of sizes. The increased size of the desktop opened the opportunity to later develop a clip-on side storage unit for the desk. This case study follows the development of the clip-on side storage unit, from concept development through to manufacture and marketing.

BODYFURN SIDE STORAGE UNIT

Concept development

In the move away from the box-style desk, Furnware needed to come up with an alternative personal storage options. The company did a number of trials of storage systems in classrooms using existing space and found that using two or three tote-trays at different points in the room worked well. They subsequently commissioned a study through Waikato University. The study found that using tote-trays this way saved 25% in the time required to access these materials.

“We felt well-supported in our observations, but consumer preference was for storage at the desk site,” said Pat. “There was a mind-set that students had to stay at their desks, particularly in Year 4-8 classrooms. Some schools had book bags made for the junior students to hang over the chair – that worked for little kids but not the older ones.”

Subsequent research on the ideal size of desktops led the company to increase their size, which gave an opportunity for a novel solution to the issue: “There was now an overlap – maybe we could put some storage down the side”.

Pat set up focus groups of teachers and a development class – the Year 7/8s at Peterhead School in Flaxmere, a decile 1 school close to the Furnware factory

– to test out some ideas. After introducing the side storage concept – and all agreed that it was a good idea – Pat asked the students about their existing systems to help refine the concept to accommodate things that were important to them. “An immediate issue was the security of pens and pencils – they nearly all kept them hidden on a ledge on the frame under the desk, something the teachers didn’t realise.”

To find out what the students needed to store, Pat then took what they had in their tote trays and removed what they didn’t need, which turned out to be about half. “We were looking to accommodate standardised stuff (the tallest item being a scrapbook) to fix the size of the unit. We ignored items that can be unpredictable sizes, such as library books, for which there had to be a separate way of managing in the classroom.”

Over the ensuing year, Pat progressively presented the students a series of mock-ups. “We started off with a detachable cardboard box – the students liked that idea because they could to pick it up and move it around the room. After one day with it, they decided it was no good because there was nowhere to store pens and pencils. So I took the boxes away and we made cardboard dividers to divide off a portion of the box.”



An historic snapshot – the New Zealand school desk



The increased size of the new desktop created the opportunity to explore the concept of a side storage unit.

FURNWARE'S PRODUCT DEVELOPMENT

CONCEPT DEVELOPMENT

1

Market opportunity

- + Will it meet a need?
- + Will it improve things significantly?

Ergonomics

- + Is it user friendly?
- + Is it physically safe for the user?
- + Is it friendly in the wider context, e.g. classroom?

Client engagement

- + Focus groups, open discussions, directed discussions
- + Listen, listen, listen,

- and listen again
- + Prototype and test

Fitness for Purpose

- + Does it solve a problem for the users?
- + Does it meet their needs?

Efficiency/effectiveness

- + Does it make life simpler?

Optimisation

- + There will be trade-offs, so need to prioritise

Pat moved on to MDF models and the students found that the position on the desk was critical: too close and it got in the way, and too far back it was difficult to reach. “So we made sliding units that you could pull towards you to get things, then push back out of the way.”

“The final concept was developed like that – the design team weren’t involved in this process yet. I was very keen to push it through as I could see two things about it – it would be a saleable product on its own, and it would facilitate the sale of desks and systems. And that’s actually been happening.”

BODYFURN SIDE STORAGE UNIT

Design

It was only after extensive consumer testing and feedback, the ideas were ready to be put to a design team at Furnware. The design group included a range of expertise from across the company, to provide a mix of different ways of thinking, "After the relatively inexpensive process of concept development, this is when it starts to get costly, and becomes a real commitment for the company," said Pat.



Early MDF functional model

The team looked at the concept, discussing its viability and asking what could be done differently to improve it.

While investigating the sliding mechanism, Furnware Operations Manager Steve Halpin came up with the idea of it tilting forward at the same time. "That's probably the stage where I became really involved in the design process," he said. "It was the first point where I'd got involved from a practical point of view." An MDF model of it was made and shown to the students, who really liked that idea. "We had to come up with a way to mount it to the desk," said Steve. "We used drawer runners initially, and we tried telescopic drawer runners but they would be too expensive. Then we came up with the idea where we split the pins and had the back one dropping down. That was where we got quite excited with it – it had real potential!"

A contract designer, Murray, had also been employed. "We challenged his ideas and also he could challenge ours, so that was a good process," said Steve. "For example, at one point Murray designed a rapid prototype based on our ideas that we could pull apart and find out what we had to alter," said Steve. "We decided on a release mechanism to detach the storage box from the desk, there had to be a handle to pull it out, which needed a hole in it to see the books through, and a place to put the ruler. All of those little things came out of the design meetings. I can't say who came up with what – it really was a team effort."



Final MDF functional model

– and the consumer implications of those choices. "When we showed the kids the first plastic one, they thought it looked flash compared to all the rough stuff they'd been working with. But when they came to use it they quickly found what would work and what wouldn't.

"I was surprised how quickly they overcame the superficial and looked for the more practical considerations. They became very involved in the whole process, and were critical to its overall success of the product. I can't speak highly enough of the value of that student input."

Finally, a rough physical model of the storage units was approved by the design group as a concept that Furnware could commit to. "This is the final design phase," said Steve. "The final design ideas, final decisions about whether it was going to be steel or plastic or wood, how we were going to make the pins. Then we had to look at the production considerations – things like finalising the construction materials. At this stage we had the business managers, financial manager, production manager, marketing manager and the designer all involved."

The whole process from concept to the final prototype for manufacture took about four months.

Throughout the entire design process, student feedback continued to be essential. "We kept referring things back to the 'experts' – the kids – who would say things like 'That's a stupid idea' or 'That really doesn't matter'. So the design team focused on the best elements by constantly referring back to this group, and also by trialling it in eight other classes."

Part of this stage was to examine the materials – whether it would be pressed metal and/or plastic

FURNWARE'S PRODUCT DEVELOPMENT

DESIGN

Functionality

- + Does it meet the findings of the concept development process
- + Durability - will it stand up to warranty expectations

Codes of Practice

- + External, such as industry guidelines
- + Internal, such as own company's philosophy *
- + Environmental considerations

Legal Requirements

- + Must do's

Packaging and transportation

- + Protection of the product
- + Ability to stack efficiently

Prototyping

- + Refinement of concept prototyping (above)

Testing

- + In market trials and feedback
- + Making improvements

Brand fit

- + Does it fit fully with brand expectations?
- + Does it enhance the brand?
- + Are there design links with other products in the brand?

Materials selection

- + For efficiency, cost, durability
- + For brand consistency
- + Availability of materials on an ongoing basis

Aesthetics

- + Is it pleasing to the eye?
- + What colours are appropriate?
- + Does it fit the brand?

2

BODYFURN SIDE STORAGE UNIT Production planning



The next stage for Furnware was deciding how to manufacture the unit efficiently. Getting a prototype to the final manufactured product is a big responsibility said Steve.

“At this point you start investing time and money into materials. If you’re still just talking, things it can be changed quite easily, whereas from now on, if you get it wrong, there’s a large cost. And that’s my responsibility – I’m the one that has to say ‘Yes we should move with this tool!’.”

Generally Furnware products are made on-site, mostly from raw materials such as tubular steel and MDF. The

only outsourced manufactured items are

the general assembly components such as wheels, castors, plastic plugs and hinges, and commissioned injection-moulded plastic items for seat shells and the side storage unit.

Furnware contracted Wanganui company Axiam to injection-mould the plastic components which make up the side storage unit, and they were involved in the decision-making and design of the tools to make them.

“Once Murray had done his first conceptual design and we’d ironed out the issues and got all the little additional pieces put into it – like the clip and the release mechanism – we got Axiam to run through and to look at plastics. They gave us good feedback on our design moulds and costs etc. Part of the role was to help us with information about designing tools, shrinkage of plastics, and which materials would best suit us. A lot of time was spent going back and forward using Murray’s 3D models, with Axiam’s involvement about how it would effect their tooling and the size of their machines, etc, until we got to the point of signing off on the manufacture of the tools.”

“For manufacturing, we looked at splitting the top half of the box in two and realised that we had potential to make the box slide in. This was desirable, but there was an extra cost – an extra tool, assembly time, screws, etc. We went

back and analysed it and Murray came up with an idea where he castellated parts of the injection moulding tool we were designing, which gave us a simple solution for what we wanted and saved us a lot of tooling money.

Steve went to Axiam’s Wanganui factory to help test and fine tune it. “For example, we’d calculated the energy required to snap off the box, but when I tested the clip, the box came off too easily. So I spent a few days going through the method to fine-tune the tool so it made the clip strong enough. I also went through some production issues, like how to get rid of the little sprag that gets left in the tool.”

Steve said these sorts of issues occur in every new job and some don’t become apparent until you’ve started working with the materials.

“For example the handle was made of the same material as the rest of the unit, but it was giving us too much flex and didn’t look strong enough, and the clips weren’t rigid enough. So we ended up changing the material and added a component of glass-filled nylon to the clips. This caused another issue: the shrinkage factor of glass-filled nylon is less than the plastic. So we then had to make a modification to the tool to allow for this lack of shrinkage.”



FURNWARE’S PRODUCT DEVELOPMENT

PRODUCTION

People/Labour

- + Availability of skills required
- + Production time per unit
- + Assembly time per unit
- + Packaging and dispatch time

Tooling

- + Major tools to be built
- + Templates
- + Jigs
- + Special tools, e.g. for assembly

Other resources

- + Processing capabilities, e.g. painting or powder coating
- + Factory space

Outsourcing

- + Can someone else do parts of the process for us?

Costs

- + Can we keep the total cost within the target?
- + How many sales are required to recover the development cost?
- + How long will it take to recover the costs?

BODYFURN SIDE STORAGE UNIT

Manufacturing

By the time manufacturing of the side storage units began, Furnware had already sold 1,000 units. Normally the company would do a trial production, but they had already trialled 30 test samples in a classroom. “Because of the process we’d gone through, we were extremely confident with what we had, so we went ahead and made that first 1,000 units,” said Steve.

Standard production time for Furnware products is three weeks, as the company needs time to: process the orders; order in materials, some of which has a long lead time (the MDF for the desks has a five day turn-around); do any drawings/plans of special items; a five day cycle of production from machining to assembly; and then dispatch. However, the manufacturing time for a side storage unit is literally a day or less, as it’s only a matter of minutes to put one together and screw it to a desk.

Furnware orders the components in lots of 500 – the plastic ones from Axiam and the steel from a local company that laser-cuts and folds the steel. The only in-house manufacturing is the powder-coating of the steel – which can be done in lots of between 100 and 500 units – and assembly.

To ensure that they do not run out of components, the factory uses a kanban system. The kanban (Japanese: literally ‘visual card’) system is a card inventory system used in manufacturing plants to ensure a continuous supply of components while minimising overstocking. The system was first introduced by Toyota in their main plant machine shop in 1953. At Furnware, trolleys are used, each of which holds 60 units – whenever they are half empty they are replenished.

The Furnware factory itself normally runs on a 10-day production turn-around. Twice a day – at 8am and 12 noon – orders come from the front office to the leader of the production team who does the production planning. The production team works through these orders within the four-hour period to produce the Bill of Materials, which lists the costings for materials and labour and methods of assembly and dispatch.

An information sheet listing the jobs to be placed is sent to the planner, who plans the next appropriate time for the jobs to be done within the following ten days. About three to four days before the assembly date, the job will start

to be machined or assembled. Two teams – the steel department and the panel department – have a daily link that makes sure that they’re both on track, so that the product arrives back to the production team leader on the day that he designated, so that it can be assembled on the due date.

“Things can be done quicker than ten days,” said Steve, “but that may mean taking something out of our plan if we have a fully loaded workshop. However, if there are gaps, it’s quite easy to fit something in. If I needed Bodyfurn chairs dispatched quickly, there’s no reason why I couldn’t place an order at 10am and have them dispatched at 10am the next day if I really had to – our robots can punch out 100 items a day. This is because we have a lot of plastic in stock – we order them in lots of 1,000.”

“The only thing that holds us up is the desktop material – we don’t keep any in stock as the we have a kanban system agreed with the manufacturer, which means we carry a lot less stock and that saves us – and ultimately the customer – a lot of money.



Cutting and drilling of the panels is done automatically by computer-controlled cutters on a large flat-bed machine.



Powder coating is done at the Furnware factory – a dry powder is sprayed alongside the unit and is attracted on to the surfaces using electrostatic forces.

STAFF AT FURNWARE

Furnware has staff with roles in: procurement; drawing design; programming the CNC (computer numeric control) machines; dispatch and finishing of job cards; general office administration; health and safety staff; team leading – one each for the steel department, the panel department and for planning and final assembly; manufacturing at different skill levels – tradesman in the joinery department, welders in the steel department, people who cut and process steel, and who run the robots.

“As a company we’re getting more flexible,” said Steve. “We don’t want manufacturing staff who can only do one task – that can trip us up badly – so we get them to sign off on more than one process.”

Furnware also has new employees who come to us with no previous skills, who, with experience on the job, can move up to doing anything in the factory. “We try quite hard to give school-leavers a good chance, but in the times when our staff retention is very high, there aren’t many opportunities.”

The best way for students to get into Furnware is by taking a holiday job. Furnware employs up to 15 students – either university students or school-leavers over their busy period. “In school-leavers we’re looking at attitude. Employers tend to employ on skill and knowledge – the things you can see – and for a school-leaver it may be about marks. At Furnware, we’re looking for people who can come in and take ownership of the task, feel that its theirs and see it through to completion.”

MANUFACTURING AT FURNWARE

Factory Tour 1



1 Steel is delivered to the steel storage bay, before it is cut, bent, welded, cleaned and powder coated.



4 Holes for various components are punched or drilled in the metal.



7 The pieces to be welded for a desk being set up in a jig. Pat: "Making a jig is quite an involved process, so if something changes it has to be really well thought through."



10 The cleaned units ready for powder coating.



2 Pat Kane: "We've got a good supply chain and there's a lot of cooperation between industries, which improves efficiencies enormously. For example much of the tubular steel is now supplied by our various suppliers in exact length cuts."



5 The welding bay – components stored in numbered and colour coded batches.



8 Pat: "An entire desk-worth of pieces goes straight to the machine, which is programmed to go round and weld the bits together."



11 In powder coating, a dry powder is sprayed alongside the unit and is attracted on to the surfaces using electrostatic forces.



3 Lengths of tubing being cut and bent.



6 Furnware has two welding robots Pat: "Robotic welding gives consistently high quality welds – you don't get the little bits and pieces that you tend to have with a hand welded product."



9 Before powder coating, the metal has to be completely cleaned or else the powder coat doesn't bond properly, so the welded units are cleaned in a three-step immersion process.



12 After powder coating the units are baked in the paint drier.

MANUFACTURING AT FURNWARE

Factory Tour 2



13 After baking the units have an anti-graffiti glaze put on them.



16 Each panel is labelled when done – with job number, part name, etc – to facilitate assembly.



19 The assembly area where the stocks are kept ready for assembly.



22 The main body is then fixed into the slider mechanism to complete the side storage unit.



14 The panel factory. Pat: "Its all wood, mainly MDF, and we don't keep a huge amount of stock."



17 The edge banding machine runs an PVC edge around the cut MDF panels. It applies hot melt to the tape as it is rolled on to the edges, and trims the tape. Pat: "It's a New Zealand design, computer-controlled and very reliable."



20 The side storage unit is assembled here – the part shown screws onto the desk. The metal is laser cut and pressed into shape by a subcontractor and is powder coated at the Furnware factory.



23 Furnware's dispatch area. Pat: "If you were standing here at the end of January there would be five big furniture trucks lined up, with stuff just pouring out of here as fast as we can get it away."



15 The cutting and drilling is done automatically by computer-controlled cutters on a large flat-bed machine.



18 Furnware also do more specialised, custom-built work. "We've got a very clever carpenter who does some beautiful work with timbers – boardroom tables and stuff like that."



21 The plastic slider mechanisms are then fitted into the metal bracket.



24 The site office – for design work, administration and management of the factory.

THE BODYFURN RANGE

Marketing and sales

Furnware sees its strategy of extensive consumer consultation and engaging schools in the development of their products as a key part of their marketing strategy. “With schools involved in discussion groups and in testing our products they were buying into it in a participatory role,” said Pat.

“Over the early years of the development of the Bodyfurn suite there was not only a massive research component but the new product required a major repositioning in the marketplace because the new furniture was going to end up costing about three times the existing unit cost. So we had to convince schools of its improved value.

“We also went to a lot of national and international conferences. Normally suppliers take a whole lot of product to show – we went along for a couple of

years and didn’t take any product with us. Instead we put up posters about the research we were doing and we had a height weight machine which we would get people to use and give them a print-out of their individual BMI index, just to get them thinking about this type of data.”

“Bigger companies tend to create their own markets,” said Steve “They tell their customers what they need or want – they’ll create the need for a product through their own marketing. We, on the other hand, don’t tell the schools that they need something that isn’t right for them – even though we could probably convince them – because down the line the company would suffer for it.”

All new products have to be integrated into the existing product range which can cause issues. “We had a good market for our box desks, but we knew that they weren’t right. But pricing is important to the market – a new product needs to offer a great deal more to justify even a moderate rise in cost. So with our new desks and storage units, and particularly so with our dynamic chair, there were considerations as to how much of a loss would be involved as the sales pattern changed.”

Timing is also an issue. Pat said that there is a phase where the sales team had to tell schools that a new product was coming up that going to be a lot better than the box desks. “There’s a difficult phasing in period that has to be considered and it does have cost implications. Some schools may put off a purchase, other might opt to buy the alpha desk with the top offset as preparation for retrofitting the new product.”

Furnware is working at the top of the market selling directly to schools in New Zealand and Australia, but there is a strong belief in the company that, once the benefits of the Bodyfurn range becomes more understood, there is a lot of room for growth.

There is also a growing market overseas, particularly Hong Kong, Singapore, the US and the Middle East, but these markets often have several layers through which the product has to travel – there is a supplier and their distributors who need to take a margin – which can add a substantial amount to the cost.

It is vital in these emerging markets to show that the research has been done and that Furnware’s furniture is the result, said Pat. “The expectation is the

FURNWARE’S PRODUCT DEVELOPMENT

MARKETING & SALES

Market position

- + Are we selling just a product, or a part of a system?
- + Does it reinforce and improve the market’s perception of us?

Price

- + Price expectation of the market
- + Value for money
- + Profitability

Promotion

- + Brochures
- + Conferences and sponsorships

- + Media releases
- + Design Awards
- + Advertising

Service

- + User information and advice
- + Guarantee
- + Ease of ordering
- + Delivery time

Follow-up

- + Assessing performance in the market
- + Honouring guarantees

same as that in New Zealand – that chairs cost \$35, whereas for our dynamic chair we’re talking about \$130. It can be quite hard – particularly when the sales people are used to selling commodities rather than systems that will change a classroom culture.”



FURNWARE

Environmental and sustainability issues

A major aim of the company is to be environmentally friendly and sustainable throughout the whole manufacturing process. Sustainability is a strong issue worldwide, both within education and in the building industry, and it's growing exponentially.

"A couple of years ago we could see there was a strong international movement towards the concept of green buildings," said Pat, "so two of us sat the exams got qualified as accredited Green Buildings professionals."

The New Zealand government encourages green building by putting a 10% premium on funding if you get a green rating – the benefits of this have been verified in the US, where it's been going for longer. Furnware wanted to be in a position to say that, if someone wanted a green building, they could supply furniture for it that has Environmental Choice (EC) certification. To get a licence requires approval for the materials and where they're sourced from.

"The system works by providing a downward force. A school that decides to build a green building has to go and look at what they want to put in it. And the suppliers have to be able to verify that their bits comply – otherwise they don't get the points that they need to get their building rated as 'green'.

Furnware went through an exhaustive process of identifying the materials of all of the many components of their range and examining their environmental footprint, looking to make any changes they could to ensure better environmental responsibility and sustainability.

"A good example is the PVC wrap-around edging on the desk," said Pat. "PVC is something that they're trying to minimise in buildings, so we asked our supplier if there was another material we could use. Two other materials appeared to be better, but when we examined the energy use in their production and the long term impact on the environment, PVC still comes out on top, believe it or not. So we stuck with PVC because we could prove that the environmental cost of producing it was lower."

"We now try to source materials from suppliers that can verify that they are recyclable. We see all this as important in the marketplace, and also for our own peace of mind in the way we do things."

The company also went through the factory processes and made changes in, for example, some of the cleaning materials that they use, and identified areas where they could make improvements in their energy usage.

"The environmental or 'green' aspects of manufacturing are starting to ramp up rapidly, despite the tough economic times," said Steve. "There is a perception that introducing a 'green' factor adds to the cost but that's not necessarily so – it can result in savings. It's not a cheap thing to do – there is an initial cost – but there is a payback over time. The bottom line for us is, if a green building is being built and you want to be a supplier, you have to be part of it."

Furnware's EC process expectations can have a knock-on effect with suppliers as exemplified in a recent investigation into the changing of a paint used in the factory. "The EC questions we asked prompted the paint company to say, 'Hey, let's look and see if we can create something that fits with this criteria. And they've really bought into it and got very excited – it's got a lot of potential. Another example is our laminate people, who found suitable alternatives to the formaldehyde in their MDF."



Pat: "When doing our eco-audit, we found that we were using toluene– which is highly volatile – for removing the labels. So we tested all sorts of adhesives on all the surfaces we put labels on and came up with one that you can peel off and put back on again. So there's 1,200kg of toluene gone from the factory."



Toluene was used to wipe the excess glue off but has been replaced with a more environmentally acceptable cleaner.

"It's a win-win situation," said Steve. "At no cost to our company, other companies are developing products that benefit us and will ultimately benefit them too."

Environmentally aware design is also an important issue, particularly in terms of health and safety in the classroom. For example, we have rounded off the sharp corners on our desks so people don't bruise their thighs when passing. That's been a huge improvement for teachers, and it's more important to do that when you've got a bigger desk – because it's a bigger obstacle to have to get around. So there's a whole lot of design features targeting the physical environment they have to work in."

Environmental awareness is built into the company's mission statement: "Creating best learning environments through research, development, and interactive sharing of knowledge". This mission statement was a major outcome of a two-day staff development session in 2006 which involved all aspects of the company operation – senior management, production supervisors, sales and customer service staff, finance and purchasing. There they rigorously re-examined core company values and identified what the company was aiming to achieve and its differences from other suppliers in the marketplace. "Every word of the new mission statement was hammered out, refined from a previous version," said Pat. "This ensured there was a real sense of ownership of and commitment to it at every level of the company."

Starters questions for use with senior students

PAGE 1 - IDENTIFYING A NEED

Brief development exercise:

- Identify the issue.
- Identify the need.
- Explain how the issue was identified?
- Why is research important in the process of identifying issues?
- What key factors (desirable attributes) should be considered for classroom furniture?
- What key factors/attributes were given a lower priority to ensure cost was prioritised?
- What did the initial research using focus groups find out?
- What research did Furnware undertake to support their designs?
- What does the term “ergonomics” mean in relation to the research undertaken?
- What conceptual statement do you think Furnware would have started with?

Extension activity

- Develop a brief to include the identified issue and need, with a conceptual statement, and desirable attributes that you think Furnware could have used to develop the desk with a side storage unit.

PAGE 2 - CONCEPT DEVELOPMENT

- Identify the methods of functional modelling used at this stage.
- What are the advantages and disadvantages of using these methods of modelling?
- Identify the stakeholders involved with this stage of practice.
- Explain how each stakeholder group were important to the practice?
- Why was it necessary for development for Furnware to go into the classroom and trial concepts with students?

Extension activity

- Sketch your own conceptual model of the side storage unit with annotations to describe materials, components and functions to show its intended fitness for the purpose.

PAGE 3 – DESIGN

- Once the concept had been developed through consumer testing and feedback, what input did the design team have to the project?
- What is a rapid prototype?
- Why were students still part of feedback at this stage of practice?
- What people had to be involved with the design process to finalise a production process? Why?

Extension activity

- Make up a diagram to the steps in the practice and the people involved during this design stage.

PAGE 4 – PRODUCTION PLANNING

- What is the difference between a prototype and a finished manufactured product?
- Why was outsourcing essential in relation to the plastic components?
- How was the outsourcing company involved with production planning?
- Why was a company in China used to make the injection moulding tool?
- What trialling was done to prepare for production?
- What issues came up in relation to material selection?

Extension activity

- What does castellated mean?
- Describe and/or draw what you think this component may look like.

PAGE 5 – MANUFACTURING

- What is the “kanban system”?
- Why is Furnware using this system?
- Why was a trial production run not necessary for this new product?
- Why would a trial production run normally be carried out?
- Why is planning such an important part of the manufacture process?

Extension activity

- Identify the main steps in the factory’s 10-day production turnaround?
- What project management tools/systems do Furnware use for planning?

PAGE 6 & 7 - MANUFACTURING: FACTORY TOUR 2

- Use the information and photographs of production, factory machinery, and materials:
 - Develop a flow diagram to show the main steps of production for a desk with a side storage unit.
 - Include inputs and outputs at each stage.

Extension activity

- Indicate on your flow diagram what and where the quality control checks would be carried out?

PAGE 8 – MARKETING AND SALES

- What do Furnware consider is key to their marketing strategy?
- How did they do this?
- What can cause issues? Explain why.

PAGE 9 - ENVIRONMENTAL AND SUSTAINABILITY ISSUES

- What process did Furnware go through to ensure better environmental responsibility and sustainability?
- How do Furnware’s EC process expectations have a knock-on effect with suppliers?
- How does this effect help Furnware?
- How does environmental awareness related to classroom furniture effect Furnware design?
- What is the purpose of having a well thought-out mission statement for the company?